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PHYSICAL ACTIVITY

Evaluating a Physical Activity App in the Classroom: A Mixed Methodological Approach Among University Students

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Abstract

The purpose of this study was to evaluate the effectiveness of using an exercise-based app in increasing student motivation, social support, self-efficacy, and enjoyment in a university physical activity class. A convenience sample of 48 college-aged students (28 males, 20 females) from one university located in the Southeastern United States participated in this study. The study occurred during the students' regularly scheduled activity classes. The students met 4 days per week for 5 weeks during the summer semester. A mixed methods research design was employed for this study. Four major variables were measured pre- and postintervention for the intervention group and postintervention only for the comparison group, including exercise motivation, social support, exercise self-efficacy, and enjoyment. Analyses relied primarily on descriptive (frequency, means) statistics, with inferential statistics (t tests for intra- and intergroup comparisons) as supporting data.

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Alpha level for statistical significance was set at 0.05, and data were analyzed using SPSS 21.0. Qualitative analysis was used for the focus group data. A significant difference was found between self-efficacy and family support between the intervention and comparison group. Additionally, focus group analysis revealed that students enjoyed the exercise mobile app. The results indicate that the integration of technology, such as app-based interventions, may affect students' enjoyment of physical activity courses.

Physical activity is vital for maintaining and improving health outcomes. Nevertheless, physical activity patterns decrease with age, with less than 1 in 5 teenagers achieving the recommended 150 min of physical activity per week (Centers for Disease Control and Prevention [CDC], 2010). In efforts to combat this trend, researchers have often investigated physical activity variables among young adults (Aelterman et al., 2012; Egli, Bland, Melton, & Czech, 2011; Pauline, 2013). Commonly, the interventions have centered on increasing exercise motivation, social support, exercise self-efficacy, and enjoyment.

Motivation, defined as the reasons why individuals engage in physical activity, is particularly important in the classroom (Ingledrew & Markland, 2007). In fact, motivation has been identified as one of the most important predictors of exercise (Lewis & Sutton, 2011). Physical educators are challenged to motivate students in their physical education classrooms (Spittle & Byrne, 2009). Several researchers have used pedometers to increase motivation in college physical activity courses (Hick, 2009; Jackson & Howton, 2008). Furthermore, tips to increase motivation in the classroom have been noted, including age-appropriate equipment, inviting spaces, and outside-of-class opportunities (Faber, Kulinna, & Darst, 2007).

Another critical element to promote physical activity is social support, which can be defined as information from others reflecting love and care and can be used as a network of communication to influence an individual directly or indirectly (Song et al., 2012). Lubans, Morgan, and McCormack (2011) found that school sport programs can help in promoting physical activity. This is supported by research that reveals that social support is second, next

to self-efficacy, in influencing student physical activity (Zhang, Solmon, Gao, & Kosma, 2012). Furthermore, self-efficacy, defined as situation-specific self-confidence, has been identified as a mediator of physical activity and adherence (Pauline, 2013; Seok, Buckworth, Focht, & Ko, 2013). Notably, high exercise self-efficacy is associated with higher rates of exercising and low self-efficacy is related to deterred exercising and procrastination in carrying out the health behaviors (Buckley & Cameron, 2011).

More recently, enjoyment has been investigated for its link to promoting physical activity, specifically within the context of sport and fitness education (Fu et al., 2013). Physical educators have successfully used the latest video exergames to increase enjoyment in college students for physical activity (Garn, Baker, Beasley, & Solmon, 2012).

In addition to e-mail discussion groups and electronic mailing lists, the use of accelerometers and other monitoring devices has become increasingly popular in physical activity research. For example, after examining physical activity levels among various team sizes for basketball and soccer in a C/UIPAP setting, Cluphf, Gaudreault, LeCheminant, and Russell (2014) were able to determine the game size that proved most beneficial to participation with regard to physical activity using ActiGraph GT1M accelerometers. In other words, without the development and use of this technology, team size may not have been identified as an important component for C/UIPAP instructors to consider when designing course activities to promote physical activity. Clearly, the use of technology in physical activity settings as well as in other domains has proved effective not only in gaging appropriate physical activity levels, but also in enhancing overall well-being. Given the findings of the aforementioned studies, and given the positive link between regular engagement in physical activity and psychological and physiological health benefits in the existing literature, we expect that exercise-based apps, such as the Fitocracy fitness app, will yield similar results and promote healthy lifestyle choices through enhanced social support, motivation, and self-efficacy.

Moreover, the progression of technology and development of smartphone applications (apps) has led to the investigation of the effects of using apps as a means of monitoring, enhancing, and in-

creasing factors such as sociability, self-esteem, and physical activity. Researchers have examined using apps to monitor activity and motivation in young adults (Hebden, Cook, van der Ploeg, & Allman-Farinelli, 2012; Patrick et al., 2009). Kirwan, Duncan, Vandelanotte, and Mummery (2012) suggested that "usability" plays a key role in increasing usage of the app and promoting engagement in activities such as exercise. Given the influx of technology and the development of smartphone apps, the role of exercise-based apps in enhancing student enjoyment needs to be explored further. Specifically, greater attention must be paid to the effectiveness of an exercise-based app (Fitocracy) in increasing students' motivation, social support, and self-efficacy.

Self-determination theory (SDT), along with the attitude–social influence–efficacy model (ASE model) and physical activity research, not only provides such a framework for examining the exercise-based app within a physical activity context, but also identifies the critical role of exercise motivation, social support, and exercise self-efficacy in guiding the self-regulation of behavior, including behavior involved with physical activity initiation and maintenance. SDT argues that multiple constructs including autonomy support, psychological needs, and motivation are essential within the physical activity behavior change process (Blanchard, 2012). Furthermore, a continuum of motivations is found within SDT: amotivation, intrinsic motivation, and extrinsic motivation. Amotivation indicates an absence of motivation, whereas intrinsic motivation is defined by the enjoyment of an activity, such as exercise, and by the satisfaction of performing it for its own sake (Deci & Ryan, 2002). Extrinsic motivation, on the other hand, reflects engaging in a behavior to avoid punishment or because the individual is motivated by external rewards or pressures (Deci & Ryan, 2002).

In addition, the ASE model is a theory of behavior change based on the theory of reasoned action, social cognitive theory, and the transtheoretical model, which asserts that attitudes, social influences, and self-efficacy are the critical determinants of health behavior change (Benac, Crosby, Noar, Snow, & Troutman, 2011). Social influences include social norms, direct pressure or support to perform a behavior, and the perceived behavior of others. Self-efficacy includes confidence to perform a behavior, and attitudes reflect positive and

negative aspects of a behavior and consideration of emotional and cognitive beliefs (Benac et al., 2011). Although these models put forth different theoretical perspectives, it has been suggested that integrating theories in physical activity research using the strengths in each theory will not only enhance understanding of physical activity participation, but also reduce redundancy between theories (Blanchard, 2012).

Purpose of the Study

The purpose of this study was to evaluate the effectiveness of using an exercise-based app to increase student motivation, social support, self-efficacy, and enjoyment in university physical activity classes.

Research Questions

1. What is the effect of mobile apps on students' exercise motivation, exercise social support, or self-efficacy as a supplementary teaching tool?
2. What is the effect of the mobile app on students' enjoyment of the learning experience in a college fitness class?
3. What is the effect of the use of a physical activity app on student course satisfaction?

Method

Participants

A convenience sample of 48 college-aged students (28 males, 20 females) from a university located in the Southeastern United States participated in this study. The students were between 18 and 25 years of age, with the majority of the students between 21 and 23 years of age. Table 1 includes a listing of demographics by group; however, not all participants answered all of the demographic questions. The participants were enrolled in one of two sections of a body conditioning physical activity course during the summer 2013, which was part of their general education requirements of the university.

Table 1
Distribution of Demographic Characteristics, BMI, Physical Activity Levels by Frequency and Percentage With Mean and Standard Deviation Reported for Health-Related Variables (N = 48)

	Intervention		Control	
Demographic variables	***n***	**%**	***n***	**%**
Gender				
Male	11	42.3	17	77.3
Female	15	57.7	5	22.7
Class Rank				
Sophomore	2	7.7	3	13.6
Junior	9	34.6	5	22.7
Senior	15	57.7	13	59.1
Ethnicity				
Black	9	34.6	7	31.8
White	16	61.5	13	59.1
Biracial	1	3.8	0	
Asian	0		1	4.5
Other	0		1	4.5
Age				
18–20 years old	8	30.7	6	27.2
21–23 years old	19	71.5	12	54.5
> 24 years old	2	7.6	4	18.1
Description of Weight				
Very Underweight	0	0		
Slightly Underweight	1	3.8	2	9.1
About the right weight	12	46.2	10	45.5
Slightly overweight	11	42.3	10	45.5
Very overweight	2	7.7	0	
Trying to Do About Weight				
Lose Weight	17	65.4	12	54.5
Gain Weight	3	11.5	4	18.2
Maintain Weight	1	3.8	5	22.7
Not Concerned w/Weight	5	19.2	1	4.5

Table 1 (cont.)

Demographic variables	Intervention		Control	
	n	%	*n*	%
BMI				
Underweight	0		1	4.5
Normal	11	42.3	9	40.9
Overweight	11	42.3	7	31.8
Obese	4	15.4	5	22.7

Setting

The study occurred during the students' regularly scheduled activity classes. The students met 4 days per week for 5 weeks during the summer semester. The intervention and comparison classes had two instructors who had similar training; course syllabi and unit plans were also identical.

Intervention

The Fitocracy fitness app is an online game and free daily workout tracker with the aim to use social networking as a method of improving a person's fitness. Fitocracy connects users to the knowledge of over half a million of the world's best fitness coaches, nutrition experts, and individuals from a variety of fitness backgrounds. Users can track various activities, such as weightlifting, dancing, and walking up stairs; participate in challenges; and earn points and badges for significant achievements. In this study, body conditioning instructors reminded participants of the availability and benefits of the Fitocracy fitness app each day of class; however, no more than 1 or 2 min was spent discussing the app. Participants in the comparison groups received no such information.

Measures

A mixed methods research design was employed for this study. Four major variables were measured pre- and postintervention for the intervention group and postintervention only for the comparison group: exercise motivation, social support, exercise self-efficacy, and enjoyment.

Demographics. Basic demographics, including age, gender, year in college, and ethnic background, were self-reported. Participants' height and weight measurements were taken using a standard hospital balance beam scale and stadiometer. Height was measured to the nearest quarter inch, and weight was measured to the nearest tenth pound. BMI was calculated using the standard formula endorsed by the CDC: (pounds/inches^2) × 703 (CDC, 2014).

Exercise motivation. The Behavioural Regulation in Exercise Questionnaire - 2 (BREQ-2; Ingledew & Markland, 2008) was used to measure motivation. This questionnaire is the modified version of the original BREQ (Mullan, Markland, & Ingledew, 1997). The BREQ-2 has 19 items to measure several constructs of motivation including amotivation, external, introjected, identified, and intrinsic regulation. The questionnaire has a 5-point Likert-type scale, with anchors of 0 (*not true for me*) and 4 (*very true for me*). Cronbach's alpha for each subscale found by Ingledew and Markland (2008) is as follows: Amotivation = 0.83, External = 0.79, Introjected = 0.80, Identified = 0.73, Intrinsic = 0.86.

Social support. The Social Support and Exercise Survey by Sallis, Gross, Pinski, and Nader (1987) was used to measure family and friend support of exercise. The survey started with "During the past three months, my family (or member of my household) or friends:" and was followed by 13 statements the participants needed to rank their agreement with, for example, "offered to exercise with me" or "criticized me or made fun of me for exercising." Internal consistencies for the social support from family ($\alpha = 0.92$) and social support from friends subscales ($\alpha = 0.93$) were acceptable.

Exercise self-efficacy. The Self-Efficacy to Regulate Exercise scale is an 18-item questionnaire associated with measuring exercise self-efficacy and a person's ability to maintain exercise (Bandura, 2006). Possible scores for each measure ranged from 0 to 100, as per measurement convention for self-efficacy assessment, and all measures had excellent internal consistencies ($\alpha \geq 0.956$).

Enjoyment. Focus groups were conducted to evaluate enjoyment. Seven individuals voluntarily participated in the focus group interview, which was conducted in a classroom on the university campus. Participants sat around a *U*-shaped table arrangement during the interview. The interview was audio- and videotaped with

the permission of the participants. The interview was conducted in a semistructured fashion to maintain a focus during the process, but also to allow the opportunity for other issues to be included in the interview. The third researcher was the moderator of the focus group interview. The researcher had experience moderating focus group interviews, and she had the knowledge of conducting effective focus group interviews through her qualitative research training. Questions in the interview were related to how participants felt about their experience of using the Fitocracy fitness app. Participants were allowed to interact with each other during the interview because such conversations form authentic data for the research. One major precaution during the focus group interview was that the moderator ensured that all participants had a chance to express their views and that one or two participants did not dominate the interview (Patton, 1990). The interviews lasted approximately 45 min.

Data Analysis

Variations in student motivation, social support, self-efficacy, and enjoyment among participants were reported by means and standard deviations. Analyses relied primarily on descriptive statistics (frequency, means), with inferential statistics (*t* tests for intra- and intergroup comparisons) as supporting data. Alpha level for statistical significance was set at 0.05, and data were analyzed using SPSS 21.0. Qualitative analysis was used for the focus group data.

Results

No significant difference was found between the pre- and postintervention motivation scores, nor was a difference found between the postintervention and comparison groups (see Table 2). Although a difference in social support from family or friends with the intervention group was not found from pre- to posttest, significant differences were found in the family support scores of the intervention group ($M = 3.13$) and the comparison group ($M = 2.62$). Exercise self-efficacy was also found to be significantly different between the intervention group ($M = 53.56$) and the comparison group ($M = 70.08$). Finally, a significant difference emerged between the pre- and posttest scores of the intervention group from 47.17 to 53.76 (see Table 3).

Table 2
Descriptive (M, SD) and Paired Sample t Test to Determine Statistical Differences Between Pre- and Postsurveys for the App Intervention Study

Variable	*M*	*SD*	*df*	*t*	*p*
Motivation					
Pretest	40.10	4.53	21	0.562	0.580
Posttest	39.04	4.82			
Social Support					
Family Pretest	2.92	0.64	17	−1.159	0.263
Family Posttest	3.07	0.59			
Friend Pretest	3.41	0.87	22	−0.212	0.834
Friend Posttest	3.44	0.78			
Self-Efficacy					
Pretest	47.17	4.01	23	−2.063	0.050*
Posttest	53.76	3.81			

*$p < 0.05$.

Table 3
Independent t Test to Determine Statistical Differences Between Intervention and Control Groups Postsurvey for the App Intervention Study

Variable	*M*	*SD*	*df*	*t*	*p*
Motivation					
Intervention	38.75	4.42	42	1.459	0.152
Control	30.60	3.05			
Social Support					
Family Intervention	3.13	0.71	40	2.351	0.024*
Family Control	2.62	0.71			
Friend Intervention	3.50	0.81	40	−0.189	0.851
Friend Control	3.55	1.12			
Self-Efficacy					
Intervention	53.56	3.52	41	−2.759	0.009*
Control	70.08	5.12			

*$p < 0.05$.

The focus group interviews were analyzed qualitatively using a constant comparative method (Strauss & Corbin, 1998). In doing so, the researchers took an open coding approach. First, the transcript was read through and the first and third researchers wrote short descriptive phrases on the margins of the transcript to describe chunks of data. Then the researchers recorded all the codes; they developed and combined similar codes and deleted irrelevant ones. From these codes, they developed categories. After developing the categories, they went back to the data to validate the categories. For example, one of the categories that emerged was increased motivation to exercise. The researchers examined the data to see that motivation was expressed by all participants and present in the data throughout the interview process. After the categories were developed, researchers established connections between categories and formed themes. The qualitative analysis resulted in the following themes: improved skill development, promoted accountability, increased motivation, and issues with technology (see Table 4).

Table 4

Qualitative Analysis of the Focus Group

Theme/Category	Student comment
Improved Skill Development	
Recall	Female 1: "I thought that was very helpful because, you know, you couldn't remember something that you did in class and you type in leg and it would come up with squats, leg lifts, etc."
	Female 3: "But it was cool to follow what you did in class and keep it. I mean, if I wanted to do the workout later on that we did in class, I can always have the ability to go back and remember what it is because now I have it on the app. Which I thought was neat, and I'll use that."
Increased intensity	Male 1: "Another way that it helped with the class was during class when she tells you to do your best in an activity and you're shooting for, like, ten, it makes you shoot for a goal, like, 'I'm going to shoot for fifteen,' so when you realized you have reached that goal, you will remember that I'm going to put fifteen in later."

Table 4 (cont.)

Theme/Category	Student comment
Promoted Accountability	
Tracking	Female 4: "I thought it was cool because whenever we had to make our workout plan, like, I used it a lot, because I went back and looked at all the exercises we did and, like, how many I did. It's good to see how I kept track of it or whatever."
	Male 2: "… it kind of kept me more accountable of what I did, instead of just going in there and quitting halfway or just messing around with it and not paying attention. It made me focus: 'Okay, I'm going to be putting this into the app, so I got to know and remember exactly what I'm doing, how much I'm going up, how much I'm going down,' so that helped me out."
Points System	Male 2: "It was interesting to see how many points I received at the end of that workout."
Increased Motivation	
Rewards	Female 1: "…you know, as human beings, we work based off of the reward system. Once we get a reward, we want to do more and, you know, beat our last score, you know? So, you know, I think that's a good motivation for people."
	Female 2: "I liked was when I entered a workout, how many reps I did and everything, and I pressed calculate, I liked seeing the little robot doing its little dance."
Competition	Male 1: "I remember, like, seeing myself on the leader board and I was a little bit behind, I was, like, on fourth or fifth down there, so I started working out harder…."
	Male 2: "You know, it pushed me to try to get as many points as I could. I noticed a few people trying to catch me, so I was like, 'I need to stay in here another thirty minutes and try to do this hard stuff.' I mean it was fun, it made it fun, it wasn't like a hassle that I had to type in this information, but it made, like, a fun game I had to push myself."
	Female 3: "I would actually recommend this to my friends because it would be good to have a group of friends and you set up your own group and keep it competitive and you all can, like we did in class, you can get points and kind of pushes you to workout if your friends are doing it. That way you have a sense of comradery."

Table 4 (cont.)

Theme/Category	Student comment
Self-efficacy	Female 3: "Like, I'm proud of myself that I did some of these things, like, that I would have never done before had I not had this class, and now I've done it and I have a record of it and it kind of shows me, like OMG, I did all this in this day like I would have never been able to do that before, and it shows it as I'm logging."
Issues With Technology	
Ease of Use	Male 1: "… it was really easy to get everything set up."
	Female 3: "I liked how as soon as you went onto the app, as soon as you clicked on, it was accessible. All you had to do was track your workout. It wasn't as if I had to go search for tracking my workout, and it wasn't hard, like, I could do it fast. I could do it walking to class or walking out of the RAC. I could easily enter it."
Difficulty	Female 1: …" the app kind of confused me a little bit."
	Female 2: "Like, our instructor may call it something else and then on here you would have to try to find what it's called here, but the good thing is, they give you a description of the workout."
	Female 3: "So it's just hard to keep track if we did a bunch of things in class. Keeping track and finding it on the app."

Discussion

The purpose of this study was to examine whether a mobile exercise app increased exercise motivation, social support, exercise self-efficacy, or enjoyment in a university-based physical activity class. The results showed a significant difference between self-efficacy and family support between the intervention and comparison groups. Significant differences found among and between groups with small sample sizes are not conclusive, but may suggest areas for further investigation. Additionally, a focus group analysis revealed that students enjoyed the exercise mobile app.

Exercise Motivation

Exercise motivation did not significantly change from pretest to posttest for the intervention group, nor was it different in compari-

son group posttest scores. These results are similar to Jackson and Howton's (2008) findings, which did not demonstrate a significant difference with pedometers regarding motivation toward physical activity. The lack of change in exercise motivation may be due in part to the BREQ-2 measuring amotivation, external, introjected, identified, and intrinsic regulation, which may need a longer period to reveal changes. Additionally, although we did not find a change in exercise motivation according to the BREQ-2, motivation was clearly affected as evidenced by the focus group feedback.

Social Support

Although social support was not different from family or friends with the intervention group from pre- to posttest, a significant difference was found in family support between the intervention and control groups. The intervention group appeared to report a higher sense of family support compared to the comparison group. This could be due to taking the preintervention test and knowing they would be receiving an intervention. It is also possible that mobile devices in and of themselves denote feelings of connectedness for this group of students.

Self-Efficacy to Regulate Exercise

Self-efficacy to exercise regularly was also found to be significantly different between the intervention and comparison groups. In addition, a significant change was evidenced between the pre- and posttest of the intervention group (see Table 3). The pre- to posttest scores for self-efficacy to regulate exercise also evidenced an increase, which was similar to what Lubans and Sylva (2009) found, with this increase with females, but not the males, in this study. Similar to several other studies, self-efficacy in this study did not increase with participation in physical activity courses (LaChausse, 2012; Wingo et al., 2013).

Enjoyment

The students in focus group, who had used the exercise app, revealed positive feelings of enjoyment, making connections to improved skill development, promotion of accountability, increased motivation, and general technology. Technology has been used to increase enjoyment among college students using exercise gaming

(Garn et al., 2012). The focus group students not only commented about the accountability and motivation implications of the intervention, but also described how the instruction was reinforced by the use of the app in and outside of class. One student commented, "I thought that [it] was very helpful because, you know, you couldn't remember something that you did in class and you type in leg and it would come up with squats, leg lifts, etc."

Previous research has demonstrated that nutrition apps aid in tracking health behaviors and have a similar positive effect, with an appeal to the younger generation with technology (Hebden et al., 2013). Students felt that by using the app, they were more accountable. One student's comment indicated that even during exercise, he would increase his exercise intensity:

> . . . it kind of kept me more accountable of what I did, instead of just going in there and quitting halfway or just messing around with it and not paying attention. It made me focus: 'Okay, I'm going to be putting this into the app, so I got to know and remember exactly what I'm doing, how much I'm going up, how much I'm going down,' so that helped me out.

Students also indicated that they felt motivated by the app, its points system, and the competitive aspects this facilitated. Perhaps because this generation grew up with video games, the drive to reach the next level was ingrained in them. One student stated,

> I liked the fact that there was a reward system, like, you know, you do a certain workout, they give you a certain amount of points, and once you get a certain amount, you move up to a different level and, you know, its kind of like, awe cool. It's a cool kind of, I don't know, kind of corky feeling I use to play video games, and I like levels and crap, but it's just like the reward system, you know, as human beings, we work based off of the reward system. Once we get a reward, we want to do more and, you know, beat our last score, you know?

The students gave mixed reviews on the ease of use as several felt it was difficult to navigate the app. One student explained, "One thing that I didn't like about it when I first started using it was a

little complex, it was a lot of different buttons and a lot of different scroll downs and a lot of different options." Although students experienced frustration with some of the technology features, overall, they seemed to enjoy using the app, with one student stating, "I think overall it was a really interesting app …"

Limitations

Certain limitations may need to be considered when interpreting the findings of this study. First, because two instructors taught the courses in which participants were enrolled during the duration of the study, any changes observed, practically or statistically, were possibly the product of variability in teaching style or instructor characteristics rather than the use of the app-based intervention. However, we attempted to minimize variability in implementation and course management by using identical syllabi and training protocols for the instructors. Furthermore, this study included a 5-week intervention. Although the dose may be considered substantial given participants met 4 days a week for 5 weeks as a part of the physical activity course, an intervention spanning a longer period could have evidenced different changes among study participants. The usage of the mobile app was not tracked. Finally, given the sampling method employed was convenience in nature, and given the generalizability of the results are limited to college-aged students in the Southeastern United States, researchers may consider obtaining a more diverse sample and incorporating interventions longer in duration.

Conclusions and Recommendations

The results of this study demonstrated a significant difference between self-efficacy and family support between the intervention and comparison groups such that participants receiving the app-based intervention reported higher levels of each. Additionally, focus group analyses revealed that students enjoyed the exercise mobile app. Collectively, these results indicate that integration of technology, such as app-based interventions, may serve as one avenue in facilitating changes in psychosocial aspects of physical activity behaviors of college students.

References

Aetlterman, N., Vansteenkiste, M., Van Keer, H., Vad den Berghe, L., De Meyer, J., & Haerens, L. (2012). Students' objectively measured physical activity levels and engagement as a function of between-class and between-student differences in motivation towards physical education. *Journal of Sport & Exercise Psychology, 34,* 457–481.

Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (Vol. 5., pp. 307–337). Greenwich, CT: Information Age Publishing.

Benac, C., Crosby, R., Noar, S. M., Snow, G., & Troutman, A. (2011). Application of the attitude–social influence–efficacy model to condom use among African-American STD clinic patients: Implications for tailored health communication. *AIDS and Behavior, 15,* 1045–1057.

Blanchard, C. M. (2012). Testing and integrating self-determination theory and self-efficacy theory in a physical activity context. *Canadian Psychology, 53,* 319–327.

Buckley, J., & Cameron, L. D. (2011). Automaticity of exercise self-regulatory efficacy beliefs in adults with high and low experience in exercise self-regulation. *Journal of Sport & Exercise Psychology, 33,* 325–348.

Centers for Disease Control and Prevention. (2014). *State indicator report on physical activity, 2010.* Atlanta, GA: U.S. Department of Health and Human Services.

Cluphf, D., Gaudreault, K. L., LeCheminant, J., & Russell, J. (2014). Effects of varying team sizes on physical activity levels of college students. *The Physical Educator, 71,* 254–272.

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research.* Rochester, NY: University of Rochester Press.

Egli, T., Bland, H., Melton, B., & Czech, D. R. (2011). Effects of sex, race, and age on college students' exercise motivation of physical activity. *Journal of American College Health, 59,* 399–407.

Faber, L., Kulinna, P. H., & Darst, P. (2007). Strategies for physical activity promotion beyond the physical education classroom. *Journal of Physical Education, Recreation, and Dance, 76*(9), 27–32.

Fitocracy. (2010). Fitocracy. Retrieved from https://www.fitocracy.com/

Fu, Y., Gao, Z., Hannon, J., Shultz, B., Newton, M., & Sibthorp, J. (2013). Influence of a health-related physical fitness model on students' physical activity perceived competence and enjoyment. *Perceptual & Motor Skills, 117,* 956–971.

Garn, A. C., Baker, B. L., Beasley, E. K., & Solmon, M. A. (2012). What are the benefits of a commercial exergaming platform for college students? Examining physical activity, enjoyment, and future intentions. *Journal of Physical Activity and Health, 9,* 311–319.

Hebden, L., Cook, A., van der Ploeg, H., & Allman-Farinelli, M. (2012). Development of smartphone applications for nutrition and physical activity behavior change. *JMIR Research Protocols, 1*(2), e9.

Hebden, L., Cook, A., van der Ploeg, H., King, L., Bauman, A., & Allman-Farinelli, M. (2013). A mobile health intervention for weight management among young adults: A pilot randomised controlled trial. *Journal of Human Nutrition and Dietetics, 27,* 322–332.

Hick, L. (2009). Increasing physical activity in university students: Implementing a pedometer program into a required university wellness course. *Indiana AHPERD Journal, 38*(3), 31–35.

Ingledrew, D. K., & Markland, D. (2007). Exercise participation motives. In M. S. Hagger & N. L. D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 23–34, 302–305). Windsor, Canada: Human Kinetics.

Ingledew, D. K., & Markland, D. (2008). The role of motives in exercise participation. *Psychology and Health, 23*, 807–828.

Jackson, E. M., & Howton, A. (2008). Increasing walking in college students using a pedometer intervention: Differences according to body mass index. *Journal of American College Health, 57,* 159–164.

Kirwan, M., Duncan, M., Vandelanotte, C., & Mummery, W. (2012). Using smartphone technology to monitor physical activity in the 10,000 Steps program: A matched case-control trial. *Journal of Medical Internet Research, 14*(2). http://dx.doi.org/10.2196/jmir.1950

LaChausse, R. G. (2012). My student body: Effects of an Internet-based prevention program to decrease obesity among college students. *Journal of American College Health, 60,* 324–330.

Lewis, M., & Sutton, A. (2011). Understanding exercise behavior: Examining the interaction of exercise motivation and personality in predicting exercise frequency. *Journal of Sport Behavior, 34,* 82–97.

Lubans, D. R., Morgan, P. J., & McCormack, A. (2011). Adolescents and school support: The relationship between beliefs, social support, and physical self-perception. *Physical Education and Sport Pedagogy, 16,* 237–250.

Lubans, D. R., & Sylva, K. (2009). Mediators of change following a seniors school physical activity intervention. *Journal of Science and Medicine in Sport, 23,* 134–141.

Mullan, E., Markland, D., & Ingledew, D. K. (1997). Variations in self-determination across stages of changes for exercise in adults. *Motivation & Emotion, 21,* 349–362.

Patrick, K., Raab, F., Adams, M. A., Dillon, L., Zabinski, M., Rock, C. L., . . . Norman, G. J. (2009). A text message–based intervention for weight loss: Randomized controlled trial. *Journal of Medical Internet Research, 11*(1). http://dx.doi.org/10.2196/jmir.1100

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). London, England: Sage.

Pauline, J. S. (2013). Physical activity behaviors, motivation, and self-efficacy among college students. *College Student Journal, 47*(1), 64–75.

Sallis, J. F., Gross, R. M., Pinski, R. B., & Nader, P. R. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16,* 825–836.

Spittle, M., & Byrne, K. (2009). The influence of sport education on student motivation in physical education. *Physical Education and Sport Pedagogy, 14,* 253–256.

Seok, Y., Buckworth, J., Focht, B., & Ko, B. (2013). Feelings of energy, exercise-related self-efficacy, and voluntary exercise participation. *Journal of Sport & Exercise Psychology, 35,* 612–625.

Song, Y., Song, H., Han, H., Park, S., Nam, S., & Kim, M. (2012). Unmet needs for social support and effects on diabetes self-care activities in Korean Americans with type 2 diabetes. *The Diabetes Educator, 38*(1), 77–85.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory.* London, England: Sage

Wingo, B. C., Desmond, R. A., Brantely, P., Appel, L., Svetkey, L., Stevens, V., & Ard., J. D. (2013). Self-efficacy as a predictor of weight change and behaviors change in the PREMIER trial. *Journal of Nutrition Education and Behavior, 45,* 314–322.

Zhang, T., Solmon, M. A., Gao, Z., & Kosma, M. (2012). Promoting school students' physical activity: A social ecological perspective. *Journal of Applied Psychology, 24*(1), 92–106.