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How students' experience and learning in an educational context influence their self-directed learning and behavior outside of school has always been an important question in education. Scholars have named the effects of physical education (PE) on students' out-of-school physical activity (PA) as the "PE effect". The purposes of this dissertation research were to first test a two-pathway model of the "PE effect" and then determine the extent to which a concept-based PE curriculum influenced middle-school students' PA behavior outside of the school. Specifically, the following research questions were addressed: (a) to what extent did eighth graders' knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? (b) Did eighth-grade students who had experienced the Science of Healthful Living (SHL) curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had not?

A total of 394 eighth-grade students from five schools participated in this study, in which 168 students studied the SHL curriculum when they were in sixth grade while 226 students only experienced traditional PE. Students' knowledge, out-of-school PA, and autonomous motivation toward PE and PA were measured using valid self-report instruments. Structural equation modelling was used to test the two-pathway model of the "PE effect". A static group comparison design was adopted to answer the second research question.

Results showed that students' knowledge had a direct, positive relationship on their autonomous motivation toward PA and an indirect, positive relationship on out-of-school PA through influencing autonomous motivation toward PA. Students' autonomous motivation for PE had a direct, positive relationship on their autonomous motivation toward PA and an indirect, positive relationship on out-of-school PA through autonomous motivation toward PA. The results also showed that the students who had studied the SHL PE curriculum had significantly higher levels of knowledge, autonomous motivation toward PA, and out-of-school PA than the students who had experienced the traditional, multi-activity PE. No significant difference was found for autonomous motivation for PE.

These results indicate that the two-pathway model is tenable in terms of knowledge learning and autonomous motivation in PE and imply that teaching knowledge in an autonomy-supportive PE environment can be an effective way to promote students' out-of-school PA behavior. The findings about the effects of the SHL curriculum further supported the knowledge learning pathway of the "PE effect" and indicate that the concept-based PE approach could be an effective model to promote students' PA behavior outside of the school.

EFFECTS OF A CONCEPT-BASED PHYSICAL EDUCATION CURRICULUM ON MIDDLE-SCHOOL STUDENTS' OUT-OF-SCHOOL PHYSICAL ACTIVITY

by

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Approved by

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Committee Chair

To my family.

APPROVAL PAGE

This dissertation, written by Yubing Wang, has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

One primary goal of physical education (PE) is to promote students' lifelong physical activity (Corbin, 2002; Ennis, 2011; Green, 2014; Penney & Jess, 2004). This goal implies that PE should not only improve students' physical activity (PA) in PE or in school, but should also promote their PA outside of school. Green (2014) refers to the positive effect of PE on out-of-school PA as the "PE effect" (p. 357). The "PE effect", as Green (2014) summarized, is frequently cited by PE teachers and PE and sport science academics and is often included in government policies across the world.

To achieve the "PE effect", Ennis (2017) proposed the concept of "Transformative PE" (p. 1). She suggests that transformative PE focuses on educating students for a lifetime of PA through enhancing students' cognitive decision-making, self-motivation, and personal meaning about PA. Teaching the knowledge about PA and fitness and ways to apply this knowledge are proposed to be important components in "Transformative PE" (Ennis, 2017). In this sense, the concept-based PE, which focuses on teaching students the scientific knowledge about PA and fitness, is one type of "Transformative PE" (Ennis, 2015). Studies have shown that concept-based PE can greatly increase students' knowledge about PA and fitness (Sun, Chen, Chen, & Ennis, 2012; Wang et al., 2017). However, its influences on students' out-of-school PA behavior is still unclear. In other words, due to limited empirical studies on the connection between PE and out-of-school PA, research evidence about the aforementioned "PE effect" is scarce. The purpose of this dissertation research was to determine the effects of a concept-based PE curriculum on middle-school students' out-of-school PA behavior. In this introduction chapter, I first discuss two theoretical models that specifically illustrate the mechanisms of the "PE effect". Based on these theoretical models, I proposed a theoretical framework guiding the current dissertation research to illustrate possible ways through which PE may influence students' out-of-school PA behavior. Secondly, I present a brief review and discussion of concept-based PE interventions that may have potential effects on out-of-school PA. Thirdly, I provided justifications and rationale for this dissertation research by reviewing my preliminary studies that have led me to the current conceptualization for this research. Lastly, I present the research questions and hypotheses along with the significance of this study. At the end of the chapter, I list definitions of the key concepts.

Theoretical Framework for this Study

Although the ways to achieve the "PE effect" have been proposed from different perspectives (e.g., Corbin, 2002; Ennis, 2017; Green, 2014; Penney & Jess, 2004), few theories or models have been developed to specifically illustrate the mechanisms of the "PE effect". In my literature search, I found two such models. One model is Chen and Hancock's (2006) situational-to-self-initiated motivation model. The other is the trans-contextual model (Hagger & Chatzisarantis, 2016).

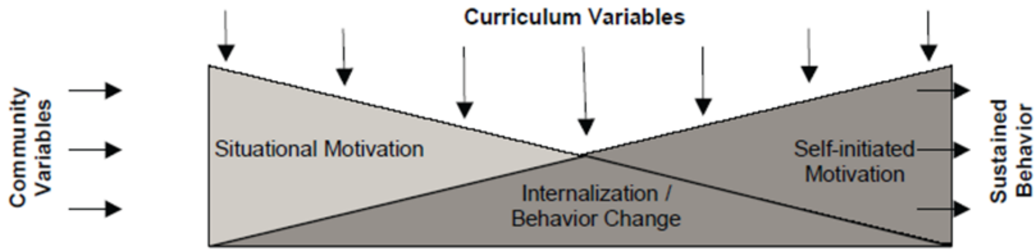
The Situational-to-Self-Initiated Motivation Model

The situational-to-self-initiated motivation model was constructed by Chen and Hancock (2006) to explain how to promote and maintain adolescents' PA motivation and behavior. The PE curriculum is considered as one important factor to promote and maintain adolescents' PA motivation and behavior. This model proposes that children and adolescents' PA motivation tends to be situational and depends on the immediate appealing characteristics of the environment or activity. This situational motivation is effective for short-term PA behavior change such as those displayed in PE classes, but not enough for long-term behavior change. The key for long-term or sustained behavior change relies on the self-initiated motivation, which is defined as "the drive to engage in an activity based on a person's self-concept system consisting of his/her perceived competence, self-efficacy, and expectancy beliefs and values in the activity" (Chen & Hancock, 2006, p. 357). Helping adolescents internalize situational motivation into self-initiated motivation is the key to realizing long-term PA behavior change. PE curriculum variables, such as knowledge and motor skill learning, can contribute to this internalization process (Chen & Hancock, 2006).

As shown in Figure 1.1, the situational-to-self-initiated motivation model is a stage of change model. Drawing from the stages of domain learning (Alexander, Jetton, & Kulikowich, 1995), Chen and Hancock (2006) suggested that adolescents' PA behavior change is a process involving progress through three stages: acclimation, competence, and proficiency. Adolescents can be categorized into one of these three stages based on their knowledge, self-conceptions, and motivation sources.

In the acclimation stage, adolescents have little knowledge, few skills, and low level or inaccurate self-concept systems (e.g., perceived competence, value, self-efficacy, and body image) for long-term PA behavior change. Their PA behavior tends to be situation-induced by situational motivators (e.g., fun in activities), not self-initiated or sustained. In the competence stage, adolescents' knowledge and skills for long-term behavior change start to grow. The level and accuracy of their self-concept systems begin to increase. They may start to realize that PA is not only fun but also beneficial to their health and academic performance. At this stage, self-initiated motivation starts to develop and self-initiated PA behavior starts to emerge. In the proficiency stage, adolescents have sufficient knowledge and skills and high level and accurate self-concept systems to understand and sustain long-term behavior change. PA motivation is highly self-initiated. The expected behavior starts to be stabilized and sustained.

PE plays a significant role during the motivation and behavior change process in this model. Chen and Hancock (2006) suggested that the PE curriculum is an important vehicle to facilitate adolescents' progress through these motivational and behavioral change stages. For example, PE can help adolescents, who can only be motivated to exercise with partners (situationally motivated), become motivated to exercise on their own (self-motivated) through effective knowledge and skill instruction. They also suggested that community variables, such as community resources and safety, can influence the process of adolescents' motivational and behavioral change. An effective PE curriculum may reinforce the positive effects and constrain or reduce the negative effects of community variables on adolescents' motivation and behavior change.



Hypothesized Behavior Change Stages

Personal Variables	*Acclimation* →	*Competence* →	*Proficiency* →
Knowledge & skill	Little	Developing	Sufficient
Self-concept system	Inaccurate	Accurate	Very accurate
Motivation source	Situational	Situational & Personal	Person - initiated
Expected behavior	None	Appearing	Stabilizing

Figure 1.1. The Theoretical Model for PA Motivation and Behavior Change (Chen & Hancock, 2006).

The Trans-Contextual Model

The trans-contextual model, as shown in Figure 1.2, explains how students' autonomous motivation for PE impacts their PA behavior in the out-of-school context through influencing their autonomous motivation and social-cognitive beliefs regarding PA (Hagger & Chatzisarantis, 2016). The trans-contextual model is a multi-theory approach to understand the transformative effects of autonomous motivation for PE on autonomous motivation toward out-of-school PA and eventually on the actual engagement of PA behavior in an out-of-school context. This model integrates the theoretical tenets of self-determination theory (Deci & Ryan, 1985, 2000), the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997), and the theory of planned behavior (Ajzen, 1985, 1991).

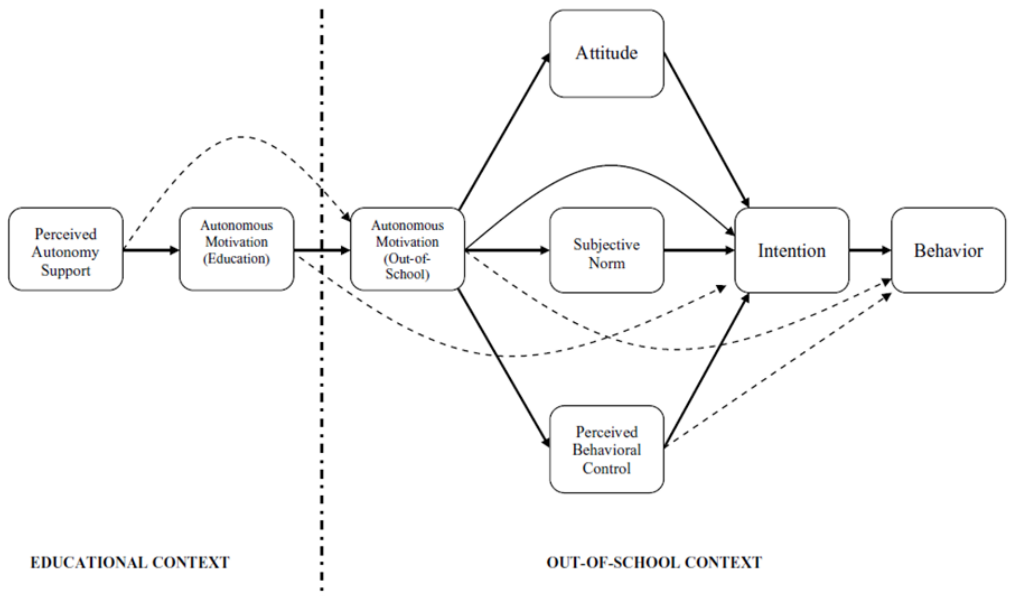


Figure 1.2. The Trans-Contextual Model (Hagger & Chatzisarantis, 2016).

Autonomous motivation in this model is defined as “engaging in activities out of a sense of personal agency, for interest and satisfaction derived from the activity itself, or its concomitant outcomes, and in the absence of any externally referenced contingencies” (Hagger & Chatzisarantis, 2016, p. 361). According to self-determination theory, there are three forms of autonomous motivation—intrinsic motivation, integrated regulation, and identified regulation—in contrast with two forms of controlled motivation—introjected regulation and external regulation (Deci & Ryan, 2000).

Hagger and Chatzisarantis (2016) proposed three basic tenets in the trans-contextual model. The first basic tenet is that students' perception of autonomy support in PE predicts their autonomous motivation for PE. This tenet derives from self-determination theory, in which autonomy, along with competence and relatedness are proposed to be the three basic human psychological needs. The satisfaction of these needs is believed to be the driving force of motivation (Deci & Ryan, 2000). Autonomy support has been shown to be an effective way to foster autonomous motivation (Reeve, 2002; Ryan & Deci, 2009).

The second basic tenet is that autonomous motivation for PE predicts autonomous motivation toward PA in an out-of-school context. Two mechanisms are proposed to underline contextual transfer of autonomous motivation. The first mechanism is based on Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation, which suggests that there are reciprocal relations between autonomous motivation across similar but distinct contexts. It is proposed that when people experience an autonomously motivated activity, a script or schema tends to form, which contains the motivation representations and the anticipated action patterns in that context. The formed schema, subsequently, serves as the template of motivation and anticipated behavior in other contexts, especially when similar cues are present in the new context (Vallerand, 1997).

The second mechanism derives from self-determination theory, which suggests that the adaptive outcomes experienced when engaging in autonomously motivated activity tend to increase one's desire to further experience the outcomes by engaging in similar activities irrespective of the context (Deci & Ryan, 1985). The mechanisms underpinning this process are psychological need satisfaction and internalization (Deci & Ryan, 2000). If a student experiences an activity that satisfies his/her psychological needs in an educational context, this activity will be internalized into his/her repertoire of need-satisfying activities. This student will likely tend to pursuit similar activities in other contexts. In other words, the fact that students experience an autonomously motivated activity in an educational context tends to increase the likelihood that they are autonomously motivated to pursue similar activities in other contexts.

The third basic tenet is that autonomous motivation toward PA in out-of-school context predicts intention to engage and actual engagement in PA in out-of-school context. The theory of planned behavior is employed to explain this process. As shown in the conceptual model (see Figure 1.2), autonomous motivation toward PA influences attitude, subjective norms, and perceived behavior control, which in turn impact PA intention and eventually PA behavior. A more detailed explanation of the process can be found in Chapter II.

Integration of the Two Models

The situational-to-self-initiated motivation model and the trans-contextual model are from different theoretical perspectives. But they share a common assumption that PE is central in impacting students' out-of-school PA behavior. The situational-to-self-initiated motivation model suggests that **effective learning** in PE can facilitate adolescents' transition from situational motivation to self-initiated motivation, which subsequently can lead to long-term PA behavior change. The trans-contextual model proposes that **autonomous motivation** experienced in PE can be transferred to autonomous motivation in the leisure-time PA context, which in turn can influence leisure-time PA behavior.

Generally, these two models imply two pathways by which PE can influence students' out-of-school PA. The first pathway is through influencing students' learning in PE; the second is through influencing their motivational experience in PE. Another common assumption of the situational-to-self-initiated motivation model and the trans-contextual model is that PE contributes to out-of-school PA behavior through influencing students' motivation toward PA. In other words, the effects of students' learning and motivation in PE on out-of-school PA tend to be mediated by their motivation toward PA.

Thus, based on the situational-to-self-initiated motivation model and the trans-contextual model, an *a priori* two-pathway model was proposed to explain how PE can contribute to out-of-school PA behavior. Figure 1.3 shows this *a priori* two-pathway model. This two-pathway model was the theoretical framework that guided the study of the effects of the concept-based PE on middle-school students' out-of-school PA behavior.

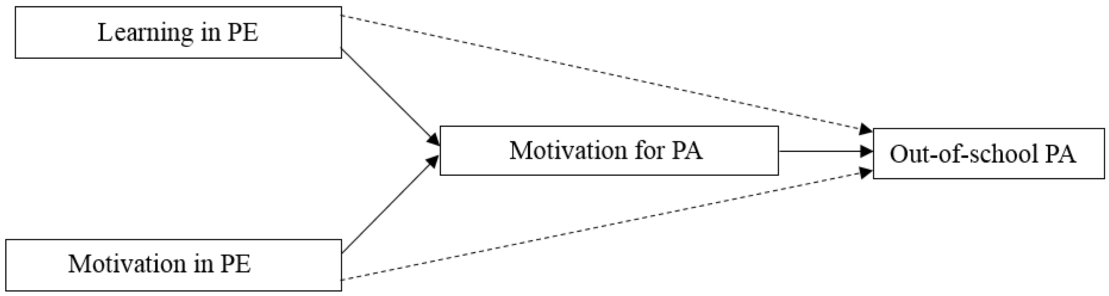


Figure 1.3. The *a priori* Two-Pathway Model of the "PE Effect". Solid lines signify direct positive paths; broken lines indirect positive paths. PE: Physical education; PA: Physical activity.

Most studies examining the "PE effect" were based on the trans-contextual model and focused on examining the pathway of motivational experience in PE (e.g., Hagger & Chatzisarantis, 2016; Shen, McCaughtry, & Martin, 2008). Very few studies examined the pathway of learning in PE to achieve "PE effect". The first purpose of this dissertation study was to examine the two pathways simultaneously to determine the tenability of this two-pathway model of the "PE effect". In this study, for the pathway of motivation in PE, I focused on autonomous motivation for PE. For the pathway of learning in PE, I focused on learning knowledge about PA and fitness.

It is important to acknowledge that this study is an initial attempt to identify possible pathways through which the "PE effect" emerges. This two-pathway model is adopted as a general conceptual framework of the "PE effect". The research intention is to establish the initial model that allows other mediators and moderators suggested in the situational-to-self-initiated motivation model and the trans-contextual model to be integrated in future research studies.

Autonomous Motivation in PE as One Major Focus

Students' motivation for PE has been studied from different theoretical perspectives. The prominent theories that have guided most motivation research in PE include self-determination theory, expectancy-value theory, achievement goal theory, self-efficacy theory, and interest theory. In this study, I focused on the construct of autonomous motivation, because this construct can reflect students' motivation in PE more holistically than the motivation constructs in other theories.

Reeve (1996) proposed that three primary motivation sources in educational context are students' needs, cognition, and emotions. Motivation constructs such as expectancy beliefs, task values, achievement goals, and self-efficacy can reflect students' cognition, but are not salient constructs reflecting students' needs and emotions. Situational interest as proposed by Chen (2001) is one motivation construct that can reflect emotion, but not needs and cognition.

Autonomous motivation in self-determination theory is driven by the satisfaction of three basic psychological needs (competence, autonomy, and relatedness) and is manifested in three forms—identified regulation, integrated regulation, and intrinsic motivation (Deci & Ryan, 2000). By definition, identified regulation is the motivational process through which one recognizes and accepts the value of an activity or behavior and regulates his/her own motivation accordingly. Integrated regulation involves not only accepting the value of an activity but also integrating the activity as part of self-identity

(Deci & Ryan, 2000). In this sense, autonomous motivation can reflect not only the needs, but also cognition to some extent.

Intrinsic motivation, as one typical form of autonomous motivation, is commonly defined as the process of performing an activity for the sake of the activity rather than as the means to an end. Deci (1998) argues that "intrinsically motivated behavior is done because it is interesting" (p. 149). Hidi (2000) suggests that situational interest is one motive that drives intrinsically motivated actions. Thus, it seems that autonomous motivation can also reflect some extent of emotions since situational interest is proposed to be one important component of emotion sources (Chen, 2001).

Based on this conceptualization, it seems that autonomous motivation for PE can, at least to some extent, reflect students' needs, cognition, and emotions. Thus, autonomous motivation for PE may be a motivational construct that can holistically reflect students' motivational experience in PE.

Even though some studies have shown that students' autonomous motivation for PE did not show significant direct effects on their out-of-school PA behavior, those based on the trans-contextual model have shown significant indirect effects (Hagger & Chatzisarantis, 2016). Recently, Hagger and Chatzisarantis (2016) conducted a meta-analytic path analysis to synthesize research findings on the trans-contextual model. They found that the empirical findings supported the trans-contextual model and an indirect but positive influence of autonomous motivation for PE on PA intention ($\beta = .19$, $p < .001$) and PA behavior ($\beta = .06$, $p = .034$) outside of the educational context. The researchers also concluded that students' autonomous motivation for PE can positively influence their leisure-time PA behavior through impacting autonomous motivation toward PA and belief-based constructs (e.g., attitude) in out-of-school context. Therefore, influencing students' autonomous motivation for PE is adopted as one mechanism that guides the current dissertation research.

Learning Knowledge in PE as Another Major Focus

Learning in PE is multidimensional, generally including three dimensions—knowledge acquisition, motor skill development, and affective character cultivation (e.g., confidence, attitude; Society of Health and Physical Educators [SHAPE], 2014). As illustrated in the situational-to-self-initiated motivation model, knowledge and skill learning in PE could be the pathway through which PE impacts out-of-school PA (Chen & Hancock, 2006). The concept-based PE adopted in this dissertation research focuses on not only teaching students the scientific knowledge about PA and fitness, but also the behavioral regulation knowledge such as the SMART goal setting strategies (Ennis, 2015; Sun et al., 2012). Therefore, influencing students' knowledge base about PA and fitness is adopted as another mechanism that guides the current dissertation research.

Many scholars have proposed that the research findings about the relationship between knowledge and PA behavior are mixed. However, based on the extensive literature review on this topic (see Chapter II), it seems that the relationship is quite complicated. There seems to be little relationship between knowledge and PA behavior among elementary school students. A positive relationship is likely among middle-school students. The findings about the relationship among high school students are mixed. Although studies on this topic are very limited and most of them are correlational in nature, current evidence does imply that increasing knowledge about PA and fitness contributes to PA behavior among middle-school students.

Another salient characteristic of existing studies on the relationship between knowledge and PA behavior is that most of them have focused on examining the direct relationship between knowledge and PA behavior. Chen and Hancock's (2006) model postulates that knowledge learning tends to contribute to the formation of self-initiated motivation which subsequently influences the PA behavior. This implies a mediated relationship between knowledge and PA behavior through motivation toward PA. In current dissertation research, this mediated relationship was examined.

Physical Education Interventions for Physical Activity Promotion

PE interventions could be categorized into PE-included interventions and PE-based interventions. PE-included interventions are usually large-scale school-based interventions in which PE is one of several intervention components (e.g., classroom instruction, parent involvement, and school environment alterations) to promote students' PA level. In PE-based interventions, PE is the only focus of the intervention to promote students' PA level.

Physical Education-Included Interventions

Cale (2017) has summarized that most PE interventions for PA promotion are PE-included interventions. Most of them showed positive intervention effects on school-based PA (e.g., PA in PE classes or in school). Few examined the intervention effects on out-of-school PA, and Cale reported that most literature review studies except one (Kriemler et al., 2011) did not find positive intervention effects on out-of-school PA (e.g., De Meester, van Lenthe, Spittaels, Lien, & De Bourdeauhuij, 2009; Stone, McKenzie, Welk, & Booth, 1998). Although a few PE-included intervention studies showed positive effects on students' out-of-school PA level, other intervention components prevented a conclusion about the "PE effect" due to possible confounding factors.

Physical Education-Based Interventions

PE-based interventions usually involve designing and testing a PE curriculum. Currently, several prominent PE curricula have been advocated and implemented nationally and internationally. These curricula include SPARK (Sallis et al., 1993), Sport Education (Siedentop, Hastie, & van der Mars, 2011), Teaching Games for Understanding (Hastie & Mesquita, 2017), Fitness for Life (Corbin & Le Masurier, 2014), Science PE & Me, and Science of Healthful Living (Ennis, 2015). The SPARK curriculum focuses on increasing elementary school students' PA level in PE classes and teaching them behavioral management skills. Sport Education and Teaching Games for Understanding focus on teaching sport/motor skills and knowledge about sport and game play. Intervention studies of these curricula have shown that these curricula are effective in promoting PA level in PE or in school but the effects on PA outside of the school are not significant (Hastie & Mesquita, 2017; Sallis et al., 1997; Wallhead, Garn, & Vidoni, 2014).

Fitness for Life, Science PE & Me, and Science of Healthful Living are concept-based, fitness-oriented PE curricula which focus on teaching knowledge about PA and fitness and the knowledge about behavioral regulation strategies (e.g., goal setting). Fitness for Life is designed mainly for high school and college students; Science PE & Me for elementary school students; Science of Healthful Living for middle-school students. Empirical studies have shown that students who have learned the Fitness for Life curriculum in high school or college tend to be more physically active than students who have learned the traditional sport-based PE (Brynteson & Adams, 1993; Dale & Corbin, 2000; Dale, Corbin, & Cuddihy, 1998; Slava, Laurie, & Corbin, 1984).

Science PE & Me and Science of Healthful Living (SHL) are newly developed PE curricula by Ennis and Chen. The Science PE & Me curriculum was designed in 2003 and the Science of Healthful Living curriculum in 2011 (Ennis, 2015). Both curricula went through a large-scale, longitudinal (5 years), randomized and controlled clinical trial that aimed to determine the curricular efficacy. It has been shown that the Science PE & Me curriculum significantly increased elementary school students' knowledge about PA and fitness without jeopardizing their PA level in PE compared with the traditional multi-activity PE curriculum (Chen, Martin, Sun, & Ennis, 2007; Sun et al., 2012). The Science of Healthful Living intervention study was recently completed, the data are still being analyzed. The preliminary analysis has shown that the Science of Healthful Living curriculum was effective in increasing middle-school students' knowledge and understanding about PA and fitness (Wang et al., 2017). During these two curriculum intervention projects, students' PA motivation and out-of-school PA behavior were not measured. In this dissertation research, I examined the effects of the Science of Healthful Living curriculum on middle-school students' PA motivation and out-of-school PA behavior.

My Preliminary Studies on Concept-based PE

This dissertation research is a continuation of my current research studies focusing on knowledge learning and knowledge impact. With a strong research interest in understanding the process and impact of knowledge learning in PE, I conducted four studies in the past three years using data from the Science of Healthful Living project at UNCG. These studies provide the foundations for the current dissertation research. In this section, I briefly presented the four studies and their connection to the dissertation research.

With a recognition that students' interest in learning science is declining, I analyzed the data to understand the change of students' interest in learning scientific knowledge about exercise (Wang et al., 2018). A random sample of 447 sixth graders was followed for three years in this study. Their interest in learning exercise knowledge was measured eight times (beginning of 6th grade, end of 6th, beginning of 7th, middle of 7th, end of 7th, beginning of 8th, middle of 8th, and end of 8th). Hierarchical Linear Modeling (HLM) was adopted to analyze the data since the interest scores at the eight time points were nested in each individual. The results showed that on average, interest in learning exercise knowledge was declining over the three middle-school years.

In the second study (Wang et al., 2018), I used a cross-lagged, correlational design to determine the extent to which students' interest in learning exercise knowledge influenced their knowledge acquisition when learning concept-based PE. A total of 4,670 sixth-, seventh-, and eighth-grade students provided the data for this study. Their knowledge about exercise and fitness and interest in learning exercise knowledge were measured before and after the semester during which the SHL curriculum was taught. The results showed that students' knowledge increased from 33% correct responses to 56% correct responses (p<.01) over the one semester of learning the SHL curriculum, while their interest decreased from a score of 3.23 to 3.10 (p<. 01). A structural equation modeling (SEM) analysis of the cross-lagged panel model showed that there was no significant relationship between students' interest in learning exercise knowledge and their knowledge acquisition. This study suggests that the SHL curriculum can increase students' knowledge about exercise and fitness. Even though students' interest in learning exercise knowledge is declining, it seems not to influence students' knowledge learning outcome.

In my third study (Wang et al., 2017), I attempted to understand students' knowledge learning process in the SHL curriculum from the perspectives of the nature of learning tasks and cognitive engagement. A total of 992 sixth, seventh, and eighth graders provided data for this study. Students' knowledge about PA was measured before and after learning the SHL curriculum to determine their knowledge achievement. Students' cognitive engagement in three different cognitive levels of learning tasks (descriptive, relational, and reasoning) was operationalized as their performance in the in-class student workbook. The results showed that students' knowledge score increased from 37% correct responses to 61% correct responses ($p<.01$) after one semester of learning the curriculum. Students' engagement in the high-level (reasoning) cognitive tasks showed greater effects on their knowledge acquisition than engagement in the low-level (descriptive) tasks. However, students' cognitive engagement in the lower level learning tasks contributed sizably to their engagement in the higher level learning tasks and indirectly contributed to their knowledge achievement. The findings of this study further support that the SHL curriculum is an effective curriculum to increase middle-school students' knowledge about PA. The design and integration of different levels of cognitive learning tasks seem to be one important factor that contributes to students' knowledge learning.

In the fourth research inquiry (Wang et al., in review), I used a two-year longitudinal design to determine the extent to which students' knowledge learning in the first year contributed to their further knowledge learning in the second year. A cohort of 716 sixth graders participated in this study. Students' knowledge learning was operationalized as their performance in the three different levels of learning tasks (descriptive, relational, and reasoning) in the in-class workbook. Students' workbooks were collected when they were at sixth grade and seventh grade. Canonical correlation and multivariate multiple regression were adopted to analyze the data. The results showed that students' knowledge learning in the first year significantly contributed to their further learning in the second year. The deeper the learning in the first year, the larger the contribution tended to be to the learning in the second year.

These preliminary studies helped me understand the effects of the SHL curriculum on middle-school students' knowledge learning and the process of students' knowledge learning in this curriculum. These findings, along with findings about the positive relationship between knowledge and PA behavior among middle-school students (see Chapter II) and the positive effects of concept-based PE on long-term behavior change among high school and college students, point to a need to further study the effects of the SHL curriculum on middle-school students' out-of-school PA behavior.

Statement of the Problem

The above literature summary suggests a need to further understand the "PE effect" and the effects of the SHL curriculum on middle-school students' out-of-school PA. There are two major gaps which may be bridged by this dissertation research.

Gap one, the current theoretical models suggest two pathways through which PE impacts out-of-school PA behavior (Chen & Hancock, 2006; Hagger & Chatzisarantis, 2016). One pathway is through knowledge /skill learning in PE; the other is through positive motivational experiences in PE. Both knowledge/skill learning and motivation for PE are proposed to contribute to out-of-school PA behavior through influencing their motivation toward PA (Chen & Hancock, 2006; Hagger & Chatzisarantis, 2016). Most studies examining the mechanism of the "PE effects" tend to only focus on the pathway of motivation for PE (e.g., González-Cutre, Sicilia, Beas-Jiménez, & Hagger, 2014;

Hagger et al., 2003). It is important to examine the two pathways simultaneously to further our understanding about the underlying mechanisms of the “PE effect”.

Gap two, it has been shown that the SHL curriculum can significantly increase middle-school students’ knowledge about PA and fitness (Wang et al., 2017). It is still unclear about the effects of the curriculum on middle-school students’ out-of-school PA behavior and the other two salient variables of the “PE effect”—motivation for PE and motivation toward PA.

Research Questions

The purposes of this study, therefore, were to test the two-pathway model of the “PE effect” and determine the effects of the SHL curriculum on middle-school students’ knowledge, motivation for PE and PA, and out-of-school PA behavior. Specifically, this dissertation research answered the following two research questions: (a) to what extent did eighth graders’ knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? (b) Did eighth-grade students who had experienced the SHL curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, or out-of-school PA than those who had not?

Research Hypothesis

For the first research question, I hypothesized that students’ knowledge and autonomous motivation for PE would indirectly influence out-of-school PA behavior through influencing their autonomous motivation toward PA, since both the situational-to-self-initiated motivation model and the trans-contextual model imply that PE influences students' out-of-school PA behavior indirectly through motivation toward PA.

An *a priori* path diagram, as shown in Figure 1.4, was constructed to show the hypothesized path relationships. All the solid lines in the path diagram represent positive direct effects and broken lines indicate positive indirect effects. Specifically, I hypothesize that (a) both students' knowledge about PA and autonomous motivation for PE would have a positive direct effect on their autonomous motivation toward PA; (b) students' autonomous motivation toward PA would have a positive direct effect on out-of-school PA; (c) both students' knowledge about PA and autonomous motivation for PE would also have a positive indirect effect on their out-of-school PA through influencing their autonomous motivation toward PA.

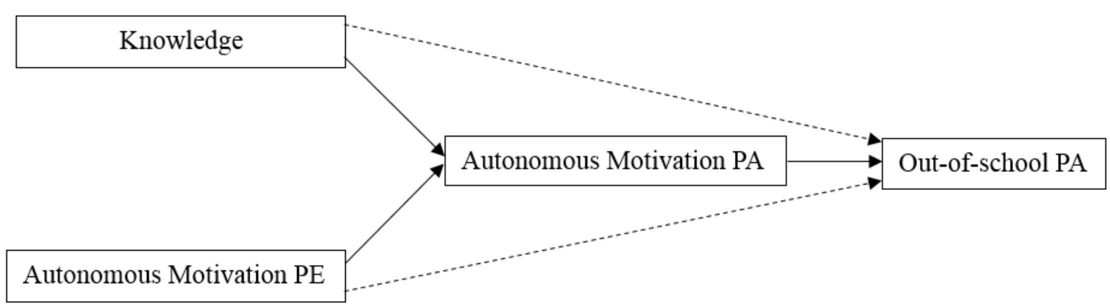


Figure 1.4. The *a priori* Path Diagram. Solid lines signify direct positive paths; broken lines represent indirect positive paths. PE: Physical education; PA: Physical activity.

My preliminary studies have shown that the SHL curriculum is effective to increase middle-school students' knowledge about PA and fitness (Wang et al., 2017). Although the influences of the curriculum on students' autonomous motivation for PE have not been investigated, the content, structure, and instructional model adopted in the SHL curriculum are designed to elicit high levels of autonomous motivation among students (Ennis, 2015; Sun et al., 2012). For example, the emphasis of learning rationale, opportunities for making task choice, advocacy of mastery rather than competition, and encouragement of cooperative peer communication in the curriculum are expected to increase students' psychological need satisfaction, and subsequently promote their autonomous motivation (Wang, 2017). A detailed description of the SHL curriculum can be seen in Chapter III. I hypothesized that students who had taken the SHL curriculum would have higher levels of knowledge and autonomous motivation for PE than students who had only taken the traditional multi-activity PE during middle-school.

Based on the two theoretical "PE effect" models (Chen & Hancock, 2006; Hagger & Chatzisarantis, 2016) and the findings supporting positive effects of concept-based PE on PA behavior (e.g., Brynteson & Adams, 1993; Dale & Corbin, 2000), I hypothesized that students who had taken the SHL curriculum would have higher levels of autonomous motivation toward PA and out-of-school PA behavior than students who had only taken the traditional multi-activity PE during middle-school.

Significance of the Research

This dissertation research aimed to further understand the "PE effect" and determine the effects of a concept-based PE on out-of-school PA among middle-school students. The study has theoretical and practical significance. First, the findings about the relationship between knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA behavior would contribute to the refinement of current theoretical models about the "PE effect". Secondly, determining the effects of concept-based PE on out-of-school PA behavior may contribute to the literature about the "PE effect". Practically, determining the effects of concept-based PE on students' motivation in PE, motivation toward PA, and out-of-school PA behavior can provide relevant evidence for PE teachers to make decisions about curriculum selection and justify their decision.

Definitions of Key Terminologies

Autonomous motivation is defined as the drive of engaging in an activity out of a sense of personal agency, for either interest and satisfaction derived from the activity itself or its concomitant outcomes, and in the absence of any externally referenced contingencies (Hagger & Chatzisarantis, 2016).

Educational physical education emphasizes student learning in physically active learning environment, in which learning content is highly focused, concept-based, and skill- or fitness-oriented (Ennis, 2010).

Identified regulation is the process through which people recognize and accept the value of an activity or behavior (Deci & Ryan, 2000).

Integrated regulation involves not only accepting the value of an activity but also integrate the activity as part of self-identity (Deci & Ryan, 2000)

Intrinsic motivation as one typical form of autonomous motivation is commonly defined as the process of performing an activity for the sake of itself rather than as the means to an end (Deci & Ryan, 2000).

Physical education-based interventions are physical activity promotion interventions in which physical education is the only focus of the intervention.

Physical education-included interventions are usually large-scale school-based interventions in which physical education is just one of several intervention components (e.g., classroom instruction, parent involvement, and school environment alteration) to promote students' physical activity level (Cale, 2017).

Public health physical education focuses on one specific goal—providing students with a recommended dose of physical activity in physical education (Ennis, 2010).

Recreational physical education focuses on providing enjoyable opportunities for students to play sports or games with little instruction (Ennis, 2010).

Self-initiated motivation refers to the drive to engage in an activity based on one's self-concept system which mainly consists of perceived competence, self-efficacy, expectancy beliefs, and values in the activity (Chen & Hancock, 2006).

Situational motivation refers to the drive to engage in an activity which is situation-induced and based on the immediate appealing characteristics of the environment or activity (Chen & Hancock, 2006).

The "PE effect" refers to the positive effects of physical education on students' physical activity behavior in their leisure time and, in the longer run, over the life course (Green, 2014).

The concept-based physical education is fitness-oriented educational physical education focusing on teaching conceptual knowledge about physical activity and fitness and behavioral skills such as goal setting (Ennis, 2015).

Transformative PE focuses on educating students for a lifetime of physical activity through enhancing students' cognitive decision making, self-motivation, and personal meaning about physical activity (Ennis, 2017).

CHAPTER II

REVIEW OF THE LITERATURE

Educating students for a lifetime of PA has been widely acknowledged as a primary goal of PE (Corbin, 2002; Ennis, 2017; Green, 2014; Penney & Jess, 2004). Many studies have examined how to increase students' motivation, knowledge learning, and in-class PA in PE. But, few have investigated the effects of PE on students' PA behavior beyond the PE context. The purpose of this dissertation research aimed at determining the extent to which the effects of a concept-based PE on middle-school students' out-of-school PA behavior. In the following sections, I expanded the review of the theoretical models, briefly introduced in Chapter I, about the effects of PE on out-of-school PA. Based on the current theoretical models, an integrated theoretical framework guiding current dissertation research was proposed. Empirical findings supporting the theoretical framework were reviewed and critiqued. Secondly, I reviewed intervention studies that included PE or were based on PE to promote students' PA behavior. By reviewing and critiquing the literature, I focused on providing a theoretically sound rationale and necessity for focusing on the effects of concept-based PE on out-of-school PA behavior. Lastly, based on the critique of the literature and reasoning for the need to study the effect of the concept-based PE, I articulated the specific mechanisms worthy of empirical examination and proposed specific research questions for the dissertation research.

Theoretical Models of PE Effects on Out-of-school PA

Although scholars agree that the primary goal of PE is to promote lifelong PA, they hold different perspectives on how to meet this goal. For example, Penney and Jess (2004) proposed a multidimensional model of PA and argued that to promote lifelong PA the scope of PE curricula should be broadened to include skill and knowledge about four types of PA: functional PA, recreational PA, health-related PA, and performance-related PA. Corbin (2002) emphasized that lifelong PA needs independent and self-directed PA behavior and suggested that PE should teach for independence through teaching conceptual knowledge, especially self-management knowledge (e.g., goal setting) and problem-solving skills (e.g., how to assess fitness). Sallis and McKenzie (1991) adopted the term “health-related physical education.” They proposed that lifelong PA should be the goal of PE because it helps address important public health issues such as childhood obesity, although they remained skeptical about its effects on long-term, regular PA behavior change (Salli, McKenzie et al., 2012). Thus, Salli, McKenzie et al. (2012) emphasized the importance of focusing on promoting students’ in-class PA level for children to receive immediate health benefits in PE.

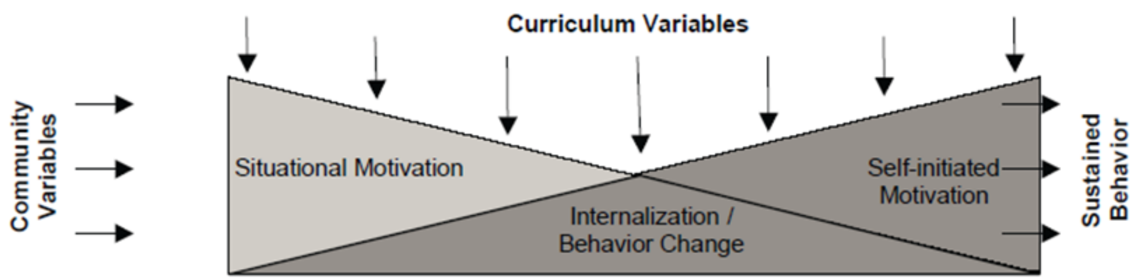
It is important for us to recognize these different perspectives and approaches in terms of enhancing students’ PA behavior beyond school context. It is equally important to realize the need for additional theoretical models and research to further our understanding about how PE, regardless of the curricular perspectives, would impact students' PA behavior outside of the school. Theoretical models focusing on "PE effect" are very few. I found two in my search of literature. One is Chen and Hancock's situational-to-self-initiated motivation model (Chen & Hancock, 2006). The other is the trans-contextual model (Hagger & Chatzisarantis, 2016).

The Situational-to-Self-Initiated Motivation Model

Chen and Hancock's (2006) situational-to-self-initiated motivation model was constructed for nurturing and sustaining adolescents' PA motivation and behavior. The role of PE curriculum is considered as the anchor for the behavior change in this model. Chen and Hancock proposed that the key to promoting adolescents' long-term PA behavior change is the cultivation of their self-initiated motivation. They argue that children and adolescents' PA motivation is highly situational initially. The situational motivation is effective to change students' immediate or short-term PA behavior. Long-term or sustained behavior change relies on self-initiated motivation, which refers to "the drive to engage in an activity based on a person's self-concept system consisting of his/her perceived competence, self-efficacy, and expectancy beliefs and values in the activity" (Chen & Hancock, 2006, p. 357).

Helping adolescents internalize situational motivation into self-initiated motivation is the key to realize long-term PA behavior change. Chen and Hancock (2006) suggested that there is often a gap between situational motivation and self-initiated motivation. For example, studies have shown that many students consider PE as the most liked among all subjects offered in school because it is fun (situationally motivating), but perceive it of the lowest value (Ennis, 2006; Goodlad, 1984). Thus, students can be highly motivated and active in PE class, but may not adopt a physically active lifestyle.

The situational-to-self-initiated motivation model focuses on the process of helping adolescents internalize situational motivation into self-initiated motivation from a holistic perspective. It is proposed that long-term PA behavior change depends on the collective impact of changes in knowledge, self-conceptions, and motivational sources (Chen & Hancock, 2006). The conceptual model can be seen in Figure 2.1.



Hypothesized Behavior Change Stages

Personal Variables	***Acclimation*** →	***Competence*** →	***Proficiency*** →
Knowledge & skill	Little	Developing	Sufficient
Self-concept system	Inaccurate	Accurate	Very accurate
Motivation source	Situational	Situational & Personal	Person - initiated
Expected behavior	None	Appearing	Stabilizing

Figure 2.1. The Theoretical Model for PA Motivation and Behavior Change (Chen & Hancock, 2006).

The conceptual model. Chen and Hancock's model is a stage of change model. Drawing from the stages of domain learning (Alexander, Jetton, & Kulikowich, 1995), Chen and Hancock (2006) suggested that adolescents' PA behavior change is a process involving the progress through three stages: acclimation, competence, and proficiency. Adolescents can be categorized into one of these three stages based on their knowledge, self-conceptions, and motivation sources. PE curriculum and community variables are proposed to be able to significantly influence adolescents' progress throughout the stages.

Stages of behavior change. At the acclimation stage, adolescents have little knowledge and few skills needed for pursuing long-term PA behavior change. They tend to have a low level of or inaccurate self-concept systems, such as perceived competence, value, self-efficacy, and body image. At this stage, adolescents' behavior is situation-induced by situational motivators (e.g., fun in activities, game partners), not self-initiated or sustained.

At the competence stage, adolescents start to develop the knowledge and skills needed for long-term behavior change. For example, they start to understand the benefits of PA and master the skills needed to design and follow the scientifically sound exercise plan. These knowledge and skills form a foundation for them to increase the level and accuracy of their self-concept systems. They may start to realize that PA is not only fun (situational motivation), but also beneficial to their health and academic performance (value-based, self-initiated motivation). At this stage, adolescents' self-initiated motivation begins to develop. The expected behavior starts to emerge and develop based on the developing self-initiated motivation. Expected behavior at the stage is not stable and can develop or diminish depending on how effectively the situational motivation can be internalized into self-initiated motivation.

At the proficiency stage, adolescents have sufficient knowledge and skills to understand and sustain long-term behavior change. They have accurate and high level of self-concept systems. The sufficient knowledge and accurate self-concept systems can help them develop appropriate strategies to overcome barriers to pursuit the expected behavior change. PA motivation is highly self-initiated, instead of situation-induced. The expected behavior becomes stabilized and eventually sustained.

The role of curriculum and community variables. Another salient characteristic of this model is its recognition of the important role of PE curriculum and community variables played during the motivation and behavior change process. Chen and Hancock (2006) suggested that PE curriculum is an important vehicle to facilitate adolescents' progress through these motivational and behavioral change stages. For example, an effective PE curriculum can help adolescents learn knowledge and skills to help adolescents, who can only be motivated to exercise with partners (situational motivated), become motivated to exercise on their own (self-motivated). They also suggested that community variable, such as community resources and safety, can influence the prior stage of adolescents before they enter the motivational and behavioral change process. An effective PE curriculum can reinforce the positive effects and constrain or reduce the negative effects of community variables on adolescents' motivation and behavior change.

The Trans-Contextual Model

The trans-contextual model, constructed by Hagger and colleagues, outlines the process by which autonomous motivation for PE predicts autonomous motivation toward, social-cognitive beliefs on, and actual engagement in PA in out of the school context (Hagger & Chatzisarantis, 2016; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). This model attempts to answer a very important educational question: how students' experience and learning in an educational context contribute to their self-directed learning and behavior outside of the context. The trans-contextual model focuses on the transfer process of one important psychological attribute—autonomous motivation.

As shown in Figure 2.2, the trans-contextual model is a multi-theory approach to understanding how students' autonomous motivation for PE influences their autonomous motivation toward PA and, eventually, impacts their actual PA engagement in out of school context. This model integrates theoretical tenets of self-determination theory (Deci & Ryan, 1985, 2000), hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997), and the theory of planned behavior (Ajzen, 1985, 1991). Although Hagger and colleagues generalized this model to include other content domains, most empirical support of this model has come from PE and out-of-school PA (Hagger & Chatzisarantis, 2016).

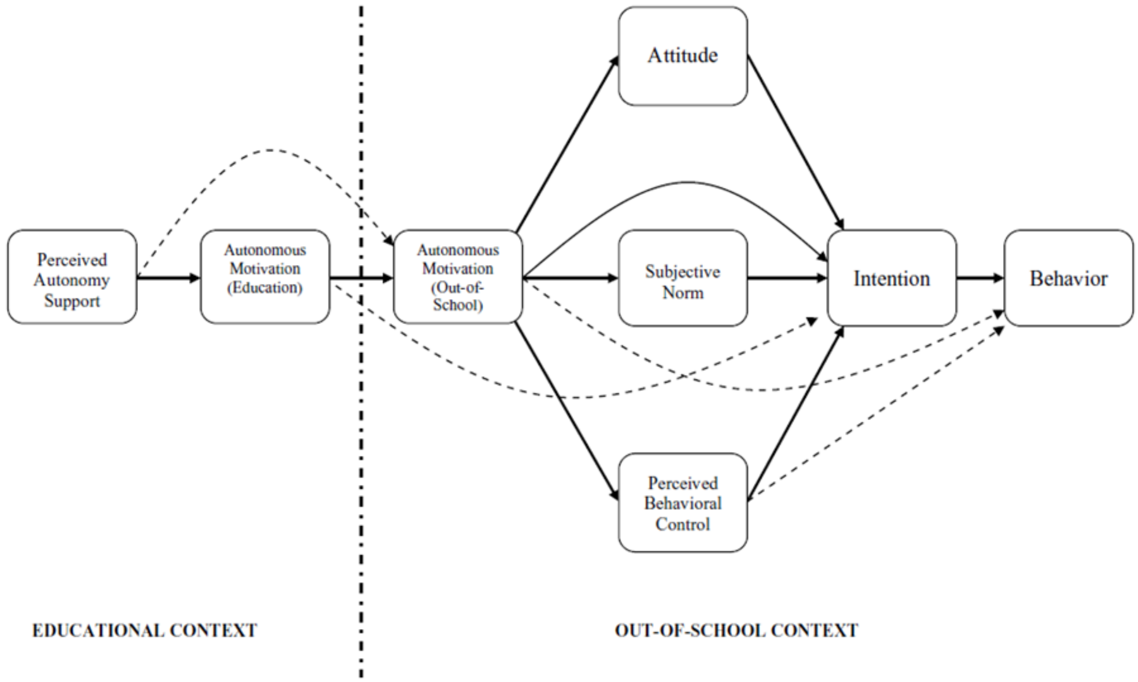


Figure 2.2. The Trans-Contextual Model (Hagger & Chatzisarantis, 2016).

Autonomous motivation in this model is defined as "engaging in activities out of a sense of personal agency, for interest and satisfaction derived from the activity itself, or its concomitant outcomes, and in the absence of any externally referenced contingencies" (Hagger & Chatzisarantis, 2016, p. 361). According to self-determination theory, there are three forms of autonomous motivation—intrinsic motivation, integrated regulation, and identified regulation—in contrast with two forms of controlled motivation—introjected regulation and external regulation (Deci & Ryan, 2000).

Basic tenets of the trans-contextual model. There are three central propositions in the trans-contextual model. The first is that perceived support for autonomous motivation predicts autonomous motivation within educational contexts; secondly, autonomous motivation toward activities in an educational context predicts autonomous motivation toward similar activities in an out-of-school context; the third is that autonomous motivation in an out-of-school context predicts future intention to engage in activities out of school and in actual behavioral engagement (Hagger & Chatzisarantis, 2016).

The first basic tenet. This first basic tenet focuses on illustrating the relationship between autonomous support and autonomous motivation in educational context. This tenet is drawn from self-determination theory. Self-determination theory categorized motivation into five types—external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation—based on the nature of behavioral regulation process. These five types of motivation form a continuum, ranging from the most controlled motivation to the most autonomous motivation. Autonomous forms of motivation are proposed to be most adaptive because they lead to persistence with activities and other salient psychological outcomes (e.g., satisfaction, enjoyment) in the absence of external contingencies or obligations (Ryan & Deci, 2016).

According to self-determination theory, the driving force of motivation is the satisfaction of three basic psychological needs—autonomy, competence, and relatedness (Deci & Ryan, 2000). The need for autonomy reflects an individual's desire to be a causal agent in her or his world. The need for competence is satisfied through the pursuit of autonomously motivated behaviors that lead to perceptions of success and control of outcomes. The need for relatedness reflects innate desires to be supported by others and to be supportive of others when engaging in behaviors. The extent to which these psychological needs are satisfied determines the degree of autonomous motivation one experiences when doing an activity (Deci & Ryan, 2000).

Autonomy support has been shown to be an effective means to foster autonomous motivation. In educational context, teachers can promote students' autonomous motivation by adopting appropriate instructional strategies and structuring the learning environment that satisfy students' basic psychological needs (Reeve, 2002; Ryan & Deci, 2009). Thus, the first tenet of the trans-contextual model is that students' perception of autonomy support in educational context predicts their autonomous motivation in the same context.

The second basic tenet. The second basic tenet is the central and unique proposition in trans-contextual model. That is, autonomous motivation toward activities in educational context predicts autonomous motivation toward similar activities in out-of-school context. Two proposed mechanisms underline the trans-contextual transfer of motivation.

The first mechanism is based on Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation, which suggests that there are reciprocal relations between autonomous motivation across similar but distinct contexts. It is proposed that when people experience an autonomously motivated activity, a script or schema tends to form, which contains the motivation representations and the anticipated action patterns in that context. The formed schema, subsequently, serves as the template of motivation and anticipated behavior in other contexts, especially when similar cues are present in the new context.

The second mechanism derives from the self-determination theory, which suggests that the adaptive outcomes experienced when engaging in autonomously motivated activity tends to increase people's desire to further experience the outcomes by engaging in similar activities irrespective of the context (Deci & Ryan, 1985). The mechanisms underpinning this process are psychological need satisfaction and internalization (Deci & Ryan, 2000). If a student experiences an activity that satisfies their psychological needs in an educational context, this activity will be internalized into his/her repertoire of activities that is need-satisfying. This student will tend to actively pursuit similar activities in other contexts. In other words, the fact that students experience an autonomously motivated activity in an educational context tends to increase the likelihood that they are autonomously motivated to pursuit similar activities in other contexts.

The third basic tenet. The third basic tenet is that autonomous motivation in out-of-school contexts predicts future intention to engage in out-of-school activities and actual behavioral engagement. The trans-contextual model employed theory of planned behavior to explain the process by which autonomous motivation influences future intention and actual behavior.

Theory of planned behavior is a belief-based, social-cognitive model (Ajzen, 1991). This theory proposes that behavior is determined by intention, a motivational construct reflecting the strength of willingness and effort to enact an activity or behavior (Ajzen, 1991). Intention is proposed to be a function of three belief-based constructs—attitude, subjective norms, and perceived behavior control (Ajzen, 1991). Attitude reflects people's belief about the favorable outcomes they may attain by engaging in certain behavior. Subjective norms reflect the belief about whether engaging in the behavior is consistent with the desire of significant others. Perceived behavior control reflects people's belief about their capacity and availability of resources to perform the behavior.

The trans-contextual model proposes that autonomous motivation positively predicts attitude, subjective norms, and perceived behavior control, because autonomous motivation is related to cognitive, affective, and behavioral outcomes and individuals have a tendency to align their beliefs with their behavioral regulations (Deci & Ryan, 1985; Vallerand, 1997). Hagger et al. (2016) proposed that autonomous motivation reflects the process of engaging in the activity out of an authentic sense of self, which is consistent with personal beliefs about outcomes (attitude). Autonomous motivation also reflects the process of engaging in the activity as an effective agent in the environment. This conceptualization is consistent with the personal beliefs about control (perceived behavior control). Hagger and colleagues (2016) also argued that subjective norms are, theoretically, less likely to be aligned with autonomous motivation because the construct is typically conceptualized as beliefs concerning social pressures to engage in the activity. But, the empirical findings have shown a positive relationship between autonomous motivation and subjective norms (Chan, Fung, Xing, & Hagger, 2014;

Hagger, Chatzisarantis, & Biddle, 2002; Hamilton, Cox, & White, 2012). Hagger et al. (2016) indicated that the reason of the positive relationship between autonomous motivation and subjective norms could be that individuals respect and value the desires of significant others and view them as supporting their autonomy.

Integration of the Two Models

The situational-to-self-initiated motivation model and the trans-contextual model illustrate how PE is central in impacting students' out-of-school PA behavior from different theoretical perspectives. Chen and Hancock (2006) suggest that effective learning in PE can facilitate adolescents' transition from situational motivation to self-initiated motivation, which subsequently can lead to long-term PA behavior change. In the trans-contextual model, it is proposed that autonomous motivation experienced in PE can be transferred to autonomous motivation in leisure-time PA context, which in turn can influence leisure-time PA behavior.

Generally, these two models imply two pathways by which PE can influence students' out-of-school PA. One pathway is thorough students' motivational experience in PE; the other is students' learning in PE. In the following, I reviewed and critiqued empirical findings on effects of motivational experience in PE on out-of-school PA and effects of learning in PE on out-of-school PA.

Motivational in PE and out-of-school PA. Students' motivation for PE has been studied from many theoretical perspectives (Chen et al., 2012). Different motivational constructs have been proposed in different motivation theories. In this part, I reviewed motivational constructs from several dominant motivation theories that have guided numerous studies in PE. These theories include achievement goal theory, expectancy-value theory, self-efficacy theory, interest theory, and self-determination theory. My review focused on the relationship between these motivational constructs in PE and out-of-school PA behavior.

Achievement goals. The achievement goal theory was constructed to better understand students' experience during challenge and setbacks from the perspective of goals that students pursue for their academic tasks (Senko, 2016). Mastery goals and performance goals are proposed as two types of general achievement goals in this theory. These goals represent students' broad purposes or reasons for engaging in academic tasks. Mastery goals represent a desire to develop competence through learning and improving. Performance goals represent a desire to demonstrate competence through outperforming others. According to the theory, mastery goals lead to desirable educational outcomes (e.g., view errors as a normal part of learning process, enjoy leaning process, persist through setbacks, try new strategies, seek outside help) while performance goals, especially when coupled with low competence, results in undesirable education outcomes (e.g., view errors or high effort as low ability, feel anxious, avoid challenge and setbacks).

The achievement goal theory further extended its goal structure by incorporating the approach-avoidance distinction to better explain findings about relationship between achievement goals and learning outcomes (Senko, 2016). Performance goals were separated into performance-approach (striving to outperform others and appear competent) and performance-avoidance (striving to avoid being outperformed or appearing incompetent). Mastery goals were divided into mastery-approach goals (striving to learn and improve) and mastery-avoidance goals (striving to avoid failures to learn or declines in skill). Mastery-approach goals are most adaptive and lead to a wide range of desirable educational outcomes (e.g., high academic achievement, good emotional experience, positive social relationship and moral development). Performance-avoidance goals are most maladaptive and lead to the opposite outcome pattern of mastery-goal approach. Performance-approach goals can positively predict academic achievement but may be detrimental to other outcomes such as social relationship and moral development. Mastery-avoidance goals are proposed to be uncommon among typical student populations (Ciani & Sheldon, 2010).

Given the salient effects of achievement goal theory, scholars also investigated how to cultivate adaptive achievement goals (Senko, 2016). They have found that the broader classroom climate and school culture is one important factor that influences students' goal orientation and, subsequently, their learning experience and outcomes. A mastery-involving climate tends to have better effects on desirable learning outcomes than a performance-involving climate (Senko, 2016).

Achievement goal theory has guided many motivation studies in PE. Most of these studies focused on examining the relationship between students' achievement goals in PE and their learning outcome in PE. Unlike findings in general education studies, achievement goal theory seems to have little effects on predicting students' learning outcome in PE. Chen and colleagues (2012) in their meta-analytic review found that achievement goals had a low correlation (r = .25) with non-competence-based learning outcomes (e.g., effort, enjoyment) in PE and no relationship (r = .15) with competence-based outcomes (e.g., knowledge, skill, and strategy use).

Currently, studies examining the relationship between students' goal orientation in PE and their PA engagement beyond the educational context are limited but emerging. The findings are mixed. For example, Bryan and Solmon (2012) investigated the relationship between middle-school students' perceptions of PE climate (perceived mastery goal climate VS perceived performance goal climate) and daily PA level (self-reported level and pedometer count). They found that students' perceptions of the goal climate in PE had no relationship with their daily PA level measured using either self-reported questionnaire (perceived mastery goal climate: r = .04, p > .05; perceived performance goal climate: r = .10, p > .05) or pedometer count (perceived mastery goal climate: r = .03, p > .05; perceived performance goal climate: r = .05, p > .05). Garn, McCaughtry, Shen, Martin, and Fahlman (2013) examined high-school girls' perceived goal climate in PE and their PA intention and self-reported PA level. They found that high school girls' perceived mastery goal climate in PE positively predicted their PA intention (path coefficient= .44, p < .01; r = .35, p < .01) and self-reported PA level (path coefficient= .17, p < .05; r = .15, p < .05). Perceived performance-approach goal climate only positively predicted self-reported PA level (path coefficient= .21, p < .05; r = .13, p

$< .05$); perceived performance-avoidance goal climate negatively predicted PA level (path coefficient= -.18, $p < .05$; $r = .05$, $p > .05$).

In addition to perceived goal climate in PE, several studies also examined the relationship between students' goal orientations in PE and their PA level. Papaioannou, Bebetsos, Theodorakis, Christodoulidis, and Kouli (2006) using longitudinal research design examined students' goal orientations in PE and their subsequent, self-reported PA level. Middle and high school students (n=882) from Greece participated in this study. Their goal orientations in PE were measured at the beginning of the academic year and their self-reported PA level were measured 7 and 14 months later. They found that the mastery/task orientation in PE predicted their PA level 7 months (path coefficient= .20, $p < .001$) and 14 months later (path coefficient= .10, $p < .01$) while performance/ego orientations did not predict PA level at either time (7 months later: path coefficient= .04, $p > .05$; 14 months later: path coefficient= .02, $p > .05$). Yli-Piipari, Leskinen, Jaakkola, and Liukkonen (2012) also using a longitudinal research design examined the relationship between 6th graders' goal orientations in PE and their self-reported PA level. They found that male students' mastery goal orientation in PE at 6th grade predicted their PA (path coefficient= .40, $p < .05$; $r = .22$, $p < .01$) after a year (when in 7th grade) while performance goal orientation did not show any significant prediction effect for any student groups.

In summary, studies examining relationship between students' achievement goals in PE and their PA levels beyond educational context are very limited. But the current findings seem to suggest that students' mastery/task orientation in PE may have a positive but small effect on students' out-of-school PA behavior. It is still unclear about the relationship between students' perceived goal climate in PE and their PA level.

Expectancy belief and task values. The expectancy belief and task values are motivational constructs in the expectancy-value theory (Wigfield & Eccles, 2002). The expectancy-value theory postulates that achievement motivation depends on students' competence-based expectancy belief about success and their perceived values of the tasks (Eccles & Wigfield, 1995). Expectancy belief is defined as one's judgement about their possibility of success in upcoming tasks. Task values refer to one's perceived worthiness of the task. They include attainment value, intrinsic value, and utility value. Attainment value refers to the personal importance of succeeding in performing a task. Intrinsic value refers to perceived enjoyment in performing a task. Utility value refers to the perceived usefulness of participating in an activity.

Currently, studies examining the relationship between students' expectancy beliefs and task values in PE and their PA behavior beyond the PE context are limited. Most studies focused on middle-school students and relied on self-reported questionnaires to measure PA levels. In general, results of the studies suggest that students' expectancy belief in PE seems to have positive effects on their PA behavior beyond PE. The findings about relationship between task values in PE and PA behavior are mixed.

Zhu and Chen (2013) examined the relationship between middle-school students' (n=854) expectancy beliefs and task values in PE and their out-of-school PA level. The 3-Day Physical Activity Recall survey was used to measure students' out-of-school PA. They found that students' expectancy beliefs in PE had significant total effects (total effect= .153, $p < .05$; $r = .12$, $p < .05$) on their out-of-school PA participation although the direct and indirect effects were not significant. Students' task values in PE showed no effects on their out-of-school PA.

Using longitudinal design, Yli-Piipari, Jaakkola, Liukkonen, and Nurmi (2013) tracked 812 sixth graders' expectancy beliefs and task values in PE and their PA level (measured using a two-item survey) for three years. They found that most students (77%) maintained a high and stable level of expectancy beliefs and tasks values over the three middle-school years. They categorized participants into four groups based on their changing trajectories of expectancy beliefs and task values in PE. These four groups were named as "mixed change" group (expectancy beliefs declined but task values increased), "negative change" group (both expectancy beliefs and task values declined), "high and stable" group (both expectancy beliefs and task values were at high level and stable), and "increasing beliefs" group (expectancy beliefs increased and task values were at high level and stable). They found that only the "increasing beliefs" group showed increasing trend on PA level over the three years; the other three groups showed declining trend. The "High and Stable" group had the highest initial PA level (PA level at sixth grade). This study suggests that both expectancy beliefs and task values in PE may have positive effects on their out-of-school PA level. When students have high task values in PE, increasing their expectancy beliefs in PE may promote their PA level.

To clearly understand the effects of tasks values in PE and PA level, Yli-Piipari, Jaakkola, and Liukkonen (2010) further examined the extent to which sixth graders' task values in PE predicted their PA level at seventh grade using a cross-lagged longitudinal design. They found that task values toward PE positively predicted PA level next year (girls: path coefficient= .14, $p < .04$; $r = .25$-.31; boys: path coefficient= .10-.12, $p < .05$; $r = .30$-.36) after controlling for previous task values and PA level.

Some scholars also examined the relationship between students' perceived PE ability and perceived PE worth and their PA level based on Welk's (1999) PA promotion model. Even though these two constructs are named differently from expectancy beliefs and task values, conceptually and operationally they are similar (Welk, 1999). Fairclough, Hilland, Stratton, and Ridgers (2012) found that perceived PE ability positively predicted middle-school girls' self-reported PA level (standardized regression coefficient= .36, $p < .01$) while perceived PE worth did not. Hilland, Ridgers, Stratton, and Fairclough (2011) addressed the same research question using both subjectively (PAQ-C) and objectively (ActiGraph accelerometer) measured PA level. They found the only the perceived PE ability predicted objectively measure daily PA (regression coefficient= 9.08, $p < .01$); both perceived PE ability and perceived PE worth predicted self-reported PA level (PE ability: regression coefficient= .29, $p < .01$; PE worth: regression coefficient= .13, $p < .05$).

In summary, based on current findings it seems to be consistent that students' expectancy beliefs in PE have positive effects on their out-of-school PA behavior. The findings about relationship between task values in PE and PA are mixed. More studies are needed to determine this relationship.

Self-efficacy. Self-efficacy is defined as "judgments of the likelihood one can organize and execute given action courses required to deal with prospective situations" (Bandura, 1980, p. 263). Studies examining self-efficacy in PE and PA behavior beyond the PE context are very limited. To my knowledge, only two studies from the same research group empirically examined this research question (Jackson, Whipp, Beauchamp, 2013; Jackson, Whipp, Chua, Dimmock, & Hagger, 2013). Jackson and colleagues (2013) examined relationship between middle-school students' self-efficacy in PE and their daily PA level using different research design from different theoretical perspectives. In the first study, they used cross-lagged longitudinal design and found that students' self-efficacy in PE positively predicted their self-reported PA level three weeks later. This relationship was partially mediated by their exercise self-regulatory efficacy two weeks later. In the second study, they addressed this research question using cross-sectional design based on trans-contextual model. They found that the relationship between self-efficacy in PE and leisure-time PA was mediated by autonomous motivation for PE and autonomous motivation toward leisure-time PA. Their studies suggest that self-efficacy in PE has positive, either direct or indirect, effects on out-of-school PA.

Situational interest. Interest, as a research construct, is a complicated, multi-layered construct (Chen & Wang, 2017). It is conceptualized as individual interest and situational interest (Hidi & Renninger, 2006). Individual interest refers to an enduring psychological disposition in preference of an activity or an action. Hidi and Renninger (2006) argued that individual interest reflects the cognitive and affective components regarding the activity or behavior of interest.

Situational interest is an individual's motivational reaction to the appealing effect of characteristics of an activity (Chen, Darst, & Pangrazi, 2001). It depends on the person-activity interaction and is triggered by the immediate appealing characteristics of the activity or environment. Chen and Wang (2017) suggested that situational interest is a spontaneous and intensive motivational force in terms of PA engagement. Chen and Zhu (2005) argued that children decide to engage or avoid an activity based on either their original interest (individual interest) or the extent to which the immediate activity or environment appeals to them (situational interest). Based on Hidi and Bared's (1986) theoretical work, Chen, Darst, and Pangrazi (1999, 2001) attempted to clarify the dimensional structure of the situational interest construct. They found a five-dimensional construct of situational interest including novelty, challenge, exploration intention, attention demand, and instant enjoyment. These five-dimensional constructs, as sources of situational interest, have been verified by multiple samples (Chen et al., 1999).

Most, if not all, research studies on the relationship between situational interest and PA engagement are conducted in PE settings. A recent literature review on the role of interest in PE suggests that students' situational interest consistently predicts their PA level in PE (Chen & Wang, 2017). For example, Shen, Chen, Tolley, and Scrabis (2003) investigated the relationship between middle-school students' situational interest and PA in PE. They found that the correlation between situational interest and PA level was about .70. Ding, Sun, and Chen (2013) found a large correlation (r = .77) between students' situational interest and objectively measured PA in a middle-school student sample from China. Recent studies also suggested the positive relationship between situation interest and PA level in PE (Sun, 2012; Sun & Gao, 2016).

Research studies examining students' situational interest in PE and their PA level beyond the PE context are very limited. To my knowledge, only one study explored this relationship. Chen, Sun, Zhu, and Chen (2014) examined the extent to which elementary school students' situational interest in PE contributed to their out-of-school PA. Situation interest was measured based students' perceptions of the five sources experienced in PE. out-of-school PA was measured using the 3-Day PA Recall survey. They found that only exploration intention positively predicted students' out-of-school PA. This finding indicates that tasks in PE that can trigger students' exploration intention tend to contribute to students' out-of-school PA participation.

Some scholars examined students' enjoyment in PE and their PA level beyond PE context. Since enjoyment is conceptualized as one source of situational interest (Chen et al., 2001), these studies could reflect to some extent the relationship between situational interest in PE and out-of-school PA level. The findings of these studies are mixed. For example, Yli-Piipari et al. (2013) using a three-year longitudinal research design found that middle-school students' enjoyment in PE positively correlated with their self-reported PA level. Bengoechea, Sabiston, Ahmed, and Farnoush (2010)'s logistic regression analysis also showed that adolescents' enjoyment in PE consistently correlated with their participation in organized and unorganized PA. In contrast, Brazendale and colleagues (2015) found that middle-school students' enjoyment in PE had no relationship with their PA level measured using a 7-day PA recall survey. Timo, Sami, Anthony, and Jarmo (2016) found that sixth graders' enjoyment in PE did not predict their self-reported PA level six years later.

In summary, current limited research findings are mixed about the effects of situational interest in PE on PA behavior beyond PE context. The mixed findings may result from different measures, research designs, and populations. More studies using validated situational interest measures and rigorous research designs are needed to further clarify the relationship between situational interest in PE and out-of-school PA behavior.

Autonomous motivation. The concept of autonomous motivation, as illustrated above in the section of trans-contextual model, comes from the self-determination theory (Deci & Ryan, 2000). Ryan and Deci (2016) categorize identified regulation, integrated regulation, and intrinsic motivation as autonomous motivation, and external regulation and introjected regulation as controlled motivation. Autonomous motivation reflects the process that individuals engage in activities or behaviors out of the sense of self, while individuals with controlled motivation engage in behaviors out of a sense of control by others.

There are relatively more studies on the relationship between autonomous motivation for PE and PA behavior out of PE context than other motivational constructs reviewed above. Even though some studies have shown that students' autonomous motivation for PE did not show significant direct effects on their out-of-school PA behavior, a lot more studies based on trans-contextual model have shown that autonomous motivation for PE had an indirect effect on their out-of-school PA level through influencing their autonomous motivation toward PA in leisure-time and belief-based constructs (Hagger & Chatzisarantis, 2016). Recently, Hagger and Chatzisarantis (2016) did a meta-analytic path analysis to synthesize current researcher findings on the trans-contextual model. They found that the empirical findings supported the trans-contextual model and autonomous motivation indirectly influenced their PA intention ($\beta = .19$, $p < .001$) and PA behavior ($\beta = .06$, $p = .034$) outside of the educational context. These findings indicate that students' autonomous motivation for PE can positively influence their leisure-time PA behavior through influencing that autonomous motivation and belief-based constructs in out-of-school context. Figure 2.3 shows the specific results of their meta-analytic path analysis.

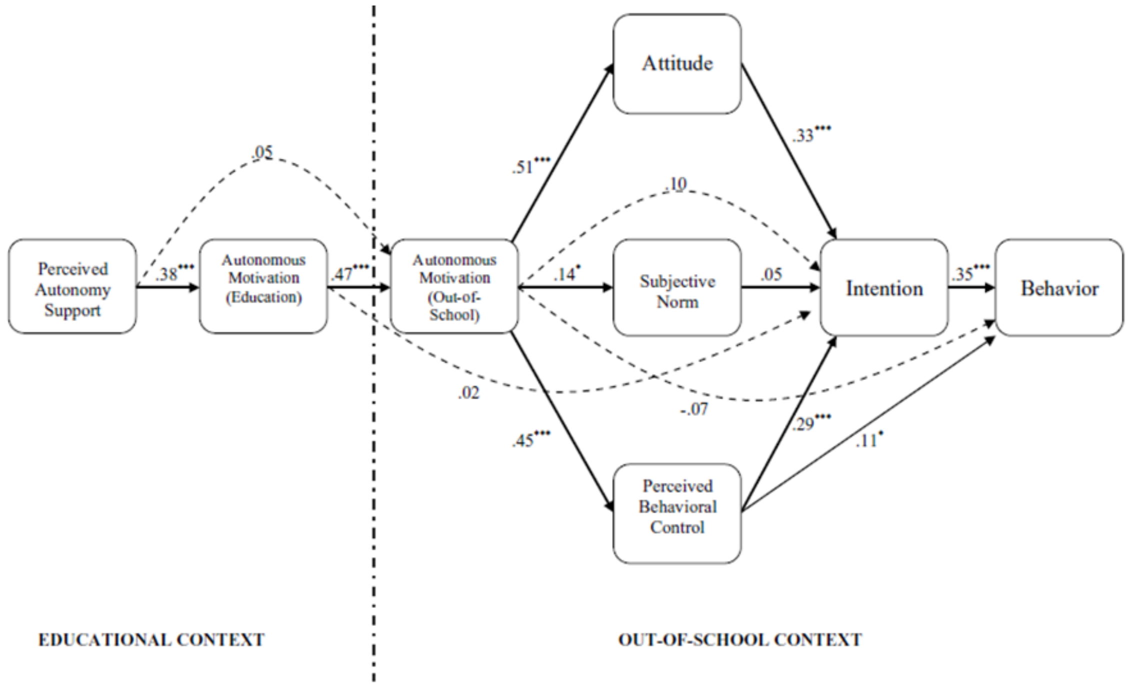


Figure 2.3. Meta-analytic Path Analysis of the Trans-Contextual Model (Hagger & Chatzisarantis, 2016). *Note.* Solid unidirectional arrowed paths represent statistically significant relations; broken arrowed paths represent nonsignificant effects. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Summary. Several conclusions can be made based on the above literature review on effects of motivational experience in PE on PA behavior outside of PE context. Firstly, currently studies focused on this topic are very limited, especially for studies based on self-efficacy theory and interest theory. Most studies about this topic are based on self-determination theory or trans-contextual model.

Secondly, based on these limited studies, several motivational constructs showed consistent, either direct or indirect, positive effects on PA behavior in out-of-physical-education/school contexts. These constructs include mastery/task goal orientation, expectancy beliefs, and autonomous motivation. Performance/ego goal orientation showed either no or negative effects. Findings on effects of task values, self-efficacy, and situational interest are either mixed or insufficient. More studies are needed to draw preliminary conclusion on effects of these motivation constructs. In addition, all these studies are correlational studies. The cause-effect relationships between these motivational constructs and out-of-school PA behavior need to be further examined using experimental design.

Thirdly, most studies did not integrate and examine mediators of the effects of motivation for PE and out-of-school PA behavior expect for some studies based on self-determination theory or trans-contextual model. Both situational-to-self-initiated motivation model and trans-contextual model indicate that motivation toward PA (self-initiated motivation toward PA in situational-to-self-initiated motivation model, autonomous motivation toward PA in trans-contextual model) is an important mediator of effects of motivation for PE on out-of-school PA behavior. This could be one reason of these mixed findings. Future studies should integrate motivation toward PA into the examination of relationship between motivation for PE and out-of-school PA behavior. It is possible that some motivation constructs in PE can influence motivation toward PA but are not strong enough to show salient effects on PA behavior. In current dissertation research, the relationship between motivation in PE, motivation toward PA, and out-of-school PA behavior will be further examined.

Another limitation of all these studies is that PA is almost exclusively measured using self-reported questionnaires or surveys. Future studies should use objective measures (e.g., accelerometers) to further examine these effects.

Overall, current research evidence does imply that positive motivational experience in PE can contribute to students' PA beyond PE. Although students' motivational experience in PE can be represented by different motivational constructs, many constructs are either conceptually overlapping or are antecedents of other constructs. Practically, it is beneficial to identify one key construct to represent students' motivational experience in PE.

Autonomous motivation in PE as major focus. Autonomous motivation, as Hagger and Chatzisarantis (2016) suggested, reflects the extent to which the three basic psychological needs (competence, autonomy, and relatedness) are satisfied. It has been shown that students' perceived competence satisfaction in PE positively contributed to their autonomous motivation for PE (Zhang, Solmon, Kosma, Carson, & Gu, 2011). Expectancy beliefs in expectancy-value theory, defined as students' judgement about how successfully they can perform a task, is a competence-based belief (Wigfield & Eccles, 2002). Conceptually, autonomous motivation for PE can, to a large extent, reflect students' expectancy beliefs in PE.

Ryan and Deci (2016) categorized identified regulation, integrated regulation, and intrinsic motivation as autonomous motivation. People with identified regulation accept the instrumental values of the activity/behavior. For example, people exercise because they accept the value of exercise on their health. Conceptually, identified regulation is similar to the utility value in expectancy-value theory (Deci & Ryan, 2000). People with integrated regulation not only accept the value of the behavior but also integrate the behavior into their self-identity. For example, people exercise because exercise is important to them or help them identify themselves socially (Deci & Ryan, 2000). Integrated regulation is conceptually similar to attainment value in expectancy-value theory. People with intrinsic motivation engage in an activity because it is interesting or enjoyable, which is conceptually similar to intrinsic value in expectancy-value theory. Therefore, students' autonomous motivation for PE can also reflect their perceived task values in PE, or vice versa.

Scholars have proposed that there is a link between achievement goal theory and self-determination theory. For example, Standage, Duda, and Ntoumanis (2003) proposed that students' goal orientations, especially their perceived goal climate in PE class, can influence students perceived need satisfaction, which subsequently impact their autonomous motivation for PE. Empirical studies did show that students' goal orientations predicted their autonomous motivation in PE and other PA contexts (e.g., Jaakkola, Washington, & Yli-Piipari, 2013). Based on these theoretical articulations and empirically findings, it is plausible to argue that goal orientations in PE could be the antecedents of students' autonomous motivation for PE.

Scholars have also proposed the integration of self-efficacy and self-determination concepts in health promotion studies (e.g., Rothman, Baldwin, & Hertel, 2004). It is proposed that self-efficacy, broadly defined as sense of confidence in one's own ability, is also competence-based belief. Empirical studies have shown that students' self-efficacy in PE positively predicted their autonomous motivation for PE (e.g., Jackson et al., 2013). Therefore, self-efficacy in PE could also be an antecedent of autonomous motivation for PE.

Reeve (1996) proposed that students' needs, cognition, and emotions are three most primary motivation sources in the educational context. Autonomous motivation, as illustrated above, can reflect students' needs (competence, autonomy, and relatedness) and cognition (e.g., expectancy beliefs and task values). It can also reflect students' emotions, at least to some extent. Chen (2001) proposes that situational interest is one important component that can reflect emotion sources in PE. Hidi (2000) suggests that situational interest is one motive that drives intrinsically motivated actions. Since intrinsic motivation is one typical form of autonomous motivation, situational interest should also drive students' autonomous motivation. Thus, autonomous motivation can also reflect students' emotions in PE as represented by their situational interest in PE. Therefore, students' autonomous motivation for PE is adopted as the key construct to represent students' motivational experience in PE in current dissertation research.

Learning in PE and out-of-school PA. Learning in PE is multi-dimensional, which can be manifested in current National Standards for K-12 PE (Society of Health and Physical Educators, 2014). In general, three dimensions are emphasized in these standards, which include knowledge acquisition, motor skill development, and affective character (e.g., confidence, attitude) cultivation. Despite of the multi-dimensional nature of learning in PE enacted in national standards, Ennis (2010) argued that, in practice, PE is taught mainly from three major perspectives: recreational, public health, and educational. Recreational PE focuses on providing enjoyable opportunities for students to play sports or games with little instruction; public health PE focuses on one specific goal—providing students with a recommended dose of PA in PE; educational PE emphasizes student learning in physically active learning environment, in which learning content is highly focused, concept-based, and skill- or fitness-oriented (Ennis, 2011).

To promote lifelong PA, it is argued that the effects of recreational and public health PE are limited in scope (Ennis, 2011). Educational PE emphasizing knowledge growth, motor skill development, and perceived competence plays an important role in influencing students' decisions to embrace PA for a lifetime (Ennis, 2011). The effects of perceived competence in PE on PA have been discussed above. In the following, I focused on reviewing the effects of knowledge and motor skill on students' PA behavior outside of the PE context.

Knowledge and physical activity. Knowledge about PA and fitness is generally referred to as health-related fitness knowledge. Keating et al. (2009) defined health-related fitness knowledge as "knowledge about individuals' ability to perform PA and protect themselves from chronic disease" (p. 335). Zhu, Safrit, and Cohen (1999) defined health-related fitness knowledge more broadly, including concepts of fitness, scientific principles, components of physical fitness, effects of exercised on health, exercise prescription, nutrition, and injury prevention. The complication of summarizing research studies about PA and fitness knowledge is that many different knowledge terms (e.g., exercise knowledge, knowledge of physical fitness, knowledge of health and fitness concepts, or perceptions of exercise) have been used in the literature and the scope and type of knowledge in these studies usually were different. This could be one reason of the mixed findings on relationship between students' knowledge and PA behavior. In this part, I adopted Zhu, Safrit, and Cohen's (1999) broad definition of health-related fitness knowledge and also included other types of knowledge (e.g., sport technique knowledge) related to PA and sport.

The mixed research findings on relationship between students' knowledge and PA behavior have been widely recognized (e.g.,Chen & Nam, 2017; Ennis, 2011; Green, 2014). The "mixed findings" statement can be found in almost every article which focuses on students' knowledge about PA and fitness. Few studies, however, have gone further to illustrate how mixed these findings are. For example, are the findings mixed in one sub-population (e.g., elementary school students) or all sub-populations? In this part, I will review these research findings based on school levels (elementary school, middle-school, and high school). In general, limited research studies examined the link between K-12 students' knowledge about PA and fitness and their PA behavior outside of PE context. After thoroughly searching several major databases (e.g., ERIC, Proquest, PubMed, and Scopus), 12 empirical articles were located which specifically examined the relationship.

Elementary school students. Three articles focused on elementary school students (Chen et al., 2014; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Erwin & Castelli, 2008). The findings of these studies are consistent and suggest that there is no relationship between knowledge and PA behavior among elementary school students, even though they used different measures of knowledge and PA. For example, Chen et al. (2014) examined the relationship between elementary students' health-related fitness knowledge achievement in PE and their out-of-school PA. They found no relationship between knowledge achievement and students' out-of-school PA behavior. Erwin and Castelli (2008) found that the correlation of elementary school students' knowledge about sport techniques (e.g., knowledge about hand placement on basketball when dribbling) and out-of-school PA behavior was .20. Their regression analysis showed that students' knowledge about sport techniques did not contribute to their out-of-school PA behavior. In addition, DiLorenzo et al. (1998) tracked a group of fifth and sixth graders' exercise knowledge and PA behavior for three years. They found that there was no relationship between exercise knowledge and exercise behavior when these students were at fifth or sixth grade. But when they were at 8th or 9th grade, their exercise knowledge positively predicted their exercise behavior.

The findings of these studies suggest that elementary school students' knowledge may have little effects on their PA behavior. This seems to be reasonable since children's PA behavior is proposed to be highly situational (Chen & Zhu, 2005; Corbin, 2002). That is, children's PA behavior tends to primarily depend on the appealing characteristics of the activity or environment instead of rational reasoning based on their cognitive knowledge.

Middle-school students. Four articles focused on middle-school students including DiLorenzo et al.'s (1998) longitudinal study mentioned above. Dilorenzo et al.'s (1998) study showed that students' exercise knowledge positively predicted their exercise behavior when they were in 8th or 9th grade (R2 = .05-.09), but not in 5th or 6th grade. In this study, students' exercise knowledge was measured using true-false factual questions (e.g., exercise helps get rid of body fat). Students' PA behavior was measured using PA Interview, a structured assessment device for estimating the duration and intensity of students' exercise behavior during a day, instead of a survey.

Recently, Chen, Liu, and Schaben (2017) examined the relationship between 8th graders' PA/fitness knowledge and their PA and sedentary behavior. Students' PA/fitness knowledge was measured using a standardized, 29-item, multiple-choice written test enclosed in the PE Metrics. PA and sedentary behavior was measured using Youth Activity Profile, a 15-item, five-point scale measuring the time-spent in PA at school, PA after school, and sedentary behavior. They found that (1) students in high knowledge group had higher level out-of-school PA behavior than low knowledge group; (2) students in low knowledge group had higher level in-school PA behavior than high knowledge group; (3) there was no significant difference in overall PA between low, medium, and high knowledge groups; (4) student in high and medium knowledge group had lower level of sedentary behavior than low knowledge group; (5) regression analysis showed that PA and fitness knowledge negatively predicted sedentary behavior, but no relationship was found between knowledge and PA behavior.

However, Furguson, Yesalis, Pomrehn, and Kirkpatrick (1989) found that middle-school students' exercise knowledge had no effect on their PA behavior and PA intention. In their study, exercise knowledge was measured using a 6-item, true-false test. Only one question was used to measure PA behavior (outside of gym class, about how often do you do some type of exercise?) and intention (I plan to exercise even when I don't have PE class anymore). Based on these measures, it is reasonable to conclude that the findings in this study are relatively less convincing than the two studies illustrated above.

Gottlieb and Chen (1985) examined relationship between students' (7th and 8th graders) heart health knowledge and their PA behavior. Students' heart health knowledge was measured by asking students to match four heart health concepts (cholesterol, CPR, aorta, and arteriosclerosis) with correct definitions. They found that students' heart health knowledge significantly predicted their frequency of participation in sports. Even though a positive relationship was found in Gottlieb et al.'s (1985) study, the knowledge focused in this study was not closely related to PA and fitness.

In summary, studies examining middle-school students' PA/fitness knowledge and their PA behavior are very limited and are all correlational studies. Based on these correlational study findings, it seems that middle-school students' PA/fitness knowledge may have positive influence on their PA behavior, especially for eighth graders. But, the positive finding could also be explained otherwise. That is, high level of PA participation may lead them learn more relevant knowledge. To determine the cause-effect relationship between knowledge and PA behavior, experimental studies are needed.

High school students. Six studies focused on high school students (Chen & Chen, 2012; Haslem, Wilkinson, Prusak, Christensen, & Pennington, 2016; Kelly, Melnyk, & Belyea, 2012; Mitchell, Castelli, & Strainer, 2003; O'Connell, Price, Roberts, Jurs, & McKinley, 1985; Tompson & Hannon, 2012). The findings of these studies are mixed. Thompson and Hannon (2012) examined relationship between high school students' health-related fitness knowledge (measured using a 100-item, multiple-choice test) and their PA behavior (measured using Physical Activity Questionnaire for Adolescents). They found that the correlation between knowledge and PA behavior was .44 ($p < .05$). Students in moderate and high active group had higher knowledge test score than students in low active group; no difference was found between moderate and high active group. Students who scored higher on knowledge test also reported higher PA level than students who scored low on knowledge test. Mitchell and colleagues (2003) found a similar correlation ($r = .49$, $p < .05$) between high school students knowledge about how to design a fitness program and their PA level outside of PE class.

However, Haslem et al. (2016) found that there was no significant correlation between high school students' health-related fitness knowledge (measured using a 22-item, multiple-choice test) and their leisure-time PA behavior (measured using Godin Leisure-time Exercise Questionnaire, a 7-day recall survey). Results of structural equation modelling showed that knowledge did not predict PA behavior, but positively predicted external regulation toward PA (path coefficient= .13, $p < .05$; $r = .08$, $p > .05$) and negatively predicted amotivation toward PA (path coefficient= -.12, $p < .05$; $r = -.16$, $p < .01$). Kelly et al. (2012) also found no relationship between high school student knowledge (measured using Adolescent Activity Knowledge Scale) and their PA behavior (measured using only one question).

Scholars also examined relationship between other types of knowledge that was not PA-focused and PA behavior. Chen et al. (2012) investigated relationship between 9th graders' energy balance knowledge and their out-of-school PA behavior. O' Connell et al. (1985) examined relationship between high school students' obesity knowledge and PA behavior. Both studies did not find any significant relationship between knowledge and PA behavior.

In summary, research findings are mixed about relationship between PA /fitness knowledge and PA behavior among high school students. It could be due to the different measures and statistical analyses used in these studies. Knowledge test used in most studies only reported the content and face validity. None of them reported the difficulty and discrimination index of the test items (Morrow, Mood, Disch, & Kang, 2015). More studies using vigorously validated knowledge test and more objective PA measures are needed to further determine the relationship.

Another noticing point, as suggested in Haslem et al.'s (2016) study, is that students' knowledge may influence their motivation toward PA. This point is also what Chen and Hancock (2006) proposed that knowledge learning contributes to the formation of self-initiated motivation toward PA, which in turn influences PA behavior. Further studies should incorporate PA motivation variables to examine whether knowledge learning increase students' PA motivation and whether motivation mediates the relationship between knowledge and PA behavior.

Summary. All current studies examining relationship between knowledge and PA behavior are correlational studies. Based on these study findings, we may conclude, preliminarily, that PA/fitness knowledge has little effects on PA behavior among elementary school students and positive effects for middle-school students. For high school student, the findings are mixed. However, these conclusions should be interpreted cautiously because they are based on very limited correlational study findings available currently and these empirical studies have several major methodological limitations as described below.

<u>Methodological limitations.</u> The major limitation is the measures used to measure knowledge and PA. The knowledge measures used in these studies are different in two major aspects. First, the forms of the knowledge measures are different. Most studies used multiple-choice question format; some used true-false question format; others used concept-mapping or concept-definition matching. Secondly, the scope of knowledge covered by these knowledge measures is different. Superficially, the number of question items included in these knowledge measures ranged from six to one hundred. Most studies did not report what kinds of PA /fitness knowledge (e.g., key concepts, principle, guidelines, or problem-solving) were included in their knowledge measures. This

problem is the manifestation of another problem which is that most studies did not define the knowledge being measured (e.g., exercise knowledge, health-related fitness knowledge, or PA /fitness knowledge). In addition, most studies did not report the reliability and validity information about their knowledge measure. These limitations about knowledge measures make it difficult to not only compare findings of different studies but also conduct in-depth research studies based on previous findings.

Future studies should pay close attention to the following aspects in terms of knowledge measurement. First, the knowledge investigated should be clearly defined and valid knowledge measures should be selected based on the definition, so that the scope of knowledge covered by the study can be identified. Secondly, students' mastery of knowledge can be in different levels in depth (Bloom, 1956). Thus, the depth of knowledge should also be considered when measuring students' knowledge mastery. Different formats of knowledge test may measure, to some extent, the depth of knowledge mastery in different degrees (Gall, 1970). In general, multiple-choice test tend to be able to measure deeper knowledge mastery than true-false test; open-ended questions do so than multiple-choice question. But this is not absolute. It depends on how each question item is constructed. Well-constructed multiple-choice question items can also accurately measure knowledge mastery as deep as open-ended questions (Rupp, Ferne, & Choi, 2006; Simkin & Kuechler, 2005). Thirdly, the knowledge test used should be reliable and valid. The reliability and validity information or the validating process of knowledge test should be clearly reported.

Another limitation is that all the studies reviewed above measured students' PA behavior based on self-report. Most of them used validated questionnaires to measure PA behavior. Some used only one question to measure PA behavior. No studies used objective measures (e.g., accelerometers) to measure PA behavior. In addition, most studies did not clearly report which part (in-school or out-of-school or daily) of PA behavior was measured. As shown in Chen et al.'s (2017) study, knowledge may have different relationship with in-school and out-of-school PA behavior. The relationship between knowledge and PA behavior should be further examined using objectively measured PA level. The context of PA behavior measured should also be distinguished and clearly reported in future studies.

Theoretical limitations. Most of these studies focused on examining the directly relationship between knowledge and PA behavior, which implies that knowledge directly influences PA behavior. However, Chen and Hancock's (2006) model proposes that knowledge contributes to PA behavior through positively influencing their self-initiated motivation toward PA. In other words, the effects of knowledge on PA behavior tend to be mediated by students' motivation toward PA. In current dissertation research, this mediated relationship between knowledge about PA and fitness and out-of-school PA will be further examined among middle-school students.

Motor skill and physical activity. Motor skill learning has long been recognized as a major learning dimension in PE (Ennis & Chen, 2011). Two types of motor skills—fundamental movement skills and context/sport-specific motor skills—are mainly emphasized in K-12 PE (Stodden et al., 2008). Fundamental movement skills refer to the basic movement elements and patterns considered to be the foundation of complex and sport-specific motor skills. Basic movement patterns are categorized as locomotor skills, non-locomotor skills, and manipulative skills (Malina, 2012). Locomotor skills involve moving body through space such as walking, running, hopping, and skipping; non-locomotor skills involve moving only parts of the body such as pushing, pulling, curling, and twisting; manipulative skills mainly involve projecting and receiving objects such as throwing, catching, kicking, and striking (Malina, 2012). It is proposed that the competence of fundamental movement skills influences not only the development of complex sport skills but also PA behavior (Malina, 2014; Stodden et al., 2008).

Currently, there are two major propositions about the relationship between fundamental movement skills and PA behavior. The first is the notion of "proficiency barrier" proposed by Seefeldt (1980). Seefeldt (1980) proposed that there might be a critical threshold of movement competence above which children would be more likely to be physically active and below which children would be less likely to be active. There is no empirical evidence to support this proposition so far (Malina, 2014; Stodden et al., 2008).

Another proposition is the dynamic association between motor skill competence and PA behavior (Stodden et al., 2008). There are two major hypotheses in the dynamic association model. Firstly, the strength of relationship between motor skill competence and PA behavior varies during different growth periods. Stodden et al. (2008) proposed that the relationship would be weak during early childhood (ages 3-5) due to a variety of salient factors (e.g., environmental conditions, parental influences, previous experience in structured movement programs) influencing children's PA and motor skill development and children's ability to accurately assess their level of motor competence. The relationship would be increasingly strengthened as children progress from middle childhood to adolescence because of children's increasingly accurate judgement of their motor skill competence and the reciprocal relationship between motor skill competence and PA behavior. The reciprocal relationship is the second major hypothesis in dynamic association model (Stodden et al., 2008). It states as motor skill competence increases, PA participation would increase, and the increased PA participation would further contribute to motor skill development.

Recently, two systematic reviews have been conducted on the relationship between motor skill competence and PA in children and adolescent (Holfelder & Schott, 2014; Logan, Kipling Webster, Getchell, Pfeiffer, & Robinson, 2015). Both reviews found that in general there is a low to moderate relationship between motor skill competence and PA behavior in children and adolescents. Several factors were found to moderate the relationship including gender, age, motor skill type, and PA type (organized and non-organized). Specifically, Logan et al. (2015) found low to moderate relationships (r =.24-.55; R^2 = 3-23%) in early childhood (3-5 years old), low to high relationships (r = .24-.55; R^2 = 6-30%) in middle to late childhood (6-12 years old), and low to moderate relationships (r = .14-.35; R^2 = 2-12.3%) in adolescence (13-18 years old). These findings seem to support Stodden and colleagues' (2008) hypotheses for early and middle to late childhood, but not for adolescence. Logan and colleagues (2015) also found that object control skills were more strongly related to PA for boys while locomotor skills for girls. In Holfelder and Schott's (2014) systematic review, they found strong evidence for a positive relationship between motor skill competence and organized PA, but not between motor skill competence and unorganized PA.

Authors of both review articles have pointed out that the results should be interpreted cautiously because of limited studies available and several major limitations of reviewed studies. They summarized that the measures used in these studies to measure motor skill and PA were highly heterogeneous. Most studies used cross-sectional research design, which makes it impossible to make conclusions about cause-effect relationship between motor skill and PA behavior. More detailed examinations using longitudinal and experimental designs were called for in future research studies.

Summary. There are two major processes through which PE can influence students' out-of-school PA behavior. One process is through influencing students' motivational experience in PE. Based on the literature review and the integration of multiple motivation constructs, students' autonomous motivation for PE could be used as the central motivation construct to reflect students' motivational experience in PE. Although the influences of the concept-based PE on students' autonomous motivation for PE have not been investigated, the content, structure, and instructional model adopted in the concept-based PE are designed to elicit high levels of autonomous motivation among students (Ennis, 2015; Sun et al., 2012). For example, the emphasis of learning rationale, opportunities for making task choice, advocacy of mastery rather than competition, and encouragement of cooperative peer communication in the curriculum should increase students' psychological need satisfaction, and subsequently promote their autonomous motivation (Wang, 2017). The detailed description of the concept-based PE curriculum can be seen in Chapter III. Therefore, positively influencing students' autonomous motivation for PE is adopted as one mechanism guiding current dissertation research.

Another process that has the potential to influence students' out-of-school PA behavior is the knowledge and skill learning in PE. Many scholars have proposed that the findings about the relationship between knowledge and PA behavior are inconclusive. The current literature seems to show "mixed findings" among high school students and encouraging positive effects among middle-school students. These conclusions are only based on limited empirical studies. Nevertheless, the findings have indicated that knowledge learning in PE is one potential way to influence students' out-of-school PA behavior, especially for middle and high school students.

In general, the relationship between motor skill competence and PA behavior is at low-to-moderate level for children and adolescents. Several factors were found to moderate this relationship, which included gender, age, motor skill type, and PA type. Even though the cause-effect relationship between motor skill competence and PA behavior cannot be determined yet, it seems that learning motor skill in PE has the potential to influence their PA behavior beyond PE context.

Recent research studies have shown that concept-based PE is effective to promote elementary and middle-school students' knowledge about PA and fitness (Sun et al., 2012; Wang et al., 2017; Zhang et al., 2014). Thus, knowledge learning in PE is adopted as another mechanism guiding current dissertation research.

Physical Education Interventions for Physical Activity Promotion

School has been recognized as an ideal site for interventions to increases children and adolescents' PA level (Chen, 2015). Since 1980s, several large-scale school-based interventions have been conducted to increase children and adolescents' PA behavior (Wallhead & Buckworth, 2004). In recent years, the Comprehensive School Physical Activity Program (CSPAP) (some countries call it as Whole-of-School Physical Activity Promotion) has also been initiated worldwide (McMullen, Ní Chróinín, Tammelin, Pogorzelska, & van der Mars, 2015). In these intervention programs, PE is unanimously recognized as a central intervention component in school to promote students' PA level (McMullen et al., 2015). Even though behavior change scholars have suggested that multicomponent interventions (e.g., CSPAP) seem to be consistently effective in increasing PA behavior (Buckworth, Dishman, O'Connor, & Tomporowski, 2013), it is important to clearly understand how each component can be designed to effectively influence PA behavior. PE intervention, as a central component in school-based PA intervention, should be further understood especially in terms of influencing students' out-of-school PA behavior. In the following, I will review PE interventions that aimed to increase students' PA behavior.

There are two types of PE intervention studies in terms of promoting PA behaviors. The first type is PE -included interventions, in which PE is one component of the intervention. The second type is PE-based interventions, in which PE is the sole focus of the intervention.

Physical Education-Included Interventions

Most PE-included interventions are large-scale, school-based PA interventions. Most of these interventions focused on increasing not only PA behavior but also other health behaviors such as dietary behavior and smoking behavior. Other intervention components are also included such as classroom health education intervention, school environment intervention, and parent intervention. PE is viewed differently in this intervention studies in terms of its role in promoting PA beyond the PE context. Some interventions emphasized the contributive role of PE to out-of-school PA, while others did not.

Not emphasizing the role of PE. Most of these PE-included interventions view PE as an opportunity in school that could be used to increase students' total amount of PA. The focus of PE in these interventions is to increase students' in-class PA, thereby increasing students' total amount of daily PA. The contributive role of PE in promoting PA outside of PE is not emphasized. These intervention programs mainly include the Child and Adolescent Trail for Cardiovascular Health (CATCH) program (Perry et al., 1992), The Go for Health (GFH) program (Simons-Morton, Parcel, Baranowski, Forthofer, & O'Hara, 1991), The Cardiovascular Health in Children (CHIC) Study

(Harrell et al., 1996), the Nebraska School Study (Donnelly et al., 1996), The Middle-School Physical Activity and Nutrition (M-SPAN) program (Sallis, McKenzie, et al., 2003).

In the CATCH intervention, the target population was elementary students (Perry et al., 1992). Another PA-related intervention in this program was a classroom curriculum intervention to teach behavioral skills such as self-monitoring, goal setting, and self-reinforcement. Over the 2.5 years intervention, it was found that students in the intervention group engaged in more moderate-to-vigorous PA (MVPA) in PE classes and reported 12 more minutes of daily vigorous PA than students in the control group (McKenzie, et al., 1996).

In GFH program, the target population was also elementary students (Simons-Morton et al., 1991). In addition to PE intervention, a classroom curriculum intervention was also implemented to teach knowledge and skills essential to lifelong performance of the target diet and PA behaviors. The program was effective in increasing the students' level of MVPA within PE lessons. No other PA behavior outcomes were examined (Simons-Morton et al., 1991).

In the CHIC Study, the target population was elementary students (Harrell et al., 1996). One intervention other than PE was classroom health education to teach the importance of regular physical exercise. It was found that students in the intervention schools had a 23% increase in self-reported PA as opposed to the 15% increase found in the comparison schools at school level. But there was no significant difference at the individual level (Harrell et al., 1996).

In the Nebraska School Study, again, the target population was elementary school students (Donnelly et al., 1996). PE intervention was the only PA-related intervention in this program. The results showed that students in the intervention group engaged in 6% more PA in PE classes, but 16% less outside of school PA than students in the control group (Donnelly et al., 1996).

In the M-SPAN program, the target population was middle-school students (Sallis, McKenzie, et al., 2003). The PA-related intervention other than PE was leisure-time PA during times before and after school, and after lunch. It was found that students in the intervention schools had higher PA level in PE classes and in school leisure times than student in the control schools (McKenzie, Sallis, et al., 2004; Sallis, McKenzie, et al., 2003).

In summary, these PE -included interventions, which did not emphasize the contributive role of PE to out-of-school PA, seems to be effective to increase students' PA in PE class. All these studies did not measure students' out-of-school PA behavior, except the Nebraska School Study in which a decrease of out-of-school PA behavior in the intervention group was reported. Even though some programs have shown positive intervention effects on students' daily PA or PA in school, the contribution of PE intervention cannot be determined because of other confounding intervention components.

Emphasizing the role of PE. There are some PE -included interventions that emphasized the contributive role of PE to out-of-school PA behavior. These interventions mainly include Lifestyle Education for Activity Program (LEAP) (Dishman et al., 2004) and Trial of Activity for Adolescent Girls (TAAG) (Webber et al., 2008). Both interventions are large-scale (TAAG was multi-center too) PA promotion programs in which PE was one intervention component. Both interventions recognized that PE was not only one opportunity in school to increase students' total amount of PA but also a learning environment in which students would learning knowledge and skills to increase their PA outside of PE context.

LEAP was designed to increase PA among high school girls (Dishman et al., 2004). PE in LEAP was designed to (1) increase students' PA level in PE, (2) enhance PA self-efficacy and enjoyment, (3) teach motor skills and behavioral skills needed to adopt and maintain an active lifestyle (Dishman et al., 2004). In addition to the PE intervention, changing the school environment was another intervention component in LEAP. The school environment intervention focused on school principle support of LEAP, a school PA team, and the presentation of messages promoting PA in school. Several other elements, such as family involvement, community agency involvement, and health education, were also recommended but not required for the participating schools. After the two-year intervention, it was found that the intervention had direct effects on self-efficacy, goal setting, and daily PA behavior. Self-efficacy partially mediated the effects of intervention on PA behavior (Dishman et al., 2004). Three years after the completion of the intervention, researchers re-surveyed these girls who participated in LEAP (Pate et al., 2007). They found that the girls from the intervention schools with high implementation quality were more physically active than those from the control schools and schools with low implementation quality.

TAAG was designed to promote MVPA among middle-school girls (Webber et al., 2008). This program combined school and community agencies to promote girls' PA. PE in TAAG was designed to increase students' PA level in PE class and to teach behavioral skills. Intervention started when the students began the 6th grade and ended when they completed the 8th grade. Students' daily PA behavior was measured at the end of 7th and 8th grade using accelerometers. It was found that there was no difference about daily PA between treatment and control group at 7th grade. Students in the treatment group had higher PA level than students in the control group at 8th grade (Webber et al., 2008).

Summary. It appears that most PE -included interventions focused on elementary school students. Two interventions focused on middle-school students (M-SPAN and TAAG); one focused on high school students (LEAP). Most PE-included interventions did not emphasize the contributive role of PE on PA beyond the PE context. Two interventions that emphasized the contributive role of PE to extra-curricular PA showed positive short-term and long-term effects on students' PA. Even though several interventions have showed positive effects on students' PA behavior, it would be premature to conclude that PE intervention has contributed to the positive effects because of other confounding intervention components. Even though scholars have proposed that these multicomponent interventions are more effective in promoting PA behavior than single component interventions (Buckworth et al., 2013), to determine the "PE effect" interventions with the sole focus on PE would be more suitable than multicomponent interventions.

Physical Education-Based Interventions

PE-based interventions target at PE as the sole focus of intervention to increase children and adolescents' PA. These interventions emphasize the effects of PE on students' PA behavior outside of the PE context. PE-based interventions usually involve designing and testing a holistic PE curriculum model. In the following section, I will review several prominent PE curriculum intervention studies.

Project Active Teens. Project Active Teens is a PE-based intervention to promote PA among high school students (Dale, Corbin, & Cuddihy, 1998). A concept-based PE curriculum, Fitness for Life (Corbin & Le Masurier, 2014), was developed and examined. The instruction system included two components: classroom sessions and activity sessions. The classroom sessions were designed to teach students important concepts and facts about PA and fitness as well as behavior skills, such as activity logging, goal setting, and program planning. A classroom session usually was followed immediately an activity session where the students had opportunities to practice and experience what they were exposed to in the classroom. The content in the activity sessions included fitness assessment, personal program-building skills, and methods for performing a variety of lifelong physical activities. Students in the intervention group took one classroom and one activity session per week for one year. Students in the control group took the traditional multi-activity PE. It was found that more male students in the intervention group reported vigorous PA participation after graduation from high school than students who took the traditional PE (Dale & Corbin, 2000). Fewer students in the intervention group reported sedentary behavior after graduation than students in the traditional PE (Dale & Corbin, 2000).

The effects of the concept-based PE have also been investigated among college students (Slava, Laurie, & Corbin, 1984). It was found that college students who were exposed to the concept-based PE tended to have more knowledge, more positive attitude, and better PA habit after graduation from college (Brynteson & Adams, 1993; Slava et al., 1984).

SPARK. Project SPARK was a PE-based intervention to increase elementary students' PA level in and out of PE (Sallis et al., 1993). In the SPARK intervention, a PE curriculum focused on health-related fitness and skill learning and a self-management curriculum focused on teaching behavior change skills, including self-monitoring, self-evaluation, and self-reinforcement skills. In this intervention study, seven elementary schools were randomly assigned to three conditions: specialist-led SPARK curriculum, trained classroom teacher-led SPARK curriculum, and control (traditional PE curriculum) (Sallis et al., 1997). Over two years of the intervention, it was found that students in the specialist-led and trained classroom teacher-led conditions had higher levels of MVPA in

PE than students in the control condition. Girls in the specialist-led condition displayed higher levels of abdominal strength and cardio-respiratory endurance than the girls in the control condition. No significant difference was found on PA outside of school (Sallis et al., 1997).

Sport Education. Sport education is a curriculum model which is designed to provide authentic educational sport experiences for children and adolescents in PE (Siedentop, Hastie, & van der Mars, 2011). The aim of this curriculum model is to cultivate "competent, literate, and enthusiastic sport players" (Siedentop et al., 2011, p. 5). Even though large-scale sport education intervention has not been conducted yet, many empirical studies have shown that sport education is effective to promote students' motor/sport skill competence, game knowledge, and motivation for PE (Hastie, 2012). A recent small-scale sport education intervention study has shown that a two-year sport education intervention was effective to increase high school students' autonomous motivation for PE comparing with a traditional multi-activity PE curriculum, but ineffective to increase the students' PA intention and leisure-time PA behavior (Wallhead, Garn, & Vidoni, 2014).

Teaching Games for Understanding. Teaching Games for Understanding (TGfU) is one typical curriculum model of Game-centered approaches to PE (Hastie & Mesquita, 2017). There are several other similar models which include Tactical Games, Game Sense, Play Practice, Invasion Games Competence Model, and Tactical Decision Learning Model (Hastie & Mesquita, 2017). The central concepts shared by these models are that game skills is best developed in situations that closely resemble the situations in which the skills will be used and that tactical knowledge and understanding of game play should be emphasized when learning game skills. Teaching Games for Understanding is the earliest model and received most empirical examination comparing to other models. Hastie and Mesquita (2017) have summarized that TGfU seems to be effective for improvement in off-the-ball skill execution but not on-the-ball skill execution comparing with the traditional skill instruction approach. TGfU was also found to be effective in improving students' tactical knowledge and understanding (Allison & Thorpe, 1997; Turner & Martinek, 1999). No study has been conducted to investigate the influence of TGfU on students' PA behavior.

Science PE & Me/Science of Healthful Living. Science PE & Me and Science of Healthful Living are two concept-based, fitness-oriented PE curricula. Both aim at teaching scientific knowledge about PA and fitness in a physically active learning environment (Ennis, 2015). Both curricula are newly developed by Catherine D. Ennis and Ang Chen. The Science PE & Me curriculum was designed in 2003 for third, fourth, and fifth grade students in elementary schools. The Science of Healthful Living curriculum was designed in 2011 for middle-school students (Ennis, 2015). Both curricula went through a large-scale, randomized and controlled clinical trial research that aimed to determine the curricular efficacy. It has been shown that the Science PE & Me curriculum significantly increased elementary school students' knowledge about PA and fitness without jeopardizing their PA level in PE comparing with the traditional multi-activity PE curriculum (Chen et al., 2007; Sun et al., 2012). The Science of Healthful Living intervention study was recently completed, but the data are still being analyzed. The preliminary analysis has shown that the Science of Healthful Living curriculum was effective in increasing middle-school students' PA and fitness knowledge and understanding (Wang et al., in press). Both curriculum interventions did not measure students' PA behavior outside of PE context.

Summary

PE -based interventions are more informative in terms of determining the "PE effect" than PE-included interventions. Current PE-based interventions focused on different learning outcomes in PE. Sport Education and TGfU focus on teaching sport/motor skills and knowledge about sport and game play. SPARK focuses on promoting PA level in PE class and teaching behavioral skill in classroom among elementary students. All these PE curricula are effective to achieve their immediate goal designated for PE. They have not shown effectiveness in promoting students' PA behavior outside of the PE context.

The concept-based PE curricula are fitness-oriented and focus on teaching conceptual knowledge about PA and fitness and behavioral skills such as goal setting. These intervention studies appear to have shown that concept-based PE can significantly increase students' knowledge and positively influence students' short-term and long-term PA and sedentary behavior among high school and college students. It has also been shown to be effective to increase elementary and middle-school students' knowledge and understanding. It is still unclear about the effects of the concept-based PE on elementary and middle-school students' PA behavior beyond the PE.

The Present Dissertation Research

In this section, I summarized what we know (the knowns) and what we don't know (the gaps) in the literature about the "PE effect". Based on these knowns and gaps, the purpose and specific research questions of current dissertation research were presented.

The Knowns

The above literature review demonstrates that learning (knowledge and motor skill) in PE and positive motivational experience in PE could be two possible path ways through which the "PE effect" emerges. Specifically, we have learned that knowledge about PA and fitness has little effects on PA behavior among elementary school students and positive effects for middle-school students. The findings are mixed for high school students. The relationship between motor skill competence and PA behavior is at low-to-moderate level for children and adolescents.

We also know that motivation toward PE do have influences on PA behavior outside the PE context. Some motivational constructs (mastery/task goal orientation, expectancy beliefs, and autonomous motivation) showed consistent, either direct or indirect, positive effects on PA behavior in out-of-physical-education/school contexts. Performance/ego goal orientation showed either no or negative effects. Findings on effects of other motivational constructs (task values, self-efficacy, and situational interest) are either mixed or insufficient.

However, all these findings mentioned above are based on correlational studies. The literature review about PE intervention studies have shown that several prominent PE curricula, such as SPARK, Sport Education, and TGfU, did not show significant effects on students' PA behavior outside of the school. The concept-based PE has shown positive influences on short-term and long-term PA and sedentary behavior among high school and college students. The concept-based PE curricula for elementary and middle-school students have been recently developed and shown positive effects on promoting students' knowledge about PA and fitness.

The Gaps

Gap one, although the theoretical models suggest two general pathways (learning in PE and motivational experience in PE) though which PE impacts out-of-school PA behavior (Chen & Hancock, 2006; Hagger & Chatzisarantis, 2016), most studies examining the mechanism of the "PE effects" tend to only focus on the pathway of motivation experiences in PE (e.g., Garn et al., 2013; Hagger et al., 2016; Zhu et al., 2013). It is important to examine the two pathways simultaneously to enhance our understanding about the underlying mechanisms of the "PE effect".

Gap two, it has been shown that concept-based PE can positively influence the short-term and long-term behavior change among high school and college students (Brynteson & Adams, 1993; Dale & Corbin, 2000; Dale et al., 1998; Slavaet al., 1984). It is still unclear about the effects of concept-based PE on PA behavior among middle-school students.

Gap three, it has been shown that concept-based PE is effective to increase students' knowledge about PA and fitness (Sun et al., 2012; Wang et al., 2017). It is still unclear about the extent to which the concept-based PE influences students' motivation for PE. The motivational experience in PE is theoretically hypothesized to be one pathway by which PE influences students' out-of-school PA (Hagger & Chatzisarantis, 2016). Understanding the effects of concept-based PE on students' motivation for PE can provide new insight on effects of concept-based PE on out-of-school PA.

Gap four, most empirical studies investigating the "PE effect" tend to directly examine the effects of PE on out-of-school PA behavior. However, both Chen and Hancock's (2006) situational-to-self-initiated motivation model and Hagger and Chatzisarantis's (2016) trans-contextual model imply that the effects of PE on out-of-school PA behavior are mediated by students' motivation toward PA (self-initiated motivation in Chen and Hancock's model, autonomous motivation in Hagger and Chatzisarantis's model). Thus, understanding the effects of concept-based PE on motivation toward PA can also help us understand the effects of concept-based PE on out-of-school PA.

The Purpose of the Dissertation Research

Based on the gaps illustrated above, there were two major purposes in current dissertation research. The first purpose was to simultaneously examine the two pathways underlying the “PE effect”. The second purpose was to determine the effects of the SHL curriculum on middle-school students’ knowledge, motivation for PE, and PA motivation and behavior. Specifically, this study addressed the following two research questions: (a) to what extent did eighth graders’ knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? In fact, to answer the first research question was to test the *a priori* path model presented in Figure 2.4. (b) Did eighth-grade students who had experienced the SHL curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had not?

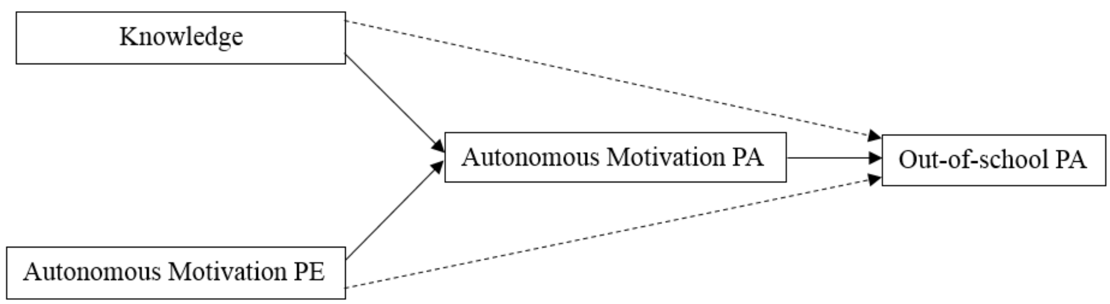


Figure 2.4. The *a priori* Path Diagram. Solid lines signify direct positive paths; broken lines indirect positive paths. PE: Physical education; PA: Physical activity.

CHAPTER III

RESEARCH METHODS

In this dissertation research, I addressed two major research questions: (a) to what extent did the eighth graders' knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? (b) Did the eighth-grade students who had experienced the SHL curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had not?

This dissertation study was a follow-up study of four completed studies (Wang et al., 2017; Wang et al., 2018; Wang et al., 2018; Wang et al., in review) based on a large-scale, concept-based PE curriculum intervention study, the Science of Healthful Living project. I was actively involved in this project as a data collector and data manager throughout my years of doctoral study at the University of North Carolina at Greensboro. In this chapter, I present my research methods including (a) the SHL project as the research background, (b) the research settings of the current study, (c) the sample, (d) variables and measures, (e) procedures of conducting this study, and (f) threats to the validity and reliability and strategies.

Research Background

The Science of Healthful Living is a five-year project to design, field-test, and disseminate a concept-based PE curriculum. This curriculum aims to teach middle-school students the scientific knowledge about exercise and heath behavior and includes two units: Cardio Fitness Club and Healthy Lifestyles (Ennis, 2015). The Cardio Fitness Club unit focuses on teaching the knowledge about PA and fitness; the Healthy Lifestyles unit focuses on knowledge about other health behaviors (e.g., nutrition, stress management). In the current dissertation research, I focused on the Cardio Fitness Club because PA behavior was the focus.

The SHL project started in 2011 and ended in 2016. The first three years of the project focused on curriculum development and the clinical trial research of the curriculum in 24 middle-schools (12 control schools and 12 experiment schools) in North Carolina. During the clinical trial phase, a randomized, controlled research design was adopted. All middle-schools in four school districts of North Carolina were stratified into several brackets based on the following stratification variables: school science test performance, school social-economic status, student ethnicity, and teacher/student ratio. Schools in each bracket were matched based on the stratification variables above. Then, in each bracket, one or two schools were randomly assigned to the experimental group or control group.

PE teachers in the experimental group received four 6-hour professional development sessions on teaching the concept-based PE curriculum. The teachers in the control group received the same amount of training with the same hours and the same format, as placebo, on teaching the state-sanctioned multi-activity curriculum. Fidelity of curriculum implementation was preserved through equal time on-site observations by the research team in both experimental and control schools.

The purpose of the clinical trial was to determine the effects of a concept-based curriculum on middle-school students' knowledge learning in comparison with the traditional multi-activity curriculum. Knowledge achievement was the key dependent variable. Students' PA motivation and behavior were not measured in this project. Preliminary analysis of the data has shown that the concept-based PE significantly increased students' knowledge level (Wang et al., 2017).

The last two years of the SHL project focused on disseminating the curriculum around the country. In this phase, school participation was voluntary. The strategy used to disseminate the curriculum was to present the curriculum to PE teachers at professional conferences. The research team presented the curriculum in several professional conferences in the year of 2014-2015. Teachers who were willing to teach this curriculum and allowed the research team to gather on learning and other variables were provided all the teaching materials (e.g., the lesson plans, the workbook). No systematic professional development workshops were provided in this phase.

Research Settings

Target Population

To determine the effects of the concept-based PE, I went to three former experimental schools from the SHL project. These schools ended teaching SHL curriculum after the 2015-2016 school year (the last year of SHL). The eighth-grade students in these schools had experienced the SHL curriculum when they were in sixth grade. They are the only students whose data could help answer the research question. Two former control schools during SHL project were also recruited in this study as the control schools.

Research Design

The two research questions were: (a) to what extent did eighth graders' knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? (b) Did eighth grade students who had experienced the SHL curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had not?

Research design for the first research question. Answering the first research question requires testing of an *a priori* model as shown in Figure 3.1. I adopted the structural equation modeling methods to test the tenability of the model, which enabled me to answer the first research question.

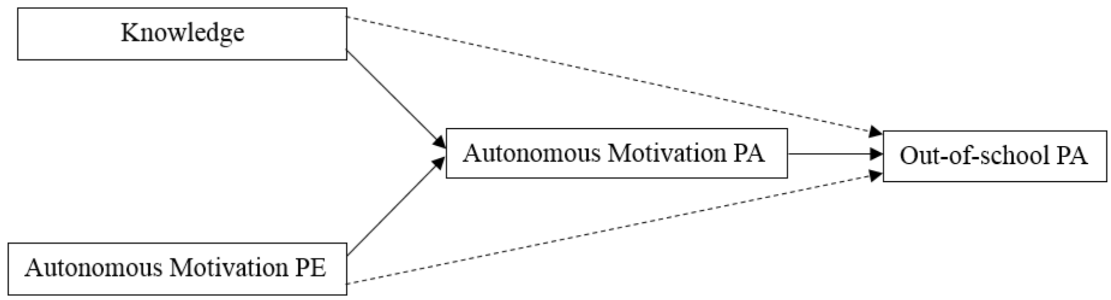


Figure 3.1. The *a priori* Path Diagram. Solid lines signify direct positive paths; broken lines indirect positive paths. PE: Physical education; PA: Physical activity.

Research design for the second research question. To answer the second research question, I adopted the static group comparison design (Thomas, Nelson, & Silverman, 2015) to retrospectively compare responses between the students who had experienced the SHL curriculum (experimental condition) with those who had not (control condition). The static group comparison design has been frequently used in previous studies investigating the effects of the concept-based PE on PA behavior among high school (Dale & Corbin, 2000; Dale et al., 1998) and college students (Brynteson & Adams, 1993; Slava et al., 1984).

Adopting this design has the following advantage for the current study. As shown in the Research Background section, a randomized, controlled experimental design was adopted in the clinical trial phase of the SHL project in which 24 schools were randomly assigned into the experimental or control conditions. The three SHL schools and two control schools used in this study were in both the three-year clinical trial phase as well as the two-year Dissemination Study. Because they were randomly selected and assigned, the previous randomization could be still considered appropriately in effect.

Research Site

The schools. The eighth graders in the experimental group were sampled from the three schools in North Carolina that had been in the experimental condition in both the clinical trial and dissemination phases of the SHL project. The teachers in the three schools already had four-years of SHL experiences before teaching the curriculum during the last year of the SHL project. In addition, they had received systematic training for teaching the SHL curriculum. The curriculum fidelity data collected during the SHL project indicated that they taught the curriculum faithfully. Therefore, the eighth graders in the treatment group had received a solid instruction of the SHL curriculum as sixth graders.

The eighth-grade students in the control condition were sampled from two former schools that had been involved in the SHL project as the control schools. The students in these two schools had never been exposed to the SHL curriculum. Table 3.1 illustrates the basic demographic information of these five schools.

Table 3.1. Basic Demographic Information of the Schools

	Experimental Schools			Comparison Schools	
	School A	School B	School C	School D	School E
Race/Ethnicity					
White %	21.2%	22%	41%	26.3%	21.4%
Others %	78.8%	78%	59%	73.7%	78.6%
Student/Teacher Ratio	15.3	12.4	14.0	13.7	13.6
School Size	690	485	557	960	752

The concept-based PE curriculum. The concept-based PE curriculum that the eighth graders in the experimental group experienced is called the Science of Healthful Living. This curriculum includes 20 lessons focused on teaching concepts and principles about exercise and fitness and creating a fitness/exercise plan. The table of contents of these lessons is presented in Table 3.2.

Table 3.2. The Table of Contents of the SHL Curriculum

Lesson	Topic
1	Measuring Heart Rate
2	Intensity – Rating of Perceived Exertion (RPE)
3	Introduction to Exercise Intensity
4	Short- and Long-term Benefits of Physical Activity
5	Introduction to Exercise Type
6	Introduction to Fitness Components
7	Comparing Muscular Strength and Endurance
8	Introduction to Flexibility
9	Introduction to Frequency
10	Introduction to Time
11	Measuring Intensity
12	Introduction to the Principle of Overload
13	Introduction to the Principle of Progression
14	Introduction to the Principle of Progressive Overload
15	Introduction to the Principle of Specificity
16	Characteristics of Anaerobic Exercise
17	Introduction to the Anaerobic Energy Systems
18	Characteristics of Aerobic Exercise
19	Introduction to SMART Goal Strategies
20	Applying SMART Goal Strategies to the Principle of Progressive Overload

Each lesson in this curriculum is delivered using a learner-centered 5-E instructional framework—engagement, exploration, explanation, elaboration, and evaluation—for students to assume the role of "Junior Scientists" in learning (Bybee et al., 1989). During Engagement, the teacher involves students in an instant PA and uses this activity to introduce the scientific vocabularies and concept they are going to learn. Often during this part, students are asked to record their pre-activity heart rate or other measures in their workbook. During Exploration, students are organized to do a variety of physical activities to collect post activity responses to compare with the pre-activity measures. Through prediction, experiment, observation, and documentation, students collect and study the data in their workbook during the process. In Explanation, students are guided to form small or large groups to "Think, Pair, Share" with their peers to interpret or make meaning of the data. They compare and contrast the data to understand the impact of PA. In Elaboration, the teacher further elaborates the concepts and principles the data inform and guides the students to discuss implications of PA to life beyond PE. In Evaluation, students summarize the data and the knowledge learned to reach conclusions beneficial to health and life. Usually they are prompted to answer an open-ended real-life question on their workbook using the knowledge just learned. A sample lesson plan is attached in Appendix A.

Another salient characteristic of the SHL curriculum is that students are required to use a workbook in each lesson. The workbook, whose content is closely tied to learning activities in class, serves as a centerpiece of knowledge construction tool that assists learning. The assignments in the workbook are sequenced in progressively complex forms, in terms of cognitive demand, from descriptive to relational and to reasoning tasks. These tasks are presented to students as questions/problems that are specifically linked to the physical activities being experienced, to facilitate students' knowledge construction. Appendix B is a sample page from the workbook.

The traditional, multi-activity curriculum. The multi-activity PE curriculum focuses on providing students with opportunities to experience multiple forms of physical activities, usually in sports and games (Ennis, 2010). Learning cognitive knowledge about PA and fitness is not typically emphasized. The curriculum is usually organized into short units so that students can be exposed to broad sport-based activities which mainly include team sports and cooperative games (Ennis, 2011). A typical lesson of this multi-activity PE starts with about 10 to 15 minutes of teacher-directed warm-up and fitness activities, then about 15 to 25 minutes of skill development or scrimmage game play, and then about 5 minutes of closure and/or cool down activities. With the progress of the unit, more time is allotted to the game play.

The Sample

Sample Size Determination

For the first research question. Answering the first research question requires testing the *a priori* model shown in Figure 3.1. Structural Equation Modelling (SEM) was used to test this model. Determining the sample size for SEM to achieve adequate power is still in debate. Many recommendations have been provided in the literature. For example, for SEM using maximum likelihood (ML) method with multivariate normal data, Anderson and Gerbing (1984) recommend 100 as the minimum sample size. Jackson (2001) proposes that a range of 200 to 400 participants can provide enough power for SEM using ML with multivariate normal data. The most commonly recommended rule of thumb to determine minimum sample size is 10 participants per free parameter (Bentler & Chou, 1987; Nevitt & Hancock, 2004), especially for simple path models. Based on this rule of thumb, the minimum sample size for the current study should be 70 because there are 7 free parameters in the *a priori* model shown in Figure 3.1.

Several scholars also investigated the sample size requirement for SEM with non-normal continuous variables. Hu and Bentler (1999) suggest that under this condition the sample size should be larger than 250. In Nevitt and Hancock's (2001) study, they noted that a sample size of 100 is enough for simple models (e.g. models without latent variables involved).

Other scholars have created statistical power/sample size tables through Monte-Carlo procedures. For example, Hancock (2006) developed a statistical power table based on the root mean square error of approximation (RMSEA) and degrees of freedom. For the *a priori* model in the current study, the degrees of freedom are 3, which is calculated based on the following formula:

$$\mathrm{df} = \frac{p(p+1)}{2} - q$$

Where *df* = degrees of freedom, p = number of observed variables, and q = number of parameters. Based on Hancock's (2006) table, the sample size I need will be around 2000. Kline (2005) provided a sample size classification for SEM with a sample size less than 100 being considered as small, between 100-200 considered medium, and more than 200 considered large.

In a recent study about sample size requirements for SEM, Wolf, Harrington, Clark, and Miller (2013) argued that these rules-of-thumb are problematic because they are not model-specific and many elements in an SEM can influence the sample size requirements, such as number of factors, number of indicators, strength of indicator loadings, strength of regressive paths, degree of missing data, and type of model. In their study, Wolf and colleagues (2013) evaluated the range of sample size requirements for common types of SEM models using Monte Carlo analyses through manipulating the values of various elements mentioned above. Their results revealed a range of sample size requirements from 30 to 460 cases.

In summary, based on these recommendations the required sample size for the current study can range from 70 to about 2000. A sample of 70 appears to be small based on most of the recommendations. A sample of 2000 may ensure that the current study has sufficient power, but it is difficult to obtain. In addition, using large sample sizes may lead to insensitivity of the Chi-square test during model fit testing (Kline, 2005).

Even though the specific sample size recommendations vary drastically, one basic rule seems to be common: that is, the simpler the model, the smaller the sample size should suffice. The *a priori* model in the current study is a simple path model without latent variables. According to Nevitt and Hancock (2001), a sample size of 100 would be sufficient for this type of simple model.

For the second research question. The second question requires a comparison of four means (knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA) between two conditions (experimental and control). Hotelling T2 test analysis was used to determine the sample size (Faul, Erdfelder, Lang, & Buchner, 2007). Determining the sample size using Hotelling T2 test was achieved through three steps: (a) establishing the alpha level and power, (b) estimating the effect size, (c) calculating the sample size. Based on recommendation of Howell (2013), the alpha level was set as .05 and the power was set as .80.

According to the calculation formula of Hotelling T2 in G*Power (Faul et al., 2007), the following information needs to be obtained to estimate the effect size: means of the four variables for each group, standard deviations (SD) of the four variables, and the bivariate correlation among these four variables. All this statistical information was estimated based on the findings of previous studies.

Estimating the bivariate correlation. Hagger and Chatzisarantis (2016) using meta-analysis summarized the correlation coefficients between autonomous motivation for PE and autonomous motivation toward PA, autonomous motivation toward PA and leisure-time PA, and autonomous motivation for PE and leisure-time PA. Based on their results, the correlation coefficients of autonomous motivation for PE and autonomous motivation toward PA was estimated as *r*=.46, autonomous motivation toward PA and out-of-school PA as *r*=.29, autonomous motivation for PE and out-of-school PA as *r*=.21

Chen, Chen, and Zhu (2012) in their meta-analytic review article summarized the correlation between students' self-determined motivation for PE and their competence-based learning outcomes in which knowledge was one major component. Based on their results, the correlation coefficient between autonomous motivation for PE and knowledge was estimated as *r*=.19.

The correlation coefficient between knowledge and out-of-school PA was estimated by averaging the correlation coefficients reported in the following studies: Chen et al. (2012), DiLorenzo et al. (1998), Ferguson et al. (1989), Martin (2008), and Thompson et al. (2012). The reason is that all these studies focused on middle-school students and reported the correlation coefficient of knowledge and out-of-school PA/daily PA. The averaged correlation coefficient of these studies was *r*=.18.

I did not find any studies that reported the relationship between knowledge and autonomous motivation toward PA. I conservatively used the estimated correlation coefficient between knowledge and PA behavior (r = .18) as the correlation between knowledge and autonomous motivation for PA. The reasoning is that based on Chen and Hancock's (2006) situational-to-self-initiated motivation model, PA motivation tends to mediate the relationship between knowledge and PA behavior. It is argued that the relationship between knowledge and PA motivation should be larger than or equal to the relationship between knowledge and PA behavior. Thus, it is reasonable to adopt the estimated correlation coefficient of knowledge and PA behavior as the conservative correlation between knowledge and autonomous motivation toward PA.

Estimating the group means and SDs. The means and SDs reported in Chen et al.'s (2017) article were used to estimate the group means and SDs of out-of-school PA and knowledge. There are two reasons for using findings in Chen et al.'s study: (a) this study also adopted the static group comparison design comparing out-of-school PA level from three knowledge performance groups (high, moderate, and low); (b) this study also focused on eighth graders. In the current dissertation study the experimental group could be considered equivalent to the knowledgeable group (high and moderate in Chen et al.) and comparison group to the low knowledge group in Chen et al. Thus, I averaged the means of high and moderate knowledge groups as the means of the experimental group. The means of the low knowledge group were used as the means of the comparison group. This resulted in the estimated means of .69 and 3.55 for knowledge and out-of-school PA, respectively, for the experimental group; and .30 and 3.28 for the comparison group. The SDs of knowledge and out-of-school PA were estimated by averaging the SDs of all three groups (low, moderate, and high) in Chen et al.' (2017) study. The estimated SDs of knowledge and out-of-school PA were .07 and .98 respectively. These statistics were subsequently used in the power analysis to determine sample sizes for this study.

The group estimations for autonomous motivation for PE and autonomous motivation toward PA were based on two intervention studies: Wallhead et al. (2014) and Wilson et al. (2005) respectively. The reasons that I selected these two articles were that

(a) both articles were based on the self-determination theory; (b) both studies used the interventions similar to that the current study was based on. Wallhead and colleagues (2014) investigated the effects of the sport education curriculum on students' autonomous motivation toward PE while Wilson and colleagues (2005) examined the effects of an intervention program (knowledge instruction included) on children and adolescents' motivation toward PA. The means of the treatment and control groups in Wallhead et al. (2014) and Wilson et al.'s (2005) studies were used in the power analysis as the estimated means of treatment and comparison groups for autonomous motivation for PE and autonomous motivation toward PA, respectively. The SDs used in the power analysis were estimated by averaging the SDs of the treatment and control groups in both studies. The above procedures resulted in the estimated means of autonomous motivation for PE for treatment and comparison groups as 1.45 and 1.31 respectively; the estimated means of autonomous motivation toward PA for treatment and comparison groups were 4.54 and 3.85 respectively; the estimated SDs for autonomous motivation toward PE and PA were 11.50 and 1.17 respectively.

Calculating the sample size. Based on the above estimated means, SDs, and correlation coefficients, the effect size Δ was 1.97 using the calculation of G*Power (Faul et al., 2007). Based on this effect size and the alpha level of .05, a minimum sample size of 18 (9 participants for each condition) would provide a statistical power of .80.

Summary. Based on the above analysis, to answer the first research question, 100 participants can provide adequate power. To answer the second research question with adequate power I need at least 18 participants. Thus, a sample size that is larger than 100 would provide adequate power for both research questions.

Participants

Five schools were involved in this study: three SHL experimental schools and two comparison schools. Considering possible participant attrition during the data collection and consenting and assenting process, all eighth graders in these schools were invited to participate in this study. Data was collected only from students who returned both the parent consent form and assent form.

A total of 995 students were invited to participate in this study. 453 (45.5%) of them returned both the parent/guardian consent form and the assent form. Following the IRB protocol, Data were collected only from these students. After the data matching and the data cleaning, a total of 394 students provided full data sets for the study. The sample consisted of 201 (51.0%) boys and 193 (49.0%) girls. It included 97 (24.6%) White, 101 (25.6%) Black, 120 (30.5%) Hispanic, 21 (5.3%) Asian/Pacific Islander, 3 (0.8%) American Indian, 2 (0.5%) Arabic American, and 50 (12.7%) mixed race.

To distinguish students who have experienced the SHL curriculum from those who have not, the names of the 394 students were matched with the roster collected during the SHL project (when they were in sixth grade). Since the roster includes all students who had experienced the SHL curriculum 1.5 years ago, the names that could be matched with the roster formed the experimental group (students who have experienced the SHL curriculum). The names that could not be matched with the roster formed the comparison group (students who have never experienced the SHL curriculum). A total of 168 (42.6%) students had experienced the SHL curriculum when they were in sixth grade, 226 (57.4%) students have never experienced the SHL curriculum.

Variables and Measures

Autonomous Motivation toward PA

Autonomous motivation for PA was operationalized as students' perceived behavioral regulations of exercise. It was measured using the Behavioral Regulation in Exercise Questionnaire (BREQ). The term "exercise" was explained at the top of the questionnaire to inform students that exercise in this questionnaire refers to any structured and unstructured physical activities. The BREQ scores were converted into one composite score named as the Relative Autonomy Index (RAI) to represents students' autonomous motivation for PA (Vallerand, 1997).

BREQ is the most commonly used measure of autonomous motivation toward PA in children and adolescents (Owen, Smith, Lubans, Ng, and Lonsdale, 2014). It includes 15 items measuring four motivational regulations which include intrinsic motivation, identified regulation, introjected regulation, and external regulation. There are four items measuring intrinsic motivation (e.g., I exercise because it's fun), identified regulations (e.g., I value the benefits of exercise), and external regulations (e.g., I exercise because other people say I should). Three items measure introjected regulation (e.g., I feel guilty when I don't exercise). Each item is scored using a five-point Likert-type scale ranging from 0 (not true for me) to 4 (very true for me). This scale has demonstrated satisfactory internal consistency reliability (α= .65-.93) and construct validity (χ^2 = 510.67, df =142, p<.001, CFI= .94, RMSEA =.059, factor loadings = .56-.84), when used to measure adolescents' autonomous motivation toward PA (Crăciun & Rus, 2012, Hagger et al., 2009; Markland & Ingledew, 2007; Wilson, Rodgers, & Fraser, 2002).

The composite score of RAI for PA is often used to represent one's autonomous motivation toward PA (e.g., Markland & Ingledew, 2007; Vallerand, 1997). RAI for PA was calculated based on the BREQ scores using this formula: RAI= 2 × Intrinsic motivation + 1× Identified regulation – 1× Introjected regulation – 2 × External regulation (Hagger et al., 2009).

Out-of-school PA

Students' out-of-school PA was operationalized as the time students spend in exercising during out-of-school hours. It was measured using the modified Three-Day Physical Activity Recall (3DPAR) survey (Weston, Petosa, & Pate, 1997). The 3DPAR provides the types and time of physical activities that participants engaged in during their out-of-school hours, from 3:00pm to 10:00pm. Appendix D shows the 3DPAR. This instrument demonstrated strong evidence for test-retest reliability (r = .98) and construct validity (r = .77 with accelerometers) in adolescents (McMurray et al., 2004; Weston et al., 1997). The 3DPAR has often been used to measure students' out-of-school PA in recent years (e.g., Chen, Chen, & Zhu, 2012; Chen et al., 2014; Zhu & Chen, 2013).

The 3DPAR provides a grid divided into 15-minute segments or blocks in which students recall and record all activities they engaged in between 3:00pm and 10:00pm of the previous day. The instrument provides a list of commonly performed activities grouped into the following categories: sport, fitness, other physical activities, sedentary-academic, sedentary-entertainment, sedentary-socializing, and rest. Appendix E shows the categories of these activities. For each block of the day, students recorded the main activity they engaged in during that 15-minute period. The main activity is defined as the one that occupied the majority of the 15-minute period.

Autonomous Motivation for PE

Autonomous motivation for PE is defined as the extent to which individuals engage in PE out of the sense of self (Hagger & Chatzisarantis, 2016). It is often operationalized as students' perceived behavioral regulations in PE (Vlachopoulos, Katartzi, Kontou, Moustaka, & Goudas, 2011). In this study, I measured students' autonomous motivation for PE using the revised Perceived Locus of Causality Scale (PLOCS, Vlachopoulos et al., 2011). Appendix F shows the scale. It includes 15 items, measuring four motivational regulation subscales: four items for intrinsic motivation (e.g., I participate in PE because PE is enjoyable), four for identified regulation (e.g., I participate in PE because it is important to me to do well in PE), four for introjected regulation (e.g., I participate in PE because I would feel bad if the teacher thought I am not good at PE), and three for external regulation (e.g., I participate in PE because in this way I will not get a low grade). Each item is scored using a seven-point Likert-type scale ranging from 0 (Not at all true for me) to 6 (Absolutely true for me).

The revised PLOCS has demonstrated good construct validity and reliability in children and adolescents. For example, Vlachopoulos et al. (2011) used four samples (two elementary student samples, one middle-school student sample, and one high school student sample) to calibrate and validate the revised PLOCS. The results showed that the revised PLOCS has acceptable construct validity for elementary students (χ^2 = 277.22, *df*=142, *p* <.001, CFI=.940, RMSEA =.048; factor loading = .52-.80), middle-school students (χ^2 = 432.07, *df* = 142, *p* <.001, CFI=.929, RMSEA =.066; factor loading = .50-.86), and high school students (χ^2 = 277.22, *df* = 142, *p* <.001, CFI=.936, RMSEA =.063; factor loading = .61-.85). The internal consistency reliability coefficients (Cronbach alpha) ranged from .69 to .89 for the subscales in revised PLOCS (Vlachopoulos et al., 2011).

RAI has also been calculated in research in PE to represent students' autonomous motivation for PE (e.g., McDavid, Cox, & McDonough, 2014; Yli-Piipari, Leskinen, Jaakkola, & Liukkonen, 2012). The RAI for PE in this study was calculated based on the PLOCS scores using the following formula: RAI= 2 × Intrinsic motivation + 1× Identified regulation – 1 × Introjected regulation – 2 × External regulation (Hagger et al., 2009). The composite score of RAI for PE was used to represent students' autonomous motivation for PE (McDavid et al., 2014).

Knowledge about PA and Fitness

Students' knowledge about PA and fitness was operationalized as their performance on a standardized knowledge test. In this study, I used a 25-item, multiple-choice knowledge test to measure knowledge about PA and fitness. Appendix G shows the knowledge test. This test measured the following knowledge domains: concepts about PA (e.g., intensity, duration) and health-related fitness (e.g., cardiorespiratory fitness, muscular strength and endurance), exercise principles (e.g., principles of overload, principles of progression), PA recommendations (e.g., the amount of PA each day), and self-management concepts (e.g., SMART goal). These items were selected from the knowledge question bank validated during the SHL project and included in the SHL Knowledge Test Manual for teachers.

The content accuracy of these question items was determined by physiologists and PE experts (n=7). These experts were tenured faculty members from departments of kinesiology with the rank of associate professor or above. All experts have published extensively in their respective kinesiology fields. All the experts were asked to rate each question on a 5-point scale for knowledge accuracy (1= "inaccurate", 5= "accurate") and language appropriateness for middle-school students (1= "inappropriate", 5= "appropriate"). Questions rated below 5 by one or more experts were discussed, revised, and re-rated. Only questions that were rated as 5 by all experts were included for a field validation with a group of students (n=330) not included in the study. Questions that met the standards of difficulty index (.45-.65) and discrimination index (>.40) criteria (Morrow, Jackson, Disch, & Mood, 2005) were included in a question bank as validated items. One sample question of the knowledge test is:

An application of the principle of progression to pushups can be ______________

(a) from regular pushup to wall pushup to knee pushup

(b) from wall pushup to knee pushup to regular pushup

(c) from knee pushup to regular pushup to wall pushup

(d) pushups performed in a random order

Condition

The variable of condition categorized the sample of this study into two groups: experimental group (students who had experienced the concept-based PE) and comparison group (students who had never experienced the concept-based PE). These two groups of students were distinguished by matching their names with the roster collected during the SHL project (when they were in sixth grade).

Procedures

To complete this dissertation research, I went through four major stages. Table 3.3 presents the general timeline of the specific procedures in these four phases. In Stage One, I obtained the approvals from the Institutional Review Board (IRB) at the University, the school districts, and the school principles. In Stage Two, I administered all the data collection activities. These activities lasted for three months. In Stage Three, I conducted the data matching, data reduction, and data analysis. In Stage Four, I finished the writing of the dissertation. The specific procedures are summarized in Table 3.3 and described below.

Stage One: To Obtain Approvals

UNCG IRB and school district approvals. I completed and submitted the application form of the Institutional Review Board to the UNCG Office of Research Integrity for review and approval. Once the IRB approval was obtained, I contacted the school districts' research (or accountability) office to request legal access to the research sites. Application of conducting this research was submitted to the Research Review Committee of the two school districts where the five schools are located. All necessary forms were carefully completed. Based on the feedback received from the districts, revision of the research plan and revised application forms were submitted again. During this process, I kept contact with principals and PE teachers of these five schools and informed them the research topic and procedures and received their support for this study.

Stage Two: Data Collection

All the data were collected during the PE classes. The five participating schools had different PE schedules. School A, B, C followed the A-semester/B-semester schedule for PE (a half number of students take PE this semester, the other half take PE next semester). School D followed the A-day/B-day schedule. School E followed the A-week/B-week Schedule. Because of the special PE schedule of school A, B, C, data collection was completed in two phases. As shown in Table 3.3, I first collected the data from school D, school E, and the first cohort of school A, B, C at the end of the fall semester of 2017. Then I went back to school A, B, C at the beginning of the spring semester of 2018 to collect the data of the second cohort.

Table 3.3. Timeline for the Dissertation Progress

<table>
<tr><th>Phase</th><th colspan="2">Date</th><th>Activity</th></tr>
<tr><td>1</td><td colspan="2">Oct. 23- Nov. 30</td><td>Approval from IRB, school districts, and school principals</td></tr>
<tr><td rowspan="7">2</td><td colspan="2">Dec. 1- Mar. 1</td><td>Data collection</td></tr>
<tr><td rowspan="3">Cohort 1 of School A, B, and C; School D; School E</td><td>Dec. 1- Dec. 8</td><td>Obtaining student rosters, consent and assent forms</td></tr>
<tr><td>Dec. 11- Jan. 5</td><td>Collecting motivation and knowledge data</td></tr>
<tr><td>Jan. 8- Jan. 19</td><td>Collection out-of-school PA data</td></tr>
<tr><td rowspan="3">Cohort 2 of School A, B, and C</td><td>Jan. 22 – Jan. 30</td><td>Obtaining student rosters, consent and assent forms</td></tr>
<tr><td>Feb. 1- Feb. 14</td><td>Collecting motivation and knowledge data</td></tr>
<tr><td>Feb.15- Mar. 1</td><td>Collection out-of-school PA data</td></tr>
<tr><td>3</td><td></td><td>Mar. 2- Mar. 20</td><td>Data matching, reduction, and analysis</td></tr>
<tr><td>4</td><td></td><td>Mar. 21- Feb. 20</td><td>Writing dissertation</td></tr>
</table>

Obtaining consent and assent forms. During the first week of each phase of the data collection, I distributed the parents' consent forms to request their permission for their children to provide data for the research. Students and their parents were informed, through the assent and consent form, about the research purpose, procedures, and the potential benefits and risks for participation. I met the students during their PE class to present the detailed information about the study and addressed their concerns and questions. The students were asked to take the consent form home for their parents' permission of participating in this study. They were informed that the participation is voluntary and they have the right to decline or withdraw from the study at any time.

Parents' concerns and questions were addressed through email or telephone. Once both parents' and students' permissions were received, I started to collect the data.

Administering the scales and questionnaires. In week two and three, I administered the Perceived Locus of Causality Scale (PLOCS), Behavioral Regulation in Exercise Questionnaire (BREQ), and knowledge test. Firstly, PLOCS and BREQ were administered together in one PE class. Then, the knowledge test was administered in another PE class. This sequence was purposely arranged so that students' response to the motivation scales would not be affected by the questions in the knowledge test. The rationale was that the questions in the knowledge test could provoke students' realization about the value of the PA or PE. The instant realization could lead them to recognize a need to give elevated (desired) responses to the motivation scales, resulting in a skewed distribution of responses on the motivation scales.

To control the confounding effects of the sequence of administering the two motivation scales (PLOCS and BREQ), a counter-balanced sequence strategy was used. Half of the students in each school were randomly selected to complete PLOCS first and then the BREQ, while the other half completed the instruments in a reversed sequence. The Three-Day Physical Activity Recall (3DPAR) surveys were administered in week four and five.

Administering the PLOCS, BREQ, and knowledge test. Before starting to answer each questionnaire, students were informed of the purpose of the instruments and instructed to answer the questions honestly and independently. Students were informed that their answers would not affect their grade. The students were asked to sit quietly in a personal space on the gym floor. The distance between students was about five feet. I distributed the pencils and instruments to each participant. Students' questions were addressed immediately. The data collection was administered at the beginning of the class. Each data collection session took about 15 minutes.

Administering the 3DPAR survey. Daily out-of-school physical activity recall was administered three times for students to record out-of-school activities for two weekdays and one weekend day. Students were instructed during school time to pay attention to the activities they would do during their out-of-school hours (3:00-10:00 pm). On the next day, I met the students and led them to complete the physical activity recall survey for the day before. I distributed the pencils and the survey to the students and asked them to recall the activities they did during the out-of-school hours the day before. I introduced the structure of the survey and demonstrate the procedures to write activities into each cell. Students were instructed to recall and record the activities as accurately as possible. I remained in the gymnasium throughout the data collection to address questions from the students. The same procedures were repeated for the other two days. For the weekend day, I met the students on Monday and asked them to recall and record activities they did on Sunday.

Stage Three: Data Reduction and Data Analysis

Data reduction. Data collected from PLOCS and BREQ were aggregated and averaged by the specified dimensions. For example, the BREQ measured four types of motivational regulations toward PA: intrinsic motivation, identified regulation, introjected regulation, and external regulation. There were four items measuring the intrinsic motivation. Students' scores on the four items were aggregated and averaged to represents students' intrinsic motivation. The same procedures were followed for other constructs measured in BREQ and PLOCS. The RAI for PA and PE were calculated using the formula—RAI = 2 × Intrinsic motivation + 1 × Identified regulation – 1 × Introjected regulation – 2 × External regulation—based on the scores of BREQ and PLOCS, respectively.

Students' knowledge scores were represented by the percentage of correct responses on the knowledge test. The data from the physical activity recall survey was coded into the following seven categories: sport, fitness, other physical activities, sedentary-academic, sedentary-entertainment, sedentary-socializing, and rest. Students' out-of-school PA level was represented by the total minutes that students spend per day on sport, fitness, and other physical activities. The number of the total minutes that students spend per day on sedentary-academic, sedentary-entertainment, sedentary-socializing was designated as students' sedentary behavior level. An average out-of-school PA time was computed by dividing the three-day total minutes by the number of days, which was three.

Data analysis. This study aimed to answer the following two research questions: (a) to what extent did eighth graders' knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? (b) Did eighth-grade students who had experienced the SHL curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had not?

To answer the first research question, structural equation modeling (SEM) was used to test the *a priori* model (Figure 3.1). The parameters to be tested include the direct path coefficients as shown by the solid arrows in the model and the indirect path coefficients as shown by the broken arrows in this model. To test the model fit, the following indices was used: Chi-square (p>.05), RMSEA (<.08), SRMR (<.08), and CFI (>.90) (Kline, 2015). The SEM was conducted using LISREL 9.30.

To answer the second research question, MANOVA was conducted with the experimental condition as the independent variable and knowledge, autonomous motivation for PE, and autonomous motivation toward PA as the dependent variables. The Mann-Whitney U Test was conducted with condition as the independent variable and out-of-school PA as the dependent variable because of the highly skewed distribution of out-of-school PA (see Chapter V). The MANOVA and the Mann-Whitney U test were conducted using IBM SPSS 25.

Potential Threats to Validity and Reliability and Strategies

In this study, one major potential threat to the interval validity could be that I aggregated the data from two periods (fall 2017 and spring 2018) in school A, B, C in the analysis, due to their unique PE schedule. Some studies have shown that season could be a significant factor that influences children and adolescents' PA behavior, especially their out-of-school PA behavior (Buckworth et al., 2013).

To address this threat, I conducted four independent t-tests to examine whether there was a difference between the first cohort participants and the second cohort from school A, B, and C in terms of the four dependent variables: knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA. The results showed that there was no significant difference between the two cohorts in terms of the knowledge (t=-.28, p>.05), autonomous motivation for PE (t=-1.94, p>.05), autonomous motivation toward PA (t=1.05, p>.05), and out-of-school PA (t=-.70, p>.05). These results indicate that season or data collection time did not impact students' response on these four dependent variables. Based on these results, I combined the data of the two cohorts and analyzed them as a whole.

In addition, to strengthen the internal validity of this study, all instruments (Knowledge test, BREQ, PLOCS, 3DPAR) used in this study were previously validated. A standardized data collection protocol was created and followed.

For the external validity, all participating schools in this study are typical public schools across the nation. It is a reasonable estimation that the student participants in this study can at least represent the larger population of eighth graders in North Carolina and, to a certain degree, their peers in the country.

For the ecological validity, the study was conducted in a non-laboratory field setting. Students in both conditions experienced their respective curriculum with their own teachers in their natural and regular PE classes in their own schools. Except the experimental curriculum, all characteristics of the research setting resembled the real-world school settings where daily instruction and learning take place. Taken these elements together, I have confidence that the results from this study have acceptable ecological validity for the findings to be generalized to typical middle-schools.

CHAPTER IV

TWO PATHWAYS UNDERLYING THE EFFECTS OF PHYSICAL EDUCATION ON OUT-OF-SCHOOL PHYSICAL ACTIVITY

Abstract

One primary goal of physical education (PE) is to promote students' lifelong physical activity (PA). This goal implies that PE should not only improve students' PA in PE classes, but also promote their PA outside of the school which is called the "PE effect". In this study, I propose a two-pathway model of the "PE effect" and suggest that learning in PE and positive motivational experience in PE are two possible pathways through which the "PE effect" emerges. The tenability of this two-pathway model was tested from the perspective of knowledge learning and autonomous motivation in PE. A total of 394 eighth-grade students from 5 schools participated in this study. Students' knowledge, out-of-school PA, and autonomous motivation toward PE and PA were measured using valid instruments. Structural equation modelling was used to test the two-pathway model. Results showed that students' knowledge had a direct effect on their autonomous motivation toward PA and an indirect effect on out-of-school PA through influencing autonomous motivation toward PA. Students' autonomous motivation for PE had a direct effect on their autonomous motivation toward PA and an indirect effect on

out-of-school PA through autonomous motivation toward PA. These results indicate that the two-pathway model is tenable in terms of knowledge learning and autonomous motivation in PE and imply that teaching knowledge in an autonomy-supportive PE environment can be an effective way to promote students' out-of-school PA behavior.

Introduction

One primary goal of physical education (PE) is to promote students' lifelong physical activity (Corbin, 2002; Ennis, 2011; Green, 2014; Penney & Jess, 2004). This goal implies that PE should not only improve students' physical activity (PA) behavior in PE or in school, but also promote their PA behavior outside of the school. Green (2014) refers to the positive effect of PE on out-of-school PA as the "PE effect" (p. 357). The "PE effect", as Green (2014) summarized, is frequently cited by PE teachers and PE and sport science academics and is often included in government policies across the world. Despite the wide citations of the "PE effect", we have little research evidence about the "PE effect" due to the limited empirical studies on the connection between PE and out-of-school PA behavior.

If one of our goals is to achieve the "PE effect", one critical step is to understand the mechanisms underlying the "PE effect". To understand the mechanisms, two issues need to be addressed. The first is to identify the key factors in PE that can contribute to out-of-school PA behavior. The second is to understand how these factors function on out-of-school PA behavior (e.g., direct effect or indirect effect). In this study, I proposed a two-pathway model of the "PE effect" by synthesizing two existing theoretical models. The tenability of this two-pathway model is empirically tested in this study.

A Two-Pathway Model of the "PE Effect"

Many scholars agree that the primary goal of PE is to promote lifelong PA, but they hold different perspectives on how to achieve this goal. For example, Ennis (2017) proposed the concept of "Transformative PE" (p. 1) to promote lifelong PA. She suggests that transformative PE focuses on educating students for a lifetime of PA through enhancing students' cognitive decision making, self-motivation, and personal meaning about PA. Penney and Jess (2004) proposed a multidimensional model of PA and argued that to promote lifelong PA the scope of PE curricula should be broadened to include skill and knowledge about four types of PA: functional PA, recreational PA, health-related PA, and performance-related PA. Corbin (2002) emphasized that lifelong PA needs independent and self-directed PA behavior and suggests that PE should teach for independence through teaching conceptual knowledge, especially self-management knowledge (e.g., goal setting) and problem-solving skills (e.g., how to assess fitness).

It is important for us to recognize these different perspectives and approaches. It is equally important to realize the need for additional theoretical models and research to further our understanding about how PE, regardless of the curricular perspectives, would impact students' PA behavior outside of the school. Theoretical models specifically focusing on the "PE effect" are rare. In my literature search, I found two such models.

One model is Chen and Hancock's (2006) situational-to-self-initiated motivation model. The other is the Hagger and Chatzisarantis's (2016) trans-contextual model.

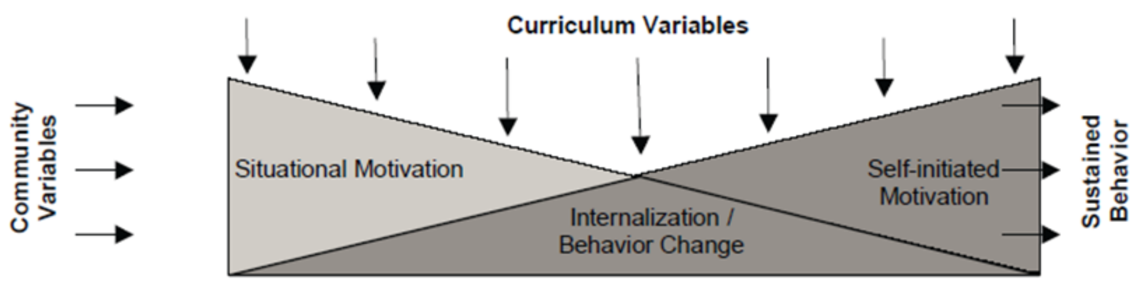
The Situational-to-Self-Initiated Motivation Model

The situational-to-self-initiated motivation model was constructed by Chen and Hancock (2006) to explain how to promote and maintain adolescents' PA motivation and behavior. The PE curriculum is considered one important factor to promote and maintain adolescents' PA motivation and behavior.

This model proposes that children and adolescents' PA motivation tends to be situational and depends on the immediate appealing characteristics of an environment or activity. This situational motivation is effective for short-term PA behavior change such as those displayed in PE classes, but not enough for long-term behavior change. The key for long-term or sustained behavior change relies on self-initiated motivation, which is defined as "the drive to engage in an activity based on a person's self-concept system consisting of his/her perceived competence, self-efficacy, and expectancy beliefs and values in the activity" (Chen & Hancock, 2006, p. 357). Internalizing situational motivation into self-initiated motivation is the key to realizing long-term PA behavior change. PE curriculum variables, such as knowledge and motor skill learning, can contribute to this internalization process (Chen & Hancock, 2006).

As shown in Figure 4.1, the situational-to-self-initiated motivation model is a stage of change model. Drawing from the stages of domain learning (Alexander, Jetton, & Kulikowich, 1995), Chen and Hancock (2006) suggested that adolescents' PA behavior change is a process involving progress through three stages: acclimation, competence, and proficiency. Adolescents can be categorized into one of these three stages based on their knowledge, self-conceptions, and motivation sources.

In this model, PE plays a significant role during the motivation and behavior change process. Chen and Hancock (2006) suggested that PE curriculum is an important vehicle to facilitate adolescents' progress through these motivational and behavioral change stages. For example, PE can help adolescents, who can only be motivated to exercise with partners (situationally motivated), become motivated to exercise on their own (self-motivated) through effective knowledge and skill instruction.



Hypothesized Behavior Change Stages

Personal Variables	***Acclimation*** →	***Competence*** →	***Proficiency*** →
Knowledge & skill	Little	Developing	Sufficient
Self-concept system	Inaccurate	Accurate	Very accurate
Motivation source	Situational	Situational & Personal	Person - initiated
Expected behavior	None	Appearing	Stabilizing

Figure 4.1. The Theoretical Model for PA Motivation and Behavior Change (Chen & Hancock, 2006).

They also suggested that community variables, such as community resources and safety, can influence the process of adolescents' motivational and behavioral change. An effective PE curriculum may reinforce the positive effects and constrain or reduce the negative effects of community variables on adolescents' motivation and behavior change.

The Trans-Contextual Model

The trans-contextual model, as shown in Figure 4.2, explains how students' autonomous motivation for PE impacts their PA behavior in the out-of-school context through influencing their autonomous motivation and social-cognitive beliefs regarding PA (Hagger & Chatzisarantis, 2016). The trans-contextual model is a multi-theory approach to understand the transformative effects of autonomous motivation for PE on autonomous motivation toward out-of-school PA and eventually on the actual engagement of PA behavior in an out-of-school context. This model integrates the theoretical tenets of self-determination theory (Deci & Ryan, 1985, 2000), hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997), and the theory of planned behavior (Ajzen, 1985, 1991).

Autonomous motivation in this model is defined as "engaging in activities out of a sense of personal agency, for interest and satisfaction derived from the activity itself, or its concomitant outcomes, and in the absence of any externally referenced contingencies" (Hagger & Chatzisarantis, 2016, p. 361). According to self-determination theory, there are three forms of autonomous motivation—intrinsic motivation, integrated regulation, and identified regulation—in contrast with two forms of controlled motivation—introjected regulation and external regulation (Deci & Ryan, 2000).

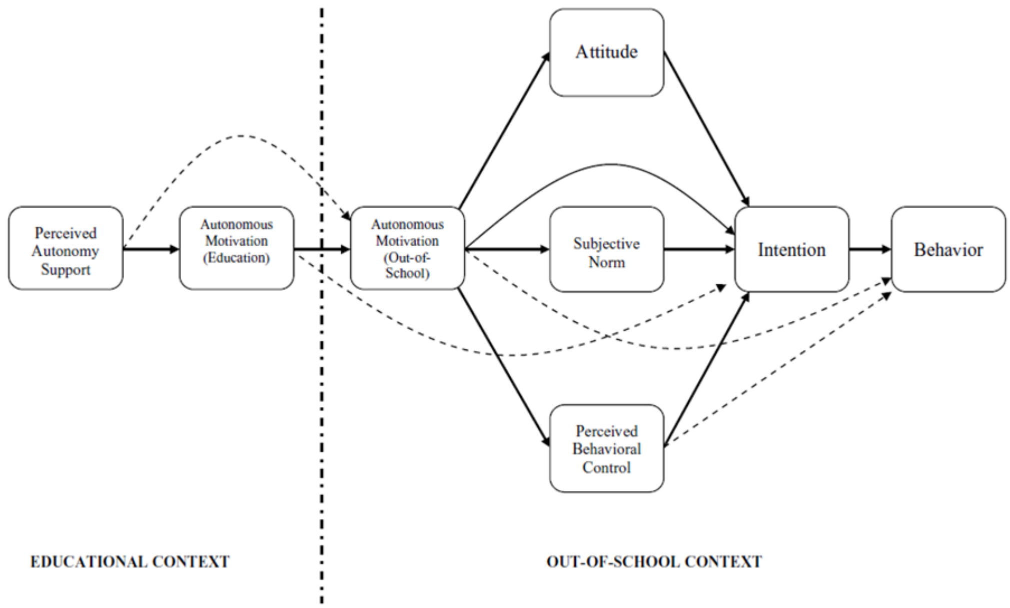


Figure 4.2. The Trans-Contextual Model (Hagger & Chatzisarantis, 2016).

Hagger and Chatzisarantis (2016) proposed three basic tenets in the trans-contextual model. The first basic tenet is that students' perception of autonomy support in PE predicts their autonomous motivation for PE. The second is that autonomous motivation for PE predicts autonomous motivation toward PA in an out-of-school context. The third basic tenet is that autonomous motivation toward PA in out-of-school context predicts intention to engage and actual engagement in PA in out-of-school context. The theory of planned behavior is employed to explain this process. As shown by the conceptual model in Figure 4.2, autonomous motivation toward PA influences attitude, subjective norms, and perceived behavior control, which in turn impact the PA intention and eventually the PA behavior.

Integrating the Two Models

The situational-to-self-initiated motivation model and the trans-contextual model are from different theoretical perspectives. But they share one common assumption. That is, PE is central in impacting students' out-of-school PA behavior. The situational-to-self-initiated motivation model suggests that effective learning in PE can facilitate adolescents' transition from situational motivation to self-initiated motivation, which subsequently can lead to long-term PA behavior change. The trans-contextual model proposes that autonomous motivation experienced in PE can be transferred to autonomous motivation in the leisure-time PA context, which in turn can influence leisure-time PA behavior.

Generally, these two models imply two pathways by which PE can influence students' out-of-school PA. The first pathway is through influencing students' learning in PE; the second is through influencing their motivational experience in PE. Another common assumption of these two models is that PE does not directly influence out-of-school PA behavior. Instead, it contributes to out-of-school PA behavior through influencing students' PA motivation. In other words, the effects of students' learning and motivation in PE on out-of-school PA tend to be mediated by their motivation toward PA.

Based on the situational-to-self-initiated motivation model and the trans-contextual model, a two-pathway model was proposed to explain how PE can contribute to out-of-school PA behavior. Figure 4.3 shows this two-pathway model. It is important to acknowledge that this study is an initial attempt to identify possible pathways through which the “PE effect” emerges. This two-pathway model is adopted as a general conceptual framework of the “PE effect”. The research intention is to establish the initial model that allows other mediators and moderators suggested in the situational-to-self-initiated motivation model and the trans-contextual model to be integrated in future research studies.

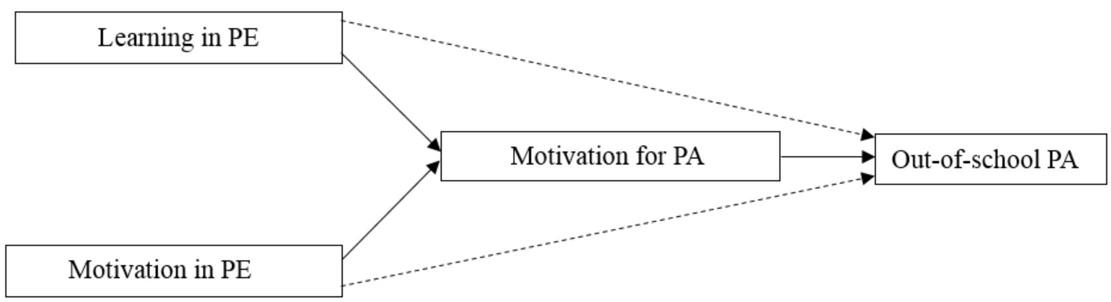


Figure 4.3. The Two-Pathway Model of the “PE Effect”. Solid lines signify direct positive paths; broken lines indirect positive paths. PE: Physical education; PA: Physical activity.

Currently, most studies examining the “PE effect” were based on the trans-contextual model and focused on examining the pathway of motivational experience in PE (Hagger & Chatzisarantis, 2016). Very few studies examined the pathway of learning in PE to achieve the “PE effect”. The two-pathway model suggests that examining these two pathways simultaneously may be a plausible way to further our understanding about the "PE effect". The purpose of this study was to examine the two pathways simultaneously to determine the tenability of this two-pathway model of the "PE effect".

The Present Study

Learning in PE is multidimensional, generally including three dimensions—knowledge acquisition, motor skill development, and affective character cultivation (e.g., confidence, attitude; Society of Health and Physical Educators [SHAPE], 2014). As illustrated in the situational-to-self-initiated motivation model, knowledge and skill learning in PE could be the sub-pathways through which PE impacts out-of-school PA (Chen & Hancock, 2006). In this study, for the pathway of learning in PE, I focused on learning knowledge about PA and fitness.

Many studies have examined the relationship between knowledge and PA behavior (e.g., Chen et al., 2014; DiLorenzo, et al., 1998; Erwin & Castelli, 2008). The findings are mixed. Some studies showed the students who had high levels of knowledge about PA and fitness had higher levels of PA than students who had low knowledge level (Chen et al., 2017; Thompson et al., 2012). Some other studies suggested that knowledge about PA did not have significant predictive effects on PA behavior (Chen et al., 2014; Erwin & Castelli, 2008). Most of these studies hypothesized and tested the direct relationship between knowledge and PA behavior. Few of them examined the mediated relationship between knowledge and PA behavior. As the two-pathway model suggests, knowledge tends to influence out-of-school PA indirectly through motivation toward PA.

In this study, both direct and indirect effects of knowledge on out-of-school PA were tested.

Students' motivation for PE has been studied from many theoretical perspectives. The prominent theories that have guided most motivation research in PE include self-determination theory, expectancy-value theory, achievement goal theory, self-efficacy theory, and interest theory (Chen et al., 2012). In this study, for the pathway of motivation in PE, I focused on the construct of autonomous motivation, because this construct is the focus of the trans-contextual model (Hagger & Chatzisarantis, 2016).

Many studies have examined the relationship between autonomous motivation for PE and out-of-school PA (e.g., Hagger et al., 2009; Shen et al., 2008; Standage et al., 2012). Both the direct and indirect effects of autonomous motivation for PE on out-of-school PA have been previously examined. Most studies indicate that there is an indirect effect but no direct effect of autonomous motivation for PE on out-of-school PA. Several variables have been found to be significant mediators of the effects of autonomous motivation for PE on out-of-school PA. These include autonomous motivation toward PA, attitude toward PA, subjective norm, perceived PA behavior control, and PA intention, enjoyment in PE, and PA level in PE. In this study, I focused on the mediator of autonomous motivation toward PA, since it was the most widely examined mediator in previous studies. To further confirm previous findings, both direct and indirect effects were examined in this study.

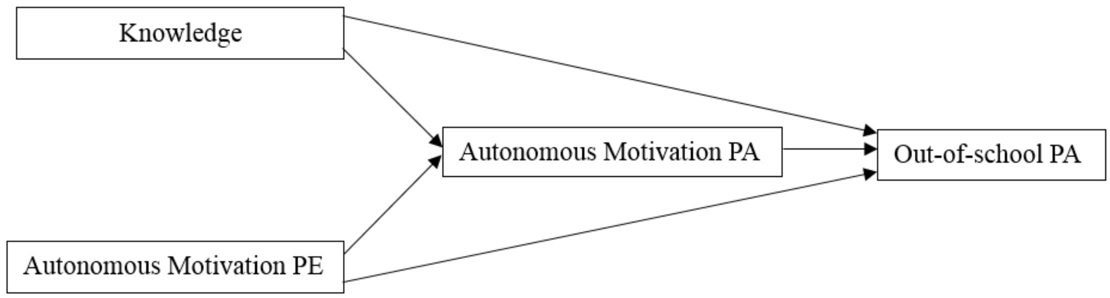


Figure 4.4. The *a priori* Path Model. PE: Physical education; PA: Physical activity.

In this study the following research question was addressed: to what extent did students' knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? I hypothesized that students' knowledge and autonomous motivation for PE would not directly influence out-of-school PA. Instead, they would indirectly influence out-of-school PA behavior through influencing their autonomous motivation toward PA. To answer the research question, an *a priori* path model, as shown in Figure 4.4, was constructed to test the hypothesized pathways among these four variables.

Methods

The Settings

Because of the research purpose, I conducted the study as a follow-up research of a concept-based PE curriculum intervention research. This design helped ensure that the sample would include middle-school students who are knowledgeable about PA and fitness, therefore the pathway of knowledge could be tested. In addition, I also aimed to determine whether eighth-grade students who had experienced the concept-based curriculum would demonstrate higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA behavior than students who had only experienced the traditional multi-activity PE curriculum in middle-school.

I recruited five middle-schools from the original curriculum intervention research. Three schools were previous experimental schools in which students studied the concept-based PE when they were at sixth grade. Two participating schools were previous comparison schools. Eighth grade students in these two school had been taking the traditional multi-activity PE curriculum since the beginning of the sixth grade.

Participants

A total of 394 eighth-grade students provided complete data sets for this study. Among this sample, 166 (42.4%) students had experienced the concept-based PE when they were at sixth grade, 226 (57.6%) students had never experienced the concept-based PE. It included 201 (51.0%) boys and 193 (49.0%) girls. The ethnicity composition of this sample was that 97 (24.6%) students were White, 101 (25.6%) Black, 120 (30.5%) Hispanic, 21 (5.3%) Asian/Pacific Islander, 3 (0.8%) American Indian, 2 (0.5%) Arabic American, and 50 (12.7%) mixed race. This study was approved by the University Institutional Review Board and the Research Committee of the school districts in which these five schools were located. All these participants returned the signed parent/guardian consent form and student assent form.

Variables and Measures

Autonomous motivation toward PA. Autonomous motivation for PA was operationalized as students' perceived behavioral regulations of exercise. The Behavioral Regulation in Exercise Questionnaire (BREQ) was used to measure it (Owen, Smith, Lubans, Ng, & Lonsdale, 2014). The term "exercise" was explained at the top of the questionnaire to inform the students that exercise in this questionnaire refers to any structured and unstructured physical activities. The BREQ scores were converted into one composite score named as the relative autonomy index (RAI) to represents students' autonomous motivation for PA (Vallerand, 1997).

BREQ includes 15 items measuring four motivational regulations which include intrinsic motivation, identified regulation, introjected regulation, and external regulation. There are four items measuring intrinsic motivation (e.g., I exercise because it's fun), identified regulations (e.g., I value the benefits of exercise), and external regulations (e.g., I exercise because other people say I should). Three items measure introjected regulation (e.g., I feel guilty when I don't exercise). Each item is scored using a five-point Likert-type scale ranging from 0 (not true for me) to 4 (very true for me). This scale has demonstrated satisfactory internal consistency reliability (α= .65-.93) and construct validity (χ^2 = 510.67, df = 142, p<.001, CFI= .94, RMSEA =.059, factor loadings = .56-.84), when used to measure adolescents' autonomous motivation toward PA (Crăciun & Rus, 2012, Hagger et al., 2009; Markland & Ingledew, 2007; Wilson, Rodgers, & Fraser, 2002).

The composite score of RAI for PA is often used to represent one's autonomous motivation toward PA (e.g., Markland & Ingledew, 2007; Vallerand, 1997). RAI for PA was calculated based on the BREQ scores using this formula: RAI= 2×Intrinsic motivation + 1×Identified regulation – 1×Introjected regulation – 2×External regulation (Hagger et al., 2009).

Out-of-school PA. Students' out-of-school PA was operationalized as the time students spent in exercising during the out-of-school hours. It was measured using the modified Three-Day Physical Activity Recall (3DPAR) survey (Weston, Petosa, & Pate, 1997). The 3DPAR provides the types and time of physical activities that participants engaged in during their out-of-school hours, from 3:00pm to 10:00pm. This instrument demonstrated strong evidence for test-retest reliability (r = .98) and construct validity (r = .77 with accelerometers) in adolescents (McMurray et al., 2004; Weston et al., 1997). The 3DPAR has often been used to measure students' out-of-school PA in recent years (e.g., Chen, Chen, & Zhu, 2012; Chen et al., 2014; Zhu & Chen, 2013).

The 3DPAR provides a grid divided into 15-minute segments or blocks in which students recall and record all activities they engaged in between 3:00pm and 10:00pm of the previous day. The instrument provides a list of commonly performed activities grouped into the following categories: sport, fitness, other physical activities, sedentary-academic, sedentary-entertainment, sedentary-socializing, and rest. For each block of the day, students record the main activity they engage in during that 15-minute period. The main activity is defined as the one that occupies the most part of the 15-minute period.

Autonomous motivation for PE. Autonomous motivation for PE was defined as the extent to which individuals engage in physical education out of the sense of self (Hagger & Chatzisarantis, 2016). It is often operationalized as students' perceived behavioral regulations in PE (Vlachopoulos, Katartzi, Kontou, Moustaka, & Goudas, 2011). In this study, the revised Perceived Locus of Causality Scale (PLOCS) was used to measure students' autonomous motivation for PE (Vlachopoulos et al., 2011). It includes 15 items, measuring four motivational regulation subscales: four items for intrinsic motivation (e.g., I participate in PE because PE is enjoyable), four for identified regulation (e.g., I participate in PE because it is important to me to do well in PE), four for introjected regulation (e.g., I participate in PE because I would feel bad if the teacher thought I am not good at PE), and three for external regulation (e.g., I participate in PE because in this way I will not get a low grade). Each item was scored using a seven-point Likert-type scale ranging from 0 (Not at all true for me) to 6 (Absolutely true for me).

The revised PLOCS has demonstrated good construct validity and reliability in children and adolescents. For example, Vlachopoulos et al. (2011) used four samples (two elementary student samples, one middle-school student sample, and one high school student sample) to calibrate and validate the revised PLOCS. The results showed that the revised PLOCS has acceptable construct validity for elementary students (χ^2 = 277.22, df = 142, p <.001, CFI=.940, RMSEA =.048; factor loading = .52-.80), middle-school students (χ^2 = 432.07, df = 142, p <.001, CFI=.929, RMSEA =.066; factor loading = .50-.86), and high school students (χ^2 = 277.22, df = 142, p <.001, CFI=.936, RMSEA =.063;

factor loading = .61-.85). The internal consistency reliability coefficients (Cronbach alpha) ranged from .69 to .89 for the subscales in revised PLOCS (Vlachopoulos et al., 2011).

Relative autonomy index (RAI) has also been widely used in PE studies to represent students' autonomous motivation for PE (e.g., Barkoukis, Hagger, Lambropoulos, & Tsorbatzoudis, 2010; McDavid, Cox, & McDonough, 2014; Yli-Piipari, Leskinen, Jaakkola, & Liukkonen, 2012). The RAI for PE in this study was calculated based on the PLOCS scores using the following formula: RAI= 2×Intrinsic motivation + 1×Identified regulation – 1×Introjected regulation – 2×External regulation. The composite score of RAI for PE was used to represent students' autonomous motivation for PE.

Knowledge about PA and fitness. Students' knowledge about PA and fitness was operationalized as their score on a knowledge test. In this study, I used a 25-item, multiple-choice knowledge test to measure knowledge about PA and fitness. This test measured the following knowledge domains: concepts about PA (e.g., intensity, duration) and health-related fitness (e.g., cardiorespiratory fitness, muscular strength and endurance), exercise principles (e.g., principles of overload, principles of progression), PA recommendations (e.g., the amount of physical activity each day), and self-management concepts (e.g., SMART goal). These items were selected from the knowledge question bank validated during the Science of Healthful Living project (Ennis, 2015). The following describes the validation process for each item.

The content accuracy of these question items was determined by physiologists and education experts (n=7). These experts were tenured faculty members from departments of kinesiology with the rank of associate professor or above. All experts have published extensively in their respective kinesiology fields. All the experts were asked to rate each question on a 5-point scale for knowledge accuracy (1= "inaccurate", 5= "accurate") and language appropriateness for middle-school students (1= "inappropriate", 5= "appropriate"). Questions rated below 5 by one or more experts were discussed, revised, and re-rated. Only questions that were rated as 5 by all experts were included for field validation testing with a group of students (n=330) not included in the study. Questions that met the standards of difficulty index (.45-.65) and discrimination index (>.40) criteria (Morrow, Jackson, Disch, & Mood, 2005) were included in the question bank as validated question items. One sample question of the knowledge test is:

An application of the principle of progression to pushups can be: ______________

(a) from regular pushup to wall pushup to knee pushup

(b) from wall pushup to knee pushup to regular pushup

(c) from knee pushup to regular pushup to wall pushup

(d) pushups performed in a random order

Data Collection

Data were collected in a planned sequence. Firstly, PLOCS and BREQ were administered together in one PE class. Then, the knowledge test was administered in another PE class. This sequence was purposely arranged so that students' response to the motivation scales would not be affected by the questions in the knowledge test. The rationale was that the questions in the knowledge test could provoke students' realization about the value of the PA or PE. The instant realization could lead them to recognize a need to give elevated (desired) responses to the motivation scales, resulting in a skewed distribution of responses on the motivation scales. To control for the confounding effects of the sequence administering the two motivation scales (PLOCS and BREQ), the counter-balanced sequence strategy was used. Half randomly selected participants in each school completed the PLOCS and then BREQ, while the other half first BREQ and then PLOCS.

The Three-Day Physical Activity Recall (3DPAR) surveys were administered during the next two weeks. Daily out-of-school physical activity recall was administered three times for students to record out-of-school activities for two weekdays and one weekend day (Sunday in this study). the students were instructed on how to document and recall their out-of-school activities. All questions were addressed immediately at the setting.

Data Reduction

Data collected from PLOCS and BREQ was aggregated and averaged by the dimensions measured. For example, the BREQ measured four types of motivational regulations toward physical activity: intrinsic motivation, identified regulation, introjected regulation, and external regulation. There were four items measuring the intrinsic motivation. Students' scores on the four items were aggregated and averaged to represents students' intrinsic motivation. The same procedures were followed for other constructs measured in BREQ and PLOCS. The RAI for PA and PE were calculated using this formula—RAI = 2×Intrinsic motivation + 1×Identified regulation – 1×Introjected regulation – 2×External regulation—based on the scores of BREQ and PLOCS, respectively.

Students' knowledge scores were represented by the percentage of correct responses on the knowledge test. The responses from the physical activity recall survey was coded into the following seven categories: sport, fitness, other physical activities, sedentary-academic, sedentary-entertainment, sedentary-socializing, and rest. Students' out-of-school physical activity level was represented by the average minutes that students spend per day on sport, fitness, and other physical activities. The number of the average minutes that students spend per day on sedentary-academic, sedentary-entertainment, sedentary-socializing was treated as students' sedentary behavior level. An average out-of-school physical activity time was computed through dividing the three-day total minutes by three.

Data Analysis

This study aimed to answer the following research question: to what extent did eighth-graders' knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? The *a priori* model, as shown in Figure 4.4, was analyzed by testing the paths between the four variables. The structural equation modeling (SEM) was used to test the *a priori* model and its competing model.

In this study, the data from the experimental group (students who had experienced the concept-based PE) and the control group (student who had only experienced the traditional, multi-activity PE) was pooled together to conduct the SEM analysis. The rationale is that knowledge→autonomous motivation toward PA→out-of-school PA is one pathway to be tested in this study. Knowledge learning is usually not emphasized in the traditional, multi-activity PE (Ennis, 2010). Students learning the traditional, multi-activity PE tend to have low level of knowledge about PA and fitness, while students learning the concept-based PE tend to have higher knowledge level than students in traditional PE (Sun et al., 2012). Pooling the data from the two groups together ensured enough variability of the knowledge measures so that the tenability of the knowledge pathway in the *a priori* path model in Figure 4.4 could be tested with adequate statistical power.

Before testing the models, the univariate normality and multivariate normality as two key statistical assumptions for SEM were checked. The *a priori* model (Figure 4.4) was a full, saturated model in which all direct effects were assumed and tested. One competing model of the full model was generated and tested in which the direct effects of knowledge and autonomous motivation for PE on after school PA were not assumed. This competing model was generated based on the following rationale: (a) the model would fit the theoretical propositions of the two-pathway model of the "PE effect"; (b) the model was a more parsimonious model based on the suggestions of the modification indices. To test the model fit, the following indices was used: Chi-square (p>.05), RMSEA (<.08), SRMR (<.08), and CFI (>.90) (Kline, 2011). The SEM was conducted using LISREL 9.30.

Results

Table 4.1 shows the descriptive results of all the variables of this study. On average, participants answered 41% of the knowledge items correct. Students spent more than one hour per day (71.54 ± 63.39 min) on physical activity outside of the school. During this PA time, 25.32 minutes were spent on sport, 22.22 on fitness, 24.00 on other PA such as walk the dog, shopping, or housework.

Before conducting SEM analysis, univariate normality was first checked based on the skewness index and kurtosis index. Because the skewness index of all four variables were between -3 and 3 and the kurtosis indices were between -7 and 7 (see Table 4.1), the univariate normality assumption was considered to be satisfied (Kline, 2011). Multivariate normality was examined based on the Mahalanobis distance (Kline, 2011). The statistical significance test is recommended to determine the multivariate outliers which is often used to infer multivariate normality (Kline, 2011). The critical value for this test is recommended as 0.001 (Kline, 2011). Through this significance test of the Mahalanobis distance, the p values of two individual cases were found to be less than 0.001, which indicates that these two cases are multivariate outliers. These two students' scores on each variable were examined and it showed that these two outliers were not due to incorrectly entered or measured data. These two outliers were not removed from the analysis.

Table 4.1. Descriptive Statistics for All Variables

Variable	*M*	*SD*	*Skew*	*Kurt*
Knowledge	.41	.17	.46	-.30
RAI-PE	2.47	5.27	.47	-.10
RAI-PA	4.07	3.24	.02	-.43
OS-PA (minutes/day)	71.54	63.39	1.18	1.58
Sport	25.32	44.60	2.53	8.66
Fitness	22.22	33.79	2.88	13.28
Other PA	24.00	35.94	1.97	4.09

Note. SD=standard deviation; Skew=skewness; Kurt=kurtosis; PA=physical activity; PE=physical education; OS-PA=out-of-school physical activity.

Figure 4.5 shows the SEM analysis results of the *a priori* model. The standardized path coefficients shown in Figure 4.5 indicate that knowledge and autonomous motivation for PE had significant direct effects on autonomous motivation toward PA (knowledge: path coefficient=.19, p<.01; autonomous motivation for PE: path coefficient= .41, p<.01). But they did not have significant direct effects on out-of-school PA (knowledge: path coefficient=-.01, p>.05; autonomous motivation for PE: path coefficient= .09, p>.05). Since some statisticians argue that the outliers should be removed before conducting the SEM (e.g., Kline, 2011), the SEM analysis without the two outliers was also conducted. The results were very similar to the results with the outliers. The same conclusions can be made based on these two sets of results. The results without outliers can be seen in Appendix C.

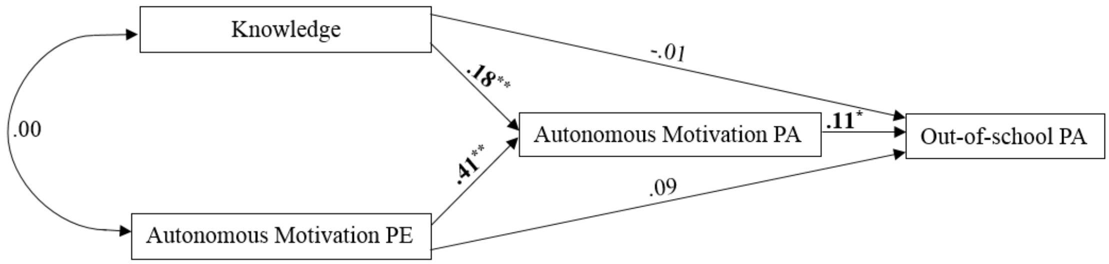


Figure 4.5. The SEM Results of the *a priori* Model (with outliers). PE: Physical education; PA: Physical activity; ** $p<.01$, * $p<.05$.

Because the *a priori* model was statistically saturated, a parsimonious model shown in Figure 4.6 was tested. This model was constructed based on the results of the *a priori* model. In this model, the direct path coefficients from knowledge and autonomous motivation for PE to out-of-school PA were fixed as 0.

The results of this parsimonious model showed that this model fitted the data very well with the following fit indices: χ^2= 2.80, *df* = 2, p =.25; RMSEA= .032; CFI=.99; SRMR=.025. The standardized path coefficients shown in Figure 4.6 indicate that knowledge and autonomous motivation for PE had significant direct effects on autonomous motivation toward PA (knowledge: path coefficient=.19, $p<.01$; autonomous motivation for PE: path coefficient= .41, $p<.01$); they also had significant indirect effects on out-of-school PA (knowledge: indirect effect coefficient=.03, $p<.05$; autonomous motivation for PE: indirect path coefficient= .06, $p<.01$) through influencing the autonomous motivation toward PA. Autonomous motivation toward PA had a significant direct effect (path coefficient= .14, p<.01) on out-of-school PA. The SEM analysis without the outliers showed similar results. Based on these results, the same conclusions can be made. The SEM results without the outliers can be seen in Appendix C.

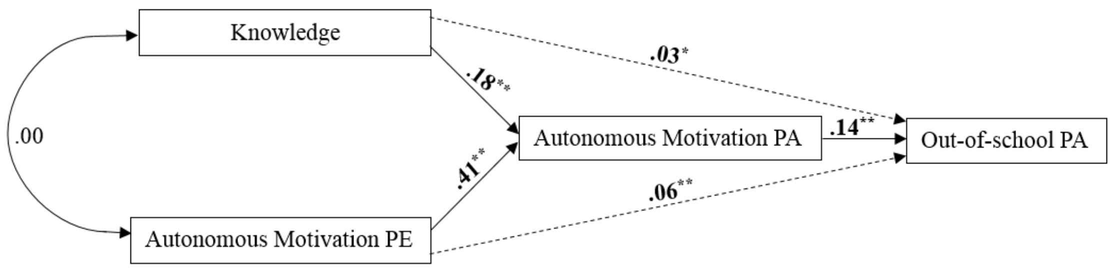


Figure 4.6. The SEM Results of the Parsimonious Model. Solid lines signify direct effect paths; broken lines indirect effect paths. PE: Physical education; PA: Physical activity; path coefficients are standardized coefficients; * p<.05; ** p<.01.

Discussion

The purpose of this study was to test a two-pathway model of the “PE effect”. I focused on the effects of knowledge and autonomous motivation for PE on out-of-school PA through influencing the autonomous motivation toward PA. This study indicates that the two-pathway model of the “PE effect” is tenable in terms of knowledge and autonomous motivation for PE. The results confirmed the hypothesis of this study. Specifically, students’ knowledge had a direct effect on their autonomous motivation toward PA and an indirect effect on out-of-school PA through influencing autonomous motivation toward PA. Students’ autonomous motivation for PE had a direct effect on their autonomous motivation toward PA and an indirect effect on out-of-school PA through autonomous motivation toward PA.

Knowledge and Out-of-school PA

The relationship between knowledge and PA behavior has been debated for a long time in PA and other health behavior change research. Some scholars suggest that knowledge does not influence behavior (e.g., Ajzen et al., 2011), while other scholars argue that knowledge has the potential to impact behavior change because behavior change is rooted in and derived from people's cognition (Chen et al., 2014; Ennis, 2007; von Glasersfeld, 1995). The findings of the current study indicate that knowledge does have the potential to influence PA behavior.

Most, if not all, previous studies examining the relationship between knowledge and PA assumed that knowledge would have a direct effect on PA behavior (e.g., Erwin & Castelli, 2008; Haslem et al., 2016; Kelly et al., 2012). Two types of research designs were mainly used in these studies. The first type was group comparison design—comparing the PA level between students who have high knowledge level and students who have low knowledge level. Several studies showed positive results using this type of research design. For example, Thompson and Hannon (2012) found that students who demonstrated high level of health-related fitness knowledge reported higher PA level than students who had low level of knowledge. Chen, Liu, and Schaben (2017) also found that students in a high knowledge group had higher level out-of-school PA than students in a low knowledge group.

The second type of research design was the correlational design—using knowledge to directly predict PA behavior. Most studies adopting this type of design did not find significant results (e.g., Chen et al., 2017; Haslem et al., 2016). The debate about the relationship between knowledge and PA behavior mainly results from the different findings of these two types of research studies.

The findings of this study suggest that the seemingly different findings of previous studies may not be contradictory to each other. In this study, I found that knowledge did not have a direct effect on out-of-school PA (see Figure 4.5), which is consistent with the findings of previous studies using the correlational design. But it did show a significant, positive, indirect effect on out-of-school PA through influencing autonomous motivation toward PA, which could be a plausible explanation of the positive findings in studies using the group comparison design. Generally, this finding indicates that knowledge about PA and fitness does not directly influence out-of-school PA. Instead, it indirectly influences out-of-school PA through influencing PA motivation.

These findings confirm the assumption of the situational-to-self-initiated motivation model which suggests that knowledge learning in PE can help students develop self-initiated motivation toward PA which subsequently would lead to behavior change (Chen & Hancock, 2006). Ennis (2015) suggests that knowledge can increase the meaningfulness of the behavior through empowering people to know what and why to do and when and how to perform. Learning knowledge about PA and fitness can help develop and sustain students' rational and voluntary participation in physical activities.

This study indicates that learning knowledge in PE could be one way for the "PE effect" to emerge. The findings partially confirmed the tenability of the pathway of learning in PE in the two-pathway model of the “PE effect” shown in Figure 4.3. Future studies should integrate another important learning component in PE—motor skill—to see how motor skill influences motivation toward PA and subsequently influences out-of-school PA, which could further our understanding about the “PE Effect”.

Autonomous Motivation for PE and Out-of-school PA

In this study, I found that autonomous motivation for PE did not have a direct effect on out-of-school PA (see Figure 4.5). But it did show a significant indirect effect on out-of-school PA through positively influencing autonomous motivation toward PA (see Figure 4.6). These findings are consistent with the findings of Standage et al. (2012), in which they found that autonomous motivation in PE positively predicted autonomous motivation toward PA, which subsequently predicted their physical activity measured by pedometer. The direct effect was also not significant in their study.

The indirect effect of autonomous motivation for PE on out-of-school PA has also been found in many other studies (e.g., Cox et al., 2008; Shen et al., 2008; Timo et al., 2016). All these studies are guided by either the trans-contextual model or the self-determination theory. In this study, the pathway of autonomous motivation for PE in the two-pathway model was derived from the trans-contextual model. Because the goal of this study was to summarize the theoretical propositions that relate to the “PE effect” and advance a general conceptual framework to further understand the “PE effect”, other mediators (e.g., attitude, perceived control, and subjective norm) proposed in the trans-contextual model were not included in this study. But the significant indirect effect found in this study is consistent with the findings of Hagger and Chatzisarantis's (2016) meta-analytic path analysis study, in which they found that autonomous motivation for PE had an indirect, positive influence on physical activity intention ($\beta = .19$, $p < .001$) and physical activity behavior ($\beta = .06$, $p = .034$) outside of the school context.

Autonomous motivation is driven by the satisfaction of three basic psychological needs (competence, autonomy, and relatedness) and is manifested in three forms—identified regulation, integrated regulation, and intrinsic motivation (Deci & Ryan, 2000). Many studies have shown that a high level of autonomous motivation can lead to many adaptive outcomes such as high levels of enjoyment, engagement, achievement, performance, and wellbeing (e.g., Black & Deci, 2000; Grolnick & Ryan, 1987; Grolnick, Ryan, & Deci, 1991; Miserandino, 1996). Deci and Ryan (1985) suggest that the adaptive outcomes experienced when engaging in autonomously motivated activity tends to increase people's desire to further experience the outcomes by engaging in similar activities irrespective of the context. The mechanisms underpinning this process are psychological need satisfaction and internalization (Deci & Ryan, 2000). When a student experiences an activity that satisfies their psychological needs in an educational context, he/she will likely internalize the activity into his/her repertoire of activities that is need-satisfying. The individual will tend to actively pursuit similar activities in other contexts. In other words, the fact that students experience an autonomously-motivated activity in an educational context tends to increase the likelihood that they are autonomously motivated to pursue similar activities in other contexts. This may explain the trans-contextual effect of autonomous motivation in PE.

Learning Knowledge in an Autonomy-Supportive PE Environment

This study indicates that learning knowledge and increasing autonomous motivation in PE could be two effective ways to influence students' PA behavior outside of the school. Chen et al. (2007) suggest that two approaches are commonly used in PE curriculum to change students' PA behavior. The first is the behaviorist approach which focuses on promoting in-class PA levels for students to receive immediate health benefits in PE. Studies have shown that this approach may be ineffective in term of influencing out-of-school PA (Sallis et al., 1997) and may have a negative impact on children's motivation for future PA participation (Xiang et al., 2005).

Another approach is the cognition-based approach which focuses on teaching the fact, concepts, and principles about physical activity and fitness. Although limited, research studies have shown that this type of PE curriculum is effective to influence the long-term PA participation among high school (Dale et al., 2000) and college students (Slava et al., 1984). These findings further corroborate the role of learning knowledge in PE for "PE effect" to emerge.

Autonomy-supportive environments have been shown to be effective to increase students' autonomous motivation for PE and their PA behavior. Chatzisarantis and Hagger (2009) randomly assigned a group of PE teachers to the experimental condition or the control condition. Teachers in the experimental condition were trained to use more autonomy supportive strategies in PE class while teachers in the control condition were only trained on the traditional teaching strategies that were not related to autonomy support. They found that students taught by teachers in the experimental condition not only had significantly higher level of needs satisfaction and autonomous motivation but also higher levels of PA intention and PA behavior than those in the control condition.

The findings of this study imply that learning knowledge in an autonomy-supportive PE environment may be an effective way to promote students' out-of-school PA. Ennis (2017) suggested that as we move into the 21st century, effective teaching in PE should transform from focusing on students and teachers' in-class behavior to students' PA behavior outside of the school. She further proposed that the "transformative PE" programs are needed to change students' lives and lead to physically active lifestyles. The current study indicates that physical education programs that focus on teaching students the knowledge about physical activity and fitness in an autonomy-supportive environment may be a plausible start for the "transformative PE".

Conclusion

In this study, a two-pathway model of the "PE effect" was proposed and tested. The results showed that the two-pathway model of the "PE effect" was tenable in terms of knowledge learning and autonomous motivation in PE. Specifically, it showed that students' knowledge had a direct effect on their autonomous motivation toward PA and an indirect effect on out-of-school PA through influencing autonomous motivation toward PA. Students' autonomous motivation for PE had a direct effect on their autonomous motivation toward PA and an indirect effect on out-of-school PA through autonomous motivation toward PA. These findings imply that teaching knowledge in an autonomy-supportive PE environment may be an effective way to promote students' out-of-school PA behavior.

CHAPTER V

EFFECTS OF A CONCEPT-BASED PHYSICAL EDUCATION CURRICULUM ON MIDDLE-SCHOOL STUDENTS' OUT-OF-SCHOOL PHYSICAL ACTIVITY

Abstract

How students' experience and learning in an educational context influence their self-directed learning and behavior outside of the school is an important question in education. The purpose of this study was to determine the extent to which a concept-based physical education (PE) curriculum influenced middle-school students' physical activity (PA) behavior outside of the school. Specifically, the following research question was addressed in this study: did eighth-grade students who had experienced the Science of Healthful Living (SHL) curriculum during middle school have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had only experienced the traditional multi-activity PE? A total of 394 eighth-grade students participated in this study, in which 168 students studied the SHL curriculum when they were at sixth grade, 226 students experienced a traditional PE. A static group comparison design was adopted to compare the differences between these two groups on four dependent variables: knowledge about PA and fitness, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA. The results showed that the students who had studied the SHL curriculum had

significantly higher levels of knowledge, autonomous motivation toward PA, and out-of-school PA than students who had experienced the traditional, multi-activity PE. No significant difference was found for autonomous motivation for PE. These findings indicate that the SHL curriculum is effective to promote students' PA behavior outside of the school.

Introduction

Despite evidence suggesting the benefits of physical activity (PA), children and adolescents' physical inactivity is still a great public concern. The Global Matrix 2.0 report, which included 38 countries representing 60% of the world population, suggests that fewer than 50% of children and youth in 34 countries meet the PA guideline of 60 minutes of moderate-to-vigorous PA daily (Tremblay et al., 2016). The America's 2016 Report Card on Physical Activity for Children and Youth suggests that fewer than 30% children and youth in United States meet the same PA guideline (Katzmarzyk et al., 2016).

To promote children and adolescents' PA level, school has been recognized as an ideal site for interventions (Chen, 2015). In school-based PA interventions, physical education (PE) has often been considered the central intervention venue (McMullen, Ní Chróinín, Tammelin, Pogorzelska, & van der Mars, 2015). Scholars have suggested that a comprehensive, multicomponent school interventions (e.g., Comprehensive School Physical Activity Program) tends to be more effective in promoting PA behavior than interventions focusing on just one component (e.g., PE curriculum) (Buckworth, Dishman, O’Connor, & Tomporowski, 2013). But, to design an effective comprehensive intervention program, we need to understand how well each component of the program can influence PA behavior. PE, therefore, should be further understood in this regard, especially in terms of its influence on students’ PA behavior outside of the school.

The positive effects of PE on out-of-school PA are referred to as the “PE Effect” (Green, 2014, p. 357). Ennis (2017) proposed the concept of “Transformative PE” (p. 1) as a vehicle to achieve the “PE effect”. She suggests that transformative PE focuses on educating students for a lifetime of PA through enhancing students’ cognitive decision making, self-motivation, and personal meaning about PA. Teaching knowledge about PA and fitness and the methods to apply the knowledge are important components in “Transformative PE” (Ennis, 2017). In this sense, concept-based PE, which focuses on teaching students scientific knowledge about PA and fitness, is one type of “Transformative PE” (Ennis, 2015). Studies have shown that concept-based PE can greatly increase students’ knowledge about PA and fitness (Sun, Chen, Zhu, & Ennis, 2012; Wang et al., 2017). However, it is still unclear about its influences on students’ out-of-school PA behavior. The purpose of this study was to determine the effects of a concept-based PE curriculum on middle-school students’ out-of-school PA behavior.

The Two-Pathway Model of the “PE Effect”

Understanding the mechanisms underlying the “PE effect” can help us identify the contributing components in PE to out-of-school PA and the contributing mechanisms. By synthesizing two PA promotion models—the situational-to-self-initiated motivation model and the trans-contextual model—that relate to the “PE effect”, Wang and Chen (2018) developed a two-pathway model to explain the “PE effect”.

In the two-pathway model of the “PE effect”, it is proposed that there are two basic pathways by which learning in PE can influence students’ out-of-school PA. The first pathway is through influencing students’ learning in PE; the second is through influencing their motivational experience in PE. It is also argued that learning in PE does not directly influence out-of-school PA behavior. Instead, it contributes to out-of-school PA behavior through influencing students’ motivation toward PA. In other words, the effects of students’ learning and motivation in PE on out-of-school PA are mediated by their motivation toward PA. Figure 5.1 shows the two-pathway model of the “PE effect”.

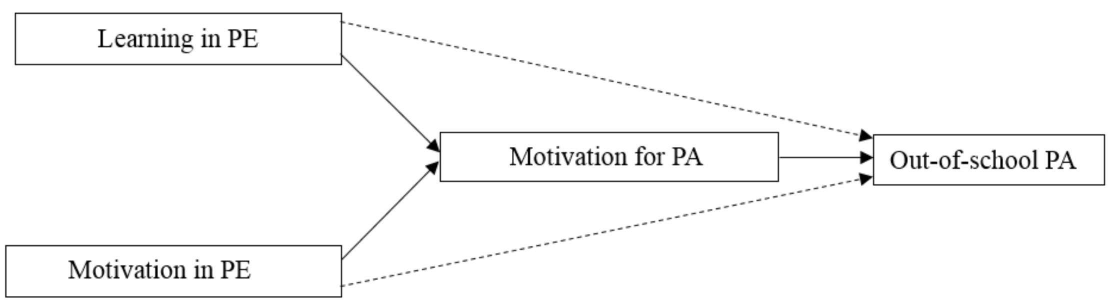


Figure 5.1. The Two-Pathway Model of the “PE Effect”. Solid lines signify direct positive paths; broken lines indirect positive paths. PE: Physical education; PA: Physical activity.

To test this two-pathway model, Wang and Chen (2018) examined the effects of knowledge and autonomous motivation for PE on out-of-school PA with autonomous motivation toward PA as the mediator. They found that students’ knowledge and autonomous motivation for PE showed significant, positive, indirect effects on out-of-school PA, but non-significant direct effects on out-of-school PA. Their findings indicate that the two-pathway model is tenable in terms of learning knowledge in PE and increasing autonomous motivation in PE. These findings imply that teaching students the knowledge about PA and fitness and increasing their autonomous motivation in PE could be effective pathways to promote their out-of-school PA.

Concept-Based Physical Education

Concept-based PE is defined as a PE curriculum that focuses on teaching conceptual knowledge about PA, fitness, and behavioral skills (Ennis, 2015). In recent years, several concept-based PE curriculum models have been developed for students in different school levels (e.g., Corbin & Le Masurier, 2014; Ennis, 2015). For example, Fitness for Life, Science PE & Me, and Science of Healthful Living (SHL) are three typical concept-based PE curricula. Fitness for Life was developed by Corbin and colleagues mainly for high school and college students (Corbin & Le Masurier, 2014); Science PE & Me and SHL were developed by Ennis and Chen for upper elementary and middle-school students respectively (Ennis, 2013).

Empirical studies have shown that high school and college students who have studied the Fitness for Life curriculum tend to be more physically active than students who have experienced the traditional sport-based PE (Brynteson & Adams, 1993; Dale & Corbin, 2000; Dale, Corbin, & Cuddihy, 1998; Slava, Laurie, & Corbin, 1984). For example, Dale and Corbin (2000) compared the PA level between high school graduates who were exposed to Fitness for Life in high school and those who were exposed to traditional, sport-based PE. They found that more students in the concept-based PE group reported vigorous PA participation than students in the traditional PE group; fewer students in the concept-based PE were categorized as being sedentary than students in the traditional PE group (Dale & Corbin, 2000). Researchers also found that college students who were exposed to concept-based PE demonstrated more knowledge, had a higher positive attitude toward PA, and better PA habit than students who had taken the tradition PE curriculum after graduation from college (Brynteson & Adams, 1993; Slava et al., 1984).

Science PE & Me and SHL are newly developed PE curricula targeting elementary and middle-school students respectively. Both curricula went through a large-scale, longitudinal (5 years), randomized clinical trial research which aimed to determine the curricula efficacy (Ennis, 2015). It has been shown that both curricula can significantly increase students' knowledge about PA and fitness (Sun et al., 2012; Wang et al., 2017). It is still unclear about their effects on students' PA motivation and behavior. In this study, I focused on the effects of the SHL curriculum on middle-school students' PA motivation and out-of-school PA behavior.

The Present Study

Guided by the two-pathway model of the "PE effect", this study was designed to address the following research question: did eighth-grade students who had studied the SHL curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had experienced the traditional multi-activity PE?

Based on the two-pathway model of the “PE effect” and the previous positive findings about the effects of concept-based PE on PA behavior (e.g., Brynteson & Adams, 1993; Dale & Corbin, 2000), I first hypothesized that students who studied the SHL curriculum would have higher levels of knowledge and autonomous motivation for PE than students in the traditional multi-activity PE group. I also hypothesized that students who had experienced the SHL curriculum would have higher levels of autonomous motivation toward PA and out-of-school PA than students who had only experienced the traditional multi-activity PE. The rationale for the hypotheses is that (a) a previous study has shown that the SHL curriculum is effective to increase students’ knowledge about PA and fitness (Wang et al., 2017); (b) although the influences of the SHL curriculum on students’ autonomous motivation for PE have not been investigated, the content, structure, and instructional system of this curriculum are designed to elicit high levels of autonomous motivation among students (Ennis, 2015). For example, there are several elements specifically emphasized in the curriculum that are designed to increase students’ psychological needs satisfaction and subsequently increase their autonomous motivation. These elements include an emphasis on learning rationale, opportunities for making task choice, advocacy of knowledge mastery rather than competition, and encouragement of cooperative peer communication. These components have been shown to be effective instructional strategies to increase students’ autonomous motivation (Wang, 2017). A detailed description of the SHL curriculum can be found in the Methods section.

Methods

The Settings

This study was a follow-up study of a large-scale, concept-based PE curriculum intervention project, the Science of Healthful Living. The SHL project started in 2011 and ended in 2016 (Ennis, 2015). In the current study, I went to three former experimental schools from the SHL project and two former comparison schools to collect data on the effects of the concept-based PE. The experimental schools stopped teaching the SHL curriculum after the 2015-2016 school year (the last year of SHL) due to a lack of regular resource support. The eighth-grade students in the experimental schools studied the SHL curriculum when they were in the sixth grade. The students in the two former comparison schools during the SHL project experienced the traditional curriculum during their sixth-, seventh-, and eighth-grade years.

Research design. To answer the research question, I adopted the static group comparison design to compare responses between the students who have experienced the SHL curriculum (experimental condition) with those who have not (comparison condition). The static group comparison design has been frequently used in studies investigating the effects of concept-based PE on PA behavior among high school (Dale & Corbin, 2000; Dale et al., 1998) and college students (Brynteson & Adams, 1993; Slava et al., 1984).

The schools. The eighth graders in the experimental group were sampled from three schools that had been in the experimental condition of the SHL project. The teachers in the three schools already had four-year experiences of teaching the curriculum before teaching the curriculum during the last year of the SHL project. In addition, they had received systematic training for teaching the SHL curriculum. The curriculum fidelity data collected during the SHL project indicated that they taught the curriculum faithfully. Therefore, the eighth graders in the experimental group had received a solid instruction of the SHL curriculum when they were at the sixth grade.

The eighth graders in the comparison condition were sampled from two former schools that had been involved in the SHL project as the comparison schools. The students in these two schools had never been exposed to the SHL curriculum and had only taken the traditional multi-activity PE during middle school.

The experimental curriculum. The concept-based PE curriculum that the eighth graders in experimental group experienced is called the Science of Healthful Living. This curriculum included 20 lessons focusing on teaching concepts and principles about exercise and fitness and creating fitness/exercise plan. The table of contents of these lessons is presented in Table 5.1.

Each lesson in this curriculum was delivered using a learner-centered 5-E instructional framework—engagement, exploration, explanation, elaboration, and evaluation—for students to assume the role of "Junior Scientists" in learning (Bybee et al., 1989). During Engagement, the teacher involved students in an instant physical activity and used this activity to introduce the scientific vocabularies and concept they were going to learn. Students were asked to record their pre-activity heart rate or other measures in their workbook. During Exploration, students were organized to investigate a variety of physical activities to collect post activity physiological and psychological responses to compare with the pre-activity measures. Through prediction, experiment, observation, and documentation, students collected and studied the data as directed by their workbook questions. In Explanation, students were guided to form small or large groups to "Think, Pair, Share" with their peers to interpret or make meaning of the data. They compared and contrasted the data to understand the impact of physical activity. In Elaboration, the teacher further elaborated the concepts and principles the data inform and guided the students to discuss implications of physical activity to life beyond physical education. The teacher frequently challenged the students by asking them to create new exercises to demonstrate their understanding of the concept being studied. In Evaluation, students summarized the data and the knowledge learned to reach conclusions that reinforced the concept. Usually they were prompted to answer an open-ended real-life question on their workbook summarizing the concept just learned.

Table 5.1. The Table of Contents of the SHL Curriculum

Lesson	Topic
1	Measuring Heart Rate
2	Intensity – Rating of Perceived Exertion (RPE)
3	Introduction to Exercise Intensity
4	Short- and Long-term Benefits of Physical Activity

Table 5.1. Cont.

Lesson	Topic
5	Introduction to Exercise Type
6	Introduction to Fitness Components
7	Comparing Muscular Strength and Endurance
8	Introduction to Flexibility
9	Introduction to Frequency
10	Introduction to Time
11	Measuring Intensity
12	Introduction to the Principle of Overload
13	Introduction to the Principle of Progression
14	Introduction to the Principle of Progressive Overload
15	Introduction to the Principle of Specificity
16	Characteristics of Anaerobic Exercise
17	Introduction to the Anaerobic Energy Systems
18	Characteristics of Aerobic Exercise
19	Introduction to SMART Goal Strategies
20	Applying SMART Goal Strategies to the Principle of Progressive Overload

Another salient characteristic of the SHL curriculum was that students were required to use a workbook in each lesson. The workbook contained content closely tied to the physical activities in a lesson and served as a centerpiece of knowledge construction tool to assist learning. The assignments in the workbook were sequenced with progressive complexity from descriptive to relational and to reasoning tasks. These tasks were presented to students as questions/problems associated with the physical activities being experienced to facilitate students' knowledge construction.

The traditional curriculum. The traditional PE curriculum focused on providing students with opportunities to experience multiple forms of physical activities, usually in team sports and games. The eighth graders in the comparison group had always had this PE curriculum. Cognitive knowledge about PA and fitness was not emphasized. The curriculum was usually organized into short units so that students could be exposed to broad sport-based activities which mainly include team sports and cooperative games. A typical lesson of this multi-activity PE started with about 10 to 15 minutes of teacher-directed warm-up and fitness activities, then about 15 to 25 minutes of skill development or scrimmage game play, and then about 5 minutes of lesson closure and/or cool-down activities. With progress, more instructional time was allotted to game play.

Participants

The participants in the current study were 394 eighth-grade students. These students provided complete data sets for this study. Among this sample, 168 (42.6%) students studied the concept-based PE two years earlier when they were in sixth grade, 226 (57.4%) students had been experiencing the traditional curriculum since sixth grade. This sample consisted of 201 (51.0%) boys and 193 (49.0%) girls. The ethnicity composition of this sample was that 97 (24.6%) students were White, 101 (25.6%) Black, 120 (30.5%) Hispanic, 21 (5.3%) Asian/Pacific Islander, 3 (0.8%) American Indian, 2 (0.5%) Arabic American, and 50 (12.7%) mixed race. This study was approved by the University Institutional Review Board and the Research Committee of the school districts in which these five schools were located. All 394 participants returned the signed parent/guardian consent form and student assent form.

Variables and Measures

Condition. The variable of condition was the independent variable of this study. It categorized the participants of this study into two groups: experimental group (students who had experienced SHL) and comparison group (students who had experienced traditional PE). These two groups of students were distinguished by matching their names with the roster collected during the SHL project two years ago (when they were at sixth grade). Roster cross-check was performed to identify students who might have had in the opposite condition in sixth grade. None was found.

Autonomous motivation toward PA. Autonomous motivation for PA was operationalized as students' perceived behavioral regulations of exercise. It was measured using the Behavioral Regulation in Exercise Questionnaire (BREQ) (Owen, Smith, Lubans, Ng, & Lonsdale, 2014). The term "exercise" was explained at the top of the questionnaire to inform students that exercise in this questionnaire refers to any structured and unstructured physical activities. The BREQ scores were converted into one composite score named as the relative autonomy index (RAI) to represents students' autonomous motivation for PA (Vallerand, 1997).

BREQ includes 15 items measuring four motivational regulations which include intrinsic motivation, identified regulation, introjected regulation, and external regulation. There are four items measuring intrinsic motivation (e.g., I exercise because it's fun), identified regulations (e.g., I value the benefits of exercise), and external regulations (e.g., I exercise because other people say I should). Three items measure introjected regulation (e.g., I feel guilty when I don't exercise). Each item is scored using a five-point Likert-type scale ranging from 0 (not true for me) to 4 (very true for me). This scale has demonstrated satisfactory internal consistency reliability (α= .65-.93) and construct validity (χ^2 = 510.67, *df* = 142, *p*<.001, CFI= .94, RMSEA =.059, factor loadings = .56-.84), when used to measure adolescents' autonomous motivation toward PA (Crăciun & Rus, 2012, Hagger et al., 2009; Markland & Ingledew, 2007; Wilson, Rodgers, & Fraser, 2002).

A composite score of RAI for PA is often used to represent one's autonomous motivation toward PA (e.g., Markland & Ingledew, 2007; Vallerand, 1997). RAI for PA is calculated based on the BREQ scores using this formula: RAI= 2×Intrinsic motivation + 1×Identified regulation – 1×Introjected regulation – 2×External regulation (Hagger et al., 2009).

Out-of-school PA. Students' out-of-school PA was operationalized as the time students spend in exercising during the out-of-school hours. It was measured using the modified Three-Day Physical Activity Recall (3DPAR) survey (Weston, Petosa, & Pate, 1997). The 3DPAR provides the types and time of physical activities that participants engaged in during their out-of-school hours, from 3:00pm to 10:00pm. This instrument demonstrated strong evidence for test-retest reliability (*r* = .98) and construct validity

(r = .77 with accelerometers) in adolescents (McMurray et al., 2004; Weston et al., 1997). The 3DPAR has often been used to measure students' out-of-school PA in recent years (e.g., Chen, Chen, & Zhu, 2012; Chen, Sun, Zhu, & Chen, 2014; Zhu & Chen, 2013).

The 3DPAR provides a grid divided into 15-minute segments or blocks in which students recall and record all activities they engaged in between 3:00 pm and 10:00 pm of the previous day. The instrument provides a list of commonly performed activities grouped into the following categories: sport, fitness, other physical activities, sedentary-academic, sedentary-entertainment, sedentary-socializing, and rest. For each block of the day, students recorded the main activity they engaged in during that 15-minute period. The main activity is defined as the one that occupied the most part (>10 minutes) of the 15-minute period.

Autonomous motivation for PE. Autonomous motivation for PE was defined as the extent to which individuals engage in physical education out of the sense of self (Hagger & Chatzisarantis, 2016). It is often operationalized as students' perceived behavioral regulations in PE (Vlachopoulos, Katartzi, Kontou, Moustaka, & Goudas, 2011). In this study, the revised Perceived Locus of Causality Scale (PLOCS) was used (Vlachopoulos et al., 2011). It includes 15 items, measuring four motivational regulation subscales: four items for intrinsic motivation (e.g., I participate in PE because PE is enjoyable), four for identified regulation (e.g., I participate in PE because it is important to me to do well in PE), four for introjected regulation (e.g., I participate in PE because I would feel bad if the teacher thought I am not good at PE), and three for external regulation (e.g., I participate in PE because in this way I will not get a low grade). Each item is scored using a seven-point Likert-type scale ranging from 0 (Not at all true for me) to 6 (Absolutely true for me).

The revised PLOCS has demonstrated good construct validity and reliability evidence for children and adolescents. For example, Vlachopoulos et al. (2011) used four samples (two elementary student samples, one middle school student sample, and one high school student sample) to calibrate and validate the revised PLOCS. The results showed that the revised PLOCS has acceptable construct validity for elementary students (χ^2 = 277.22, *df* = 142, *p* <.001, CFI=.940, RMSEA =.048; factor loading = .52-.80), middle school student (χ^2 = 432.07, *df* = 142, *p* <.001, CFI=.929, RMSEA =.066; factor loading = .50-.86), and high school students (χ^2 = 277.22, *df* = 142, *p* <.001, CFI=.936, RMSEA =.063; factor loading = .61-.85). The internal consistency reliability coefficients (Cronbach alpha) ranged from .69 to .89 for the subscales in revised PLOCS (Vlachopoulos et al., 2011).

Relative autonomy index (RAI) has also been widely used in PE studies to represent students' autonomous motivation for PE (e.g., Barkoukis, Hagger, Lambropoulos, & Tsorbatzoudis, 2010; McDavid, Cox, & McDonough, 2014; Yli-Piipari, Leskinen, Jaakkola, & Liukkonen, 2012). The RAI for PE in this study was calculated based on the PLOCS scores using the following formula: RAI= 2×Intrinsic motivation + 1×Identified regulation – 1×Introjected regulation – 2×External regulation.

The composite score of RAI for PE was used to represent students' autonomous motivation for PE.

Knowledge about PA and fitness. Students' knowledge about PA and fitness was operationalized as the score on a knowledge test. In this study, I used a 25-item, multiple-choice knowledge test to measure knowledge about PA and fitness. This test measured the following knowledge domains: concepts about PA (e.g., intensity, duration) and health-related fitness (e.g., cardiorespiratory fitness, muscular strength and endurance), exercise principles (e.g., principles of overload, principles of progression), PA recommendations (e.g., the amount of physical activity each day), and self-management concepts (e.g., SMART goal). These items were selected from the knowledge question bank validated during the Science of Healthful Living project (Ennis, 2015).

The content validity of these question items was determined by physiologists and education experts (n=7). These experts were tenured faculty members from departments of kinesiology with the rank of associate professor or above. All experts have published extensively in their respective kinesiology fields. All the experts were asked to rate each question on a 5-point scale for knowledge accuracy (1= "inaccurate", 5= "accurate") and language appropriateness for middle-school students (1= "inappropriate", 5= "appropriate"). Questions rated below 5 by one or more experts were discussed, revised, and re-rated. Only questions that were rated as 5 by all experts were included for field validation testing with a group of 300 students who were not included in the SHL study.

Questions that met the standards of difficulty index (.45-.65) and discrimination index (>.40) criteria (Morrow, Jackson, Disch, & Mood, 2005) were included in the question bank as validated question items. One sample question of the knowledge test is:

An application of the principle of progression to pushups can be: ______________

(a) from regular pushup to wall pushup to knee pushup

(b) from wall pushup to knee pushup to regular pushup

(c) from knee pushup to regular pushup to wall pushup

(d) pushups performed in a random order

Data Collection

Data were collected in a planned sequence. Firstly, PLOCS and BREQ were administered together in one PE class. Then, the knowledge test was administered in another PE class. This sequence was purposely arranged so that students' response to the motivation scales would not be affected by the questions in the knowledge test. The rationale was that the questions in the knowledge test could provoke students' realization about the value of the physical activity or physical education. The instant realization could lead them to recognize a need to give elevated (desired) responses to the motivation scales, resulting in a skewed distribution of responses on the motivation scales. To control the confounding effects of the sequence of administering the two motivation scales (PLOCS and BREQ), a counter-balanced strategy was used. Half of the participants in each school were randomly selected to complete the PLOCS and then BREQ, while the other half took the BREQ first and then the PLOCS.

The Three-Day Physical Activity Recall (3DPAR) surveys were administered during the next two weeks. Daily out-of-school physical activity recall was administered three times for students to record out-of-school activities for two weekdays and one weekend day (Sunday in this study). Students were instructed on how to document and recall their out-of-school activity. All questions were addressed immediately at the setting.

Data Reduction

Data collected from PLOCS and BREQ was aggregated and averaged by the dimensions measured. For example, the BREQ measured four types of motivational regulations toward PA: intrinsic motivation, identified regulation, introjected regulation, and external regulation. There were four items measuring the intrinsic motivation. Students' scores on the four items were aggregated and averaged to represents students' intrinsic motivation. The same procedures were followed for other constructs measured in BREQ and PLOCS. The RAI for PA and PE were calculated using this formula— RAI= 2×Intrinsic motivation + 1×Identified regulation – 1×Introjected regulation – 2×External regulation—based on the scores of BREQ and PLOCS, respectively.

Students' knowledge scores were represented by the percentage of correct responses on the knowledge test. The data from the physical activity recall survey was coded into the following seven categories: sport, fitness, other physical activities, sedentary-academic, sedentary-entertainment, sedentary-socializing, and rest. Students' out-of-school PA level was represented by the average minutes that students spend per day on sport, fitness, and other physical activities. The average minutes that students spend per day on sedentary-academic, sedentary-entertainment, sedentary-socializing was treated as students' sedentary behavior level. An average out-of-school physical activity time was computed through dividing the three-day total minutes by three.

Data Analysis

The following research question was aimed to be answered in this study: did eighth-grade students who had experienced the SHL curriculum during middle school have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had only experienced the traditional multi-activity PE? To answer the question, MANOVA was conducted with the experimental condition (experimental vs comparison) as the independent variable and knowledge, autonomous motivation for PE, and autonomous motivation toward PA as the dependent variables. Because out-of-school PA was not normally distributed (see Table 5.2 and Figure 5.2), the Mann-Whitney U Test was conducted with experimental condition as the independent variable and out-of-school PA as the dependent variable.

To determine the unit of analysis in this study, the intra-correlation/auto-correlation coefficients for each dependent variable were calculated using the following formula:

$$\rho = (MSb - MSw)/(MSb + (n-1)MSw)$$

Where ρ: intra-correlation coefficient

MSb: between-group mean square

MSw: within-group mean square

n: number of observations in each group (Chen & Zhu, 2001).

The intra-correlation coefficient for knowledge was 0.285; autonomous motivation toward PA was 0.018; autonomous motivation for PE -0.005; out-of-school PA 0.009. Chen and Zhu (2001) have recommended that when the intra-correlation coefficient is less than 0.10, the assumption of independent observation is considered to be met, and individual scores can be used for analysis. When the intra-coefficient is larger than 0.10, the assumption is violated. In that instance, two strategies can be used for data analysis: (a) using the group means as the unit of analysis, or (b) using individual scores with an adjusted α level to at least 10 times smaller than the intended p value (Chen & Zhu, 2001).

In this study, I adopted the individual scores as the unit of analysis to keep the analyses consistent with all dependent variables for consistent result interpretation. Because the intra-correlation coefficients for autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA were less than 0.10, the α levels for these three variables were set as 0.05. Since the intra-correlation coefficient for knowledge was larger than 0.10, the α level for this variable was set as 0.005. The MANOVA and the Mann-Whitney U Test were conducted using IBM SPSS 25.

Results

Table 5.2 shows the descriptive statistics of the four dependent variables. Students in the experimental group demonstrated a higher mean knowledge score than student in the comparison group. They also had higher mean scores on autonomous motivation for PE and PA, and out-of-school PA than students in the comparison group.

Table 5.2. Descriptive Statistics for All Variables

Variable	Total		Experimental		Comparison	
	Mean/*SD*	*Skew*	Mean/*SD*	*Skew*	Mean/*SD*	*Skew*
Knowledge	.41/.17	.46	.48/.18	.12	.35/.14	.57
RAI-PE	2.47/5.27	.47	2.61/5.23	.23	2.37/5.30	.64
RAI-PA	4.07/3.24	.02	4.44/2.96	-.23	3.79/3.42	.21
OS-PA (minutes/day)	71.54/63.39	1.18	77.60/64.00	1.17	67.07/62.70	1.21
Sport	25.32/44.60	2.53	30.12/48.50	2.55	21.75/41.20	2.45
Fitness	22.22/33.79	2.88	17.98/25.63	1.72	25.38/38.51	2.90
Other PA	24.00/35.94	1.97	29.76/38.47	1.61	19.71/33.38	2.37

Note. SD=standard deviation; Skew=skewness; Kurt=kurtosis; SE=standard error of skewness; PA=physical activity; PE=physical education; OS-PA=out-of-school physical activity.

Before conducting MANOVA, distribution normality assumption was examined. As shown in Table 5.2, the variable of out-of-school PA had the highest skewness index which was around 1.20. Figure 5.2 and 5.3 shows the distribution of the out-of-school PA variable. Although Chen and Zhu (2001) have recommended that the conventional *t* or *F* test can be used when the skewness index is less than 1.5, the highly positively skewed distribution of out-of-school PA indicates that a non-parametric test would be better for this variable than the conventional *t* or *F* test (Howell, 2013). Since the independent variable (condition) had two levels (experimental VS comparison), the Mann-Whitney U test was used to determine the difference between the experimental and comparison group in terms of out-of-school PA. Because the distributions of the other three dependent variables were approximately normal, MANOVA was conducted for these three variables.

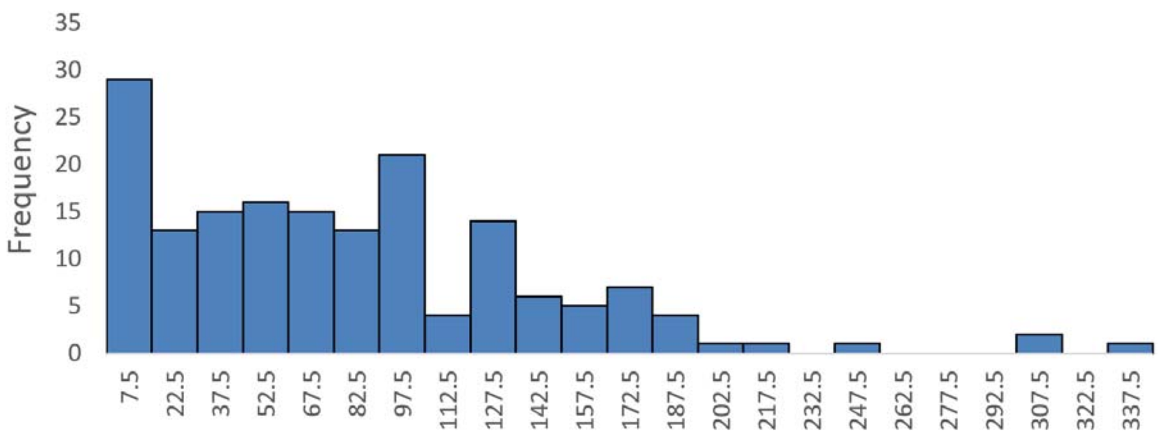


Figure 5.2. Distribution of the Out-of-school PA Time (minutes/day) for the Experimental Group (n=168).

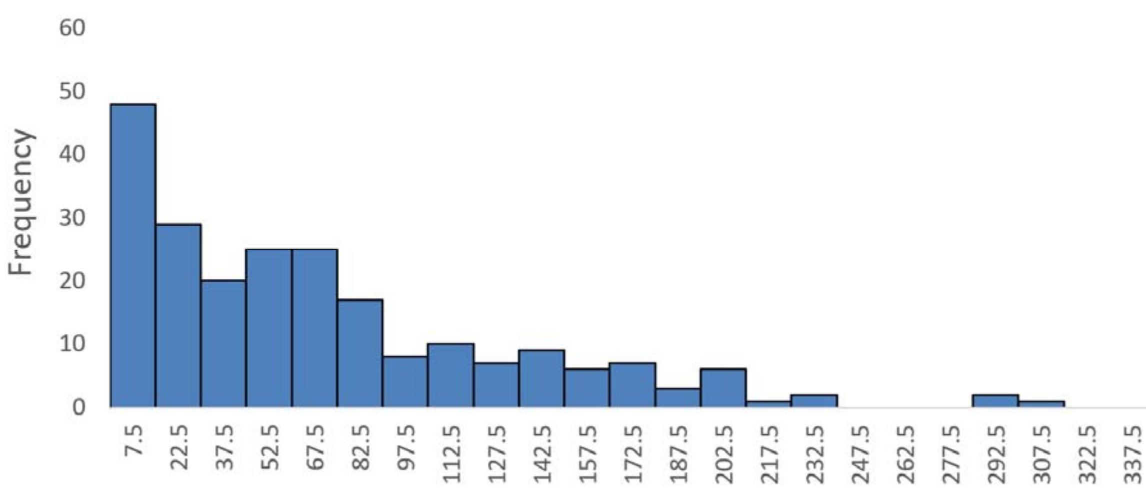


Figure 5.3. Distribution of the Out-of-school PA Time (minutes/day) for the Control Group (n=226).

MANOVA Test Results

The Box's M test was conducted to test the homogeneity assumption of the covariance matrices. The results showed a Box' M value of 13.42 with a p value of .038, which was interpreted as non-significant based on Huberty and Petoskey's (2000) guideline (i.e., $p > .005$). Thus, the covariance matrices between the two groups were assumed to be equal for the purpose of MANOVA. A statistically significant MANOVA effect was obtained, Pillai's Trace = .15, $F(3, 390) = 23.04$, $p < .001$. The multivariate effect size (η2) was .15, which implies that 15% of the variance in the canonically derived dependent variable was accounted for by the group condition.

Before conducting the follow-up ANOVAs, the homogeneity of variance assumption was tested for the three dependent variables. Based on the results of the Levene's F tests, the homogeneity of variance assumption was considered satisfied, even though two of the three Levene's F tests were statistically significant ($p < .05$). Specifically, although the Levene's F test suggested that the variances associated with knowledge and autonomous motivation toward PA were not homogenous, an examination of the standard deviations (see Table 5.2) revealed that none of the larger standard deviations were more than four times the size of the corresponding smaller ones, suggesting that the ANOVA would be robust in this case (Howell, 2013).

Three one-way ANOVAs were conducted as follow-up tests to the MANOVA. The results showed a significant difference between experimental and comparison group for knowledge ($F=68.91$, $df = 1$, $p<.001$, $\eta^2 = .15$) and autonomous motivation toward PA

(F=4.10, *df* = 1, p<.05, η^2 = .01), a non-significant difference for autonomous motivation for PE. The Cohen's d effect sizes showed that the effect size was large (Cohen's d= .81) for knowledge and small for autonomous motivation toward PA (Cohen's d= .20) based on Cohen's (1992) guidelines.

The Mann-Whitney U Test Results

Since the out-of-school PA was not normally distributed, other related descriptive statistics are reported in Table 5.3. The Mann-Whitney U test showed that students in the experimental group spent more time than students in the comparison group on physical activity during out-of-school hours (Mann-Whitney U=16677.50, *Z*= -2.07, p <.05). The mean ranks and the sum of ranks are 211.23 and 35486.50 for the experimental group, 187.29 and 42328.50 for the comparison group. To calculate effects size, the following formula was used as suggested by Rosenthal (1994) and Filed (2009): r=abs(Z/√N). The effect size for out-of-school PA was .01, which is considered as a small effect size (Field, 2009).

Table 5.3. Descriptive Statistics for Out-of-school PA (minutes/day)

Descriptive Statistics		Out-of-school PA	Sport	Fitness	Other PA
Total	Median	60	0	10	5
	Maximum	335	335	290	185
	Minimum	0	0	0	0
Treatment group	Median	70	0	5	15
	Maximum	335	335	135	180
	Minimum	0	0	0	0
Control group	Median	50	0	10	0
	Maximum	305	235	290	185
	Minimum	0	0	0	0

Discussion

The purpose of this study was to determine the effects of the SHL curriculum on middle-school students' knowledge, autonomous motivation toward PE, autonomous motivation toward PA, and out-of-school PA in comparison with a traditional multi-activity PE. The results of this study showed that students who had experienced the SHL curriculum had higher levels of knowledge, autonomous motivation toward PA, and out-of-school PA than students who had only experienced the traditional, multi-activity PE during middle school. Students in both curricula were equally motivated for their respective experiences in PE as shown by their average score on autonomous motivation toward PE.

It is important to acknowledge that this study is a 1.5-year follow-up study of a concept-based PE curriculum intervention project, the Science of Healthful Living. Participants in this study came from the schools that were randomly assigned to the experimental or comparison groups during the SHL project and remained in the assigned condition till this study. Participants in the experimental group studied the concept-based PE only for a year when they were at the sixth grade, while participants in the comparison group of this study had experienced the traditional multi-activity PE for their three-year tenure during middle school.

Long-term Effects on Knowledge Learning

The preliminary analysis of the data collected during the SHL project showed that middle-school students in the experimental group had significantly higher immediate knowledge gain than students in the comparison group. In this study, I found that 1.5 years following the conclusion of the intervention, students who had experienced the SHL curriculum still had a significantly higher knowledge than students who had only experienced the traditional multi-activity PE (Cohen's d= .81). The finding indicates a long-term, at least a 1.5-year long-term, effect of the SHL curriculum on knowledge retention.

The knowledge retention effect may derive from the constructivist-oriented curriculum and the instructional components built into the curriculum (Zhang et al., 2014). These components include connecting cognitive knowledge learning with physical activity experiences to make the learning meaningful, building new knowledge on prior knowledge to develop personalized knowledge structure, adopting the 5-E instructional structure to scaffold the learning experiences, incorporating the workbook in every lesson to facilitate cognitive engagement, and imbedding organized student-student social interactions (e.g., think-pair-share) to create effective learning communities (see the Methods section for the detailed curriculum description) (Zhang et al., 2014).

According to the constructivist learning theory, these components can help students develop a solid and deep understanding about the concepts and principles learned in the lessons (Alexander, 2006; Azzarito & Ennis, 2003; Vygotsky, 1998). When knowledge is deeply understood and integrated in existing knowledge structure, it is more like to be retained for a long time (Ausubel, 2012).

It is important to acknowledge that students in the experimental group of the current study had only experienced one year (20 lessons, see table 5.1) of SHL curriculum which was designed for sixth graders. The whole SHL curriculum includes two 20 lesson units for each grade to teach and reinforce the knowledge about physical activity and fitness (Ennis, 2015). The content of the curriculum was sequenced using the spiral sequencing structure to ensure solid and deep knowledge learning through repeatedly visiting and revisiting the key facts, concepts, and principles across different lessons and grade (Ennis, 2015). Based on the findings above, it is plausible to conclude that the SHL curriculum works in developing and enhancing middle-school students' knowledge about PA and fitness during the learning experience and long after the learning experience is over.

Curriculum Matters on Out-of-school PA Promotion

Another important finding of this study was that students who had experienced the SHL curriculum spent more time on PA during out-of-school hours than students who had only experienced the traditional PE during middle school. This finding implies that the SHL curriculum is effective to promote middle-school students' out-of-school PA behavior. Sun et al. (2012) have provided strong evidence that curriculum matters in PE to increase students' knowledge learning. The findings of the current study imply that curriculum matters not only in improving students' knowledge learning but also in promoting their out-of-school PA behavior.

In recent years, several PE curriculum models, such as SPARK, Sport Education, and Fitness for Life, have been developed and advocated. The effectiveness of these curriculum models has been documented from many perspectives (e.g., in-class PA promotion, motor skill improvement, and knowledge about sport and game play). But the evidence of the effectiveness of these curriculum models on students' out-of-school PA is scarce. For example, although the SPARK curriculum has been shown to be effective in promoting students' in-class PA level, no significant effects were found for out-of-school PA (Sallis et al., 1997). Studies have shown that sport education is effective to promote students' motor/sport skill competence, game knowledge, and motivation for PE (Hastie, 2012). But it has been shown to have little effect on increasing students' leisure-time PA behavior (Wallhead, Garn, & Vidoni, 2014). Teaching Games for Understanding (TGfU) has been found to be effective in improving students' tactical knowledge and understanding and motor skills (Allison & Thorpe, 1997; Turner & Martinek, 1999). Few studies have examined the influence of TGfU on students' PA behavior (Hastie & Mesquita, 2017).

Among the concept-based curriculum models, Fitness for Life has shown the most potential to influence students' out-of-school PA. Dale and colleagues examined the effects of Fitness for Life curriculum on high school students' PA and sedentary behavior (Dale & Corbin, 2000; Dale et al., 1998).They found that more male students in the Fitness for Life group reported being physically active than those in the traditional PE group and fewer female students in the concept-based PE group were categorized as being sedentary than in the traditional PE group (Dale & Corbin, 2000; Dale et al., 1998). All of these previous findings, coupled with the findings of this study, seem to suggest that the concept-based PE approach—a fitness-oriented PE curricula that focuses on teaching conceptual knowledge about PA and fitness and behavioral skills— may be effective in promoting students' PA behavior outside of the school.

The effectiveness of concept-based PE on promoting out-of-school PA may derive from its focus on knowledge learning. According to the two-pathway model of the "PE effect", knowledge learning in PE can influence students' out-of-school PA through influencing their motivation toward PA (Wang & Chen, 2018). This mediated pathway between knowledge and out-of-school PA has been empirically supported with autonomous motivation toward PA as the mediator (Wang & Chen, 2018).

In this study, I found that students in the concept-based PE group had not only significantly higher knowledge scores, but also significantly higher scores on autonomous motivation toward PA than students in the traditional PE group. Based on the two-pathway model of the "PE effect", it is plausible to argue that the reason that students in the concept-based PE had higher levels of out-of-school PA than students in the traditional PE is perhaps because they possessed more knowledge about PA and fitness, which enabled them to have higher levels of motivation toward PA. The higher motivation level toward PA resulted in the higher out-of-school PA level of students in the concept-based PE group than those in the traditional PE group.

Effects on Autonomous Motivation for PE

In this study, no significant difference was found between students in the concept-based PE group and those in the traditional PE group in terms of autonomous motivation for PE. The concept-based PE curriculum in this study was designed to elicit high levels of autonomous motivation among students, such as the emphasis on learning rationale, opportunities for making task choice, advocacy of mastery rather than competition, and encouragement of cooperative peer communication (Ennis, 2015; Sun et al., 2012). These components have been shown to be effective instructional strategies to increase students' autonomous motivation (Wang, 2017).

The non-significant difference between the two groups may derive from two possible reasons. The first reason could be that students' autonomous motivation for PE only reflects their motivational experience in current PE curriculum. At the time of the data collection, students in the concept-based PE group had been taking the traditional, multi-activity PE curriculum for about 1.5 years. Both groups of the students were taking same type of PE curriculum at the time of the data collection.

The second reason could be that the motivational benefits from the SHL curriculum did not endure 1.5 years later. Su and Reeve (2011) summarized that effective autonomy-supportive teacher interventions should be comprehensive, prolonged, skill-oriented, and multifaceted in training format. They also suggested that to make the intervention benefits endure, supplemental follow-up activities should be included in the intervention. Although the concept-based intervention curriculum incorporated motivation strategies in the design (e.g., situational interest, self-determination, and expectancy-value components), it was not meant to be a motivation intervention curriculum. In other words, the experimental curriculum did not target promoting students' autonomous motivation in PE. There were also no autonomous motivation-focused follow-up activities included in the curriculum intervention. These situations may result in the non-significant difference between the two groups for autonomous motivation for PE. Since this study focused on the 1.5-year long-term effects of the SHL curriculum, future studies should examine the immediate effects of the SHL curriculum on students' autonomous motivation for PE.

Conclusion

This study examined the 1.5-year long-term effect of the SHL curriculum on middle-school students' knowledge, out-of-school PA, and autonomous motivation for PE and PA. The results indicate that students who have experienced the SHL curriculum had higher levels of knowledge about physical activity and fitness, autonomous motivation toward PA, and out-of-school PA than students who had only experienced the traditional multi-activity PE curriculum. This study implies that the concept-based PE curriculum is effective not only in immediate knowledge gain but also in long-term knowledge retention. More importantly, this study indicates that a concept-based PE approach may be an effective curriculum model to promote students' PA behavior outside of the school.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

Conclusions

In this dissertation research, a two-pathway model of the "PE effect" was proposed and tested. Guided by this two-pathway model of the "PE effect", the effects of a concept-based PE curriculum on out-of-school PA was also examined. Specifically, this research was designed to answer two research questions: (a) to what extent did the eighth graders' knowledge and autonomous motivation for PE contribute to their autonomous motivation toward PA and, subsequently, influence their out-of-school PA? (b) Did the eighth-grade students who had experienced the SHL curriculum have higher levels of knowledge, autonomous motivation for PE, autonomous motivation toward PA, and out-of-school PA than those who had not? The following are the major findings.

First, the students' knowledge had a direct effect on their autonomous motivation toward PA and an indirect effect on out-of-school PA through influencing autonomous motivation toward PA. Their autonomous motivation for PE had a direct effect on their autonomous motivation toward PA and an indirect effect on out-of-school PA through influencing autonomous motivation toward PA. These findings indicate that the two-pathway model is tenable in terms of knowledge learning and autonomous motivation in

PE. It implies that teaching knowledge in an autonomy-supportive PE environment may be an effective way to promote students' out-of-school PA behavior.

Second, 1.5 years following the intervention, students who had experienced the SHL curriculum had significantly higher levels of knowledge about PA and fitness, autonomous motivation toward PA, and out-of-school PA than students who had only experienced traditional, multi-activity PE. No significant difference was found between these two groups of students for autonomous motivation for PE. These findings, coupled with previous finding on the effects of the concept-based PE curriculum, indicate that a concept-based PE curriculum is effective not only in immediate knowledge gain but also in long-term knowledge retention. More importantly, the findings of this study indicate that a concept-based PE curriculum is effective to promote students' PA motivation and their PA behavior outside of the school.

Theoretical Implications

This study proposed a general theoretical framework to understand and study the "PE effect". It indicates that the knowledge learning and autonomous motivation promotion in PE could be two effective ways for the "PE effect" to emerge. Specifically, this study indicates that the students' PA motivation is one important mediator of the effects of PE on PA behavior outside of the school. Knowledge learning and autonomous motivation in PE can contribute to out-of-school PA behavior through influencing autonomous motivation toward PA. Findings about the positive effects of the SHL curriculum on students' PA motivation and out-of-school PA behavior further supported the knowledge learning pathway of the "PE effect".

Practical Implications

The research findings of this dissertation study can inform the practice of teaching and learning in PE. Firstly, teaching knowledge about PA and fitness may be an effective way to increase students' PA motivation and out-of-school PA behavior. Secondly, increasing students' autonomous motivation in PE can be another effective way to increase students PA motivation and out-of-school PA behavior. Thirdly, the concept-base PE curriculum is an effective curriculum model to teach middle-school students knowledge about PA and fitness. This curriculum may be taught to promote students' PA motivation and out-of-school PA behavior. Collectively, this study implies that teaching knowledge about PA and fitness in an autonomy-support PE environment could be an effective way to promote students' PA motivation and behavior outside of the school.

Future Research and Recommendations

The findings of this study suggest several potential directions for future research on the "PE effect". This study is an initial attempt to explore the possible pathways to realize the "PE effect". In this study, learning and motivation in PE were proposed to be two pathways to achieve the "PE effect". Learning knowledge about PA and fitness and promoting autonomous motivation in PE have been shown to be tenable sub-pathways to influence students' out-of-school PA.

To further understand the “PE effect”, the following research directions are recommended. First, identify other sub-pathways of learning and motivation in PE that can influence students’ out-of-school PA. Motor skill has been proposed to be another important learning component in PE that has the potential to influence out-of-school PA (Chen & Hancock, 2004). Future studies should examine whether and how motor skills influence students’ out-of-school PA.

In-class PA could be another sub-pathway to influence students’ out-of-school PA. Physical activity is the key component in PE. The types of PA included in PE may influence students’ out-of-school PA. Scholars have suggested that individual sports tend to be more transferable than team sports from PE to out-of-school context because of the degree of convenience and resource requirement to initiate the sport outside of the school (Green, 2014). Other motivational beliefs about PE (e.g., expectancy beliefs, values, attitude toward PE) should also be examined in future studies to further understand the effects of students’ cognitive beliefs about PE on out-of-school PA.

Second, identify salient mediators of the “PE effect”. Both the situational-to-self-initiated motivation model and the trans-contextual model imply that PE does not directly influence student’ out-of-school PA. In this study, autonomous motivation toward PA has been identified as a mediator of the “PE effect”. To further understand the mechanisms of the “PE effect”, other mediators should be examined in future studies which include values of PA, perceived competence toward PA, self-efficacy, attitude toward PA, decisional balance (i.e., pros and cons) about PA, or intention to do PA. It is important to acknowledge that different PE components may have different salient mediators. For example, value of PA or decisional balance of PA may be salient mediators of effects of knowledge learning in PE, while the effect of motor skill learning in PA may be mediated by perceived competence or self-efficacy toward PA. Serial mediators may also exist between PE and out-of-school PA. In other words, some mediators may be the antecedents of other mediators. For example, as suggested by the trans-contextual model attitude toward PA is the antecedent of the intention to do PA (Hagger & Chatzisarantis).

Thirdly, clarify salient pathways through integrating moderators of students' out-of-school PA behavior. Physical activity behaviors are influenced by many factors. To identify the unique contributions of physical education to students' out-of-school PA behavior, other salient factors (moderators) should be controlled. Some salient moderators include gender, ethnicity, social-economic status, community variables (e.g., safety and PA environment), and family variables (e.g., social and physical support for PA).

Limitations

This study provides insights on the "PE effect" and the effects of concept-based approach to PE. But it also has several limitations. First, the sample was not randomly selected. According to the IRB protocol, data was only collected from students who returned both the parent consent and assent forms (45.5% of the total students invited). Readers should be cautious when generalizing the findings. Second, the out-of-school PA time in this study represented the total time student spent on three types of PA: sport, fitness, and other PA such as walk the dog, shopping, or housework. It should be cautious to interpret the out-of-school time in this study as students' voluntary PA time. In addition, readers should be cautious when interpreting the total out-of-school PA time. The out-of-school PA time was measured using the 3-Day PA Recall survey in which students recalled their PA time using a 15-minute block. The absolute out-of-school PA time could be overestimated.

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APPENDIX A

A SAMPLE LESSON PLAN

Cardio Fitness Club - Lesson 12

Lesson Focus: Introduction to The Principle of Overload as Related to Intensity

NC Essential Standard: PE.6.MS.1.1, PE.6.MS1.2, PE.6.MC.2.4, PE.6.HF.3.2, PE.6.PR.4.1, 6.TT.1, 6. Scientific Inquiry.

Essential Question: What physiological changes occur in my body when I increase my physical activity intensity?

Learning Target: I know that when I do more physical activity than I normally do, the Principle of Overload states that my body physiologically adapts (increased blood flow, strengthened muscles, etc.) to increased workloads, improving my health-related fitness.

Rubric:

0	1 - Unsatisfactory	2 – Competent/Satisfactory	3 – Proficient/Outstanding
Student did not dress, participate, or give effort.	Student participated but did not demonstrate an understanding of the Principle of Overload.	Student participated and could explain that the Principle of Overload means that you must do more physical activity than you normally do to increase your fitness level.	Student participated and explained the Principle of Overload as a means of overcoming the body's physiological responses to regular exercise (as your body gets stronger, you must do more to continue to increase your fitness).

Vocabulary

Intensity: The amount of effort or energy expended during a specific activity; how hard a person exercises during physical activity.

Pedometer: An instrument to measure the number of steps taken.

Prediction: To suggest an answer to a scientific question based on research, experience, or previous knowledge.

Physiological Responses: Changes that occur in your body while you exercise that you can feel, observe, and measure. In the short term, these can include sweating, breathing hard, and feeling tired.

Principle of Adaptation: Organisms change to better accommodate new, more stressful environments. Adaptation can occur when we place stress on our bodies. When we exercise, our bodies become stronger to meet the challenge.

The Principle of Overload: A rule that states that to build fitness you must gradually increase your physical activity, doing more than you normally do. Overload can occur by increasing the frequency, intensity, time (duration), and/or type of exercise. Overload is a strategy to improve your body's capacity for exercise by doing more than you have been capable of doing in the past.

Equipment

- One pedometer per student (handed out as they enter the gym)
- Stopwatch, or watch with a second hand
- Pinnies
- Balls (or Frisbees) for "Five Pass" game (can be medium-sized playground balls, team handballs, footballs or basketballs)

Setting

This lesson is easily adapted to an outdoor setting. Large classes that are team taught may choose to have one group in the gym and one group outside. Frisbee and football versions of the Five Pass game may be better in outdoor or larger settings.

ENGAGEMENT (13 min.)

Review

- *For your last homework assignment, what two activities did you perform with your partner?*
- *What two ways did you measure **intensity**? (HR & RPE).*
- *Were you and your partner able to increase your **intensity** the second time you performed the activities?*

- *We will begin with a pulse check to determine our **pre-activity heart rate**. (Ready, Count (6 sec.), Stop, Multiply).*
- Please record your **pre-activity heart rate** in your journal.

Introduction to Pedometers

- *Push the reset button to set your **pedometer t**o zero.*
- *Place it on your waistband directly above your knee.*
- *Look at the picture in your journal if you need help.*
- *The **pedometer** will record the number of steps you take during each activity today.*

Step It Up! (9 min.)

- *In your journal, **predict** the number of steps for each activity you think you will take in 45 seconds*

  - *<u>Line jumps</u> (two-footed jumps over a single line on the floor, or an imaginary line)*
  - *<u>Slides</u> (sideways shuffle from one sideline to the other)*

(The following activities take place as students all move freely in general space):

- *Hops*
- *Skips*
- *Giant steps*
- *Baby steps*
- *Gallops*

- After all 7 predictions are completed, begin with line jumps.
- After 45 seconds have the students stop, record their steps in their journal, reset their pedometer to zero, and prepare for the next activity.
- Complete all seven activities in this fashion.

EXPERIMENT (12 min.)

Five Pass Game

- The goal is to pass the ball/Frisbee five times *consecutively* without it hitting the floor/ground. One point is scored every time five passes are completed.
- Divide the class into small-sided teams (depending on the size of the class and playing area). Multiple games will occur at the same time. One team in each game will wear pinnies.
- Five Pass can be played with a medium-sized playground ball, a team handball, a Frisbee, a football, or a basketball, depending on the setting and the size of the playing area.

- A player may only hold the ball/Frisbee for three seconds, and cannot move (only pivot) while holding it. Defensive players cannot knock the ball/Frisbee from the offensive player's possession, and must stay outside of a "halo" around the player (arm's length).
- All passes must be at least 5 feet. The player may not pass back to the person who passed it to him/her. (For larger teams dictated by class size and available space or when teams are not including all team members in the game, the teacher may choose to require five *different* team members to complete consecutive catches for a point to be scored.)
- If the ball/Frisbee is intercepted or hits the ground/floor (regardless of which team touched it last), there is an automatic change of possession. An interception counts as the first completed pass.
- After a point is scored the opposing team gains possession.

- Students should reset their **pedometers** to zero.

- Encourage students to think about what they can do within the game to increase their number of steps.
- After four minutes, teams rotate to face new opponents.
- After the second four-minute game, lead the students in a **pulse check,** and have them record their **heart rate** and their **step count** in their journals.

EXPLANATION (3 min.)

Think/Pair/Share

- Think: Did you increase your intensity level after each **pedometer** check?
- How did you know when your body was working hard?
- Did you do more physical activity at a higher **intensity** level than you normally do?
- Pair: Compare your responses with the person next to you.
- Share: Can you name the **principle** that describes how your body responds to doing more physical activity than you normally do? (**Overload)**

ELABORATION (4 min.)

- *When you work hard during a cardiorespiratory activity, your body responds by trying to deliver more oxygen to your muscles while removing carbon dioxide quickly so you can continue to play.*
- *What **physiological responses** do you feel and observe in your body when it is **adapting** to vigorous activity? (Respiration increases; body becomes hot; sweating, etc.)*
- *Each time you push your body to work harder it begins to **adapt** to better respond to the stressors.*
- *Your* **respiratory and muscular systems** *adapt to become more efficient so they can deliver and use more oxygen more quickly.*
- *Your **circulatory system adapts** to be able to carry more oxygen to your muscles and remove carbon dioxide faster. Additionally, your muscles adapt to increase their capacity to use oxygen so they can work harder and longer!*
- *If you <u>do more than you normally do each day</u>, your body will **adapt** and you will be better able to perform physical activities without getting tired.*
- *This is called the **Principle of Adaptation.***
- ***Overload** is a **physiological principle** that explains what happens when you <u>add more effort or **intensity**</u> to your normal physical activity plan or routine.*
- *When this happens, your body has to work harder and use more* **calories** *so that it can complete the* ***overloaded*** *activities.*
- *Today we learned about the **Principle of Overload** as it related to **intensity**. The "do more" concept in the **Principle of Overload** also applies to **frequency** or <u>how often</u> you exercise;* ***duration/time*** *or <u>how long</u> you exercise.*
- ***The Principle of Overload** is a very important concept and greatly benefits your body and contributes to your health. <u>Doing more physical activity than you normally do</u> tells your body it needs to get stronger. You feel better and can play and work longer.*

EVALUATION (3 min.)

Working individually, students should complete questions 2-4 in their journals.

Homework:

- *Select 2 physical activities to do at home this evening that will require your body to do more than you normally do.*
- *You might run farther, perform more push-ups or sit-ups, or play longer in a game.*
- *It is okay to be tired – that's when your body begins to **adapt** and you get fitter/stronger.*
- *After completing your physical activities explain the **Principles of Adaptation and Overload** to a family member.*

APPENDIX B

A SAMPLE PAGE FROM THE WORKBOOK

Cardio Fitness Club - Lesson 12 Journal

1. Record your **pre-activity heart rate**: ______________________________________

Table 1

Activity	Predicted # of Steps in 45 seconds	Actual # of Steps
Line jumps		
Slides (side shuffles)		
Hops		
Skips		
Giant steps		
Baby steps		
Gallops		

2. Record your post-activity **heart rate** after the Five Pass game: ___________________.

3. Record the **number of steps** taken in the Five Pass game: ______________________________.

4. Think about the **Principle of Overload**. Think about how your body systems will change and adapt if you continue to exercise. Write 3 sentences explaining the **physiological responses** that occurred in your body during the activities today. What **physiological responses** occurred as your step count increased?

APPENDIX C

SEM ANALYSIS RESULTS WITHOUT OUTLIERS

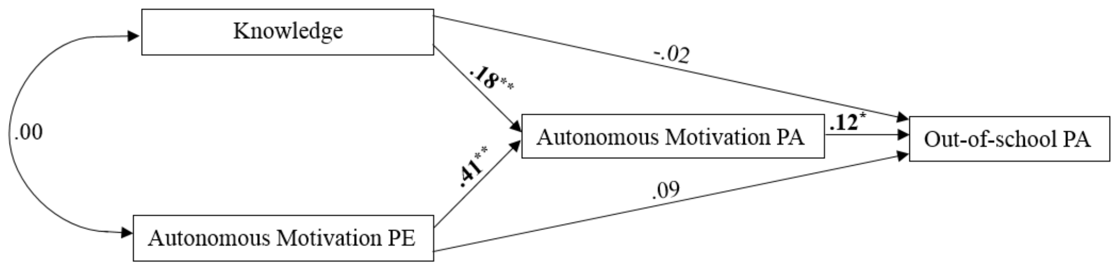

Figure 6.1. The SEM Results of the *a priori* Model (without outliers). PE: Physical education; PA: Physical activity; * p<.05; ** p<.01

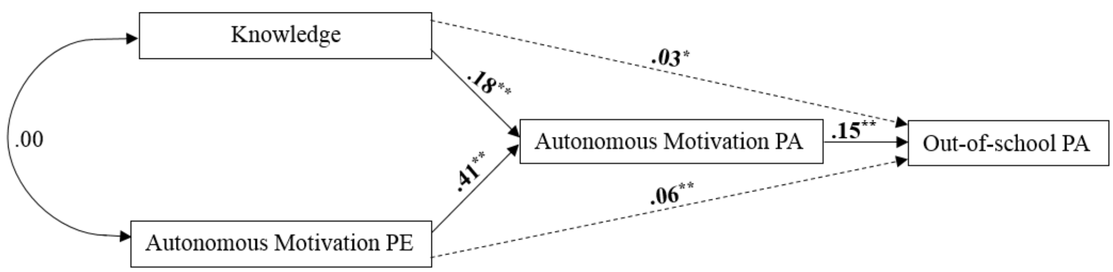

Figure 7.1. The SEM Results of the Parsimonious Model (without outliers). Solid lines signify direct effect paths; broken lines indirect effect paths. PE: Physical education; PA: Physical activity; path coefficients are standardized coefficients; * p<.05; ** p<.01; Fit indices: χ^2= 3.04, df = 2, p =.25; RMSEA= .036; CFI=.99; SRMR=.026.

APPENDIX D

BEHAVIORAL REGULATION IN EXERCISE QUESTIONNAIRE

Now read the sentence below carefully and think about yourself. Circle the number that best fit your feeling about Exercise.
WHY DO YOU ENGAGE IN EXERCISE?

		Not true		Sometimes		Very true
1	I exercise because other people say I should	0	1	2	3	4
2	It's important to me to exercise regularly	0	1	2	3	4
3	I find exercise a pleasurable activity	0	1	2	3	4
4	I exercise because family/friends/teacher will not be pleased with me if I don't	0	1	2	3	4
5	I value the benefits of exercise	0	1	2	3	4
6	I exercise because it's fun	0	1	2	3	4
7	I feel under pressure from my friends/family/teacher to exercise	0	1	2	3	4
8	I enjoy my exercise sessions	0	1	2	3	4
9	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
10	I feel guilty when I don't exercise	0	1	2	3	4
11	I think it is important to make effort to exercise regularly	0	1	2	3	4
12	I take part in exercise because my friends/family/teacher say I should	0	1	2	3	4

		Not true		Sometimes		Very true
13	I get restless if I don't exercise regularly	0	1	2	3	4
14	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
15	I feel ashamed when I miss an exercise session	0	1	2	3	4

APPENDIX E

OUT-OF-SCHOOL PHYSICAL ACTIVITY RECALL SURVEY

After-School Physical Activity Survey

INSTRUCTION: The following table divides each hour from 3:00 p.m. to 10:00 p.m. into four 15-minute boxes. You task is to think about what you did yesterday during this time and fill in each 15-minute box with the activities listed below. If you did not do any of the activities during a 15-minute period, write "none" in that box. You can use a line to show the same activity you did in more than one 15 minute period. Do not leave any boxes blank.

IMPORTANT: Please complete the form now. Otherwise you will have to sit with the UMD data collector in your next physical education class to fill out the form together.

EXAMPLE:

3:00-3:15 p.m.	3:16-3:30 p.m.	3:31-3:45 p.m.	3:46-4:00 p.m.
Walking home	*Nap*	*Homework*----------	-------------------

TIP: You can do this quickly if you ask your parents (or someone who looked after you yesterday afternoon) to help you.

Print: Name ___________________________________School ______________________________

Grade:________________ Age:________ Gender (circle one): Boy / Girl Date:______/______/______

Activities: (Read First)						
	Eating	Reading	Baseball	Dance	Hockey	Swimming
	Homework	Sleeping	Basketball	Football	Karate	Tennis
	Napping	TV	Bike	Golf	Ping pong	Volleyball
	On bus/car	Badminton	Bowling	Gymnastics	Running	Walking

3:00 - 3:15 p.m.	3:16 - 3:30 p.m.	3:31 - 3:45 p.m.	3:46 - 4:00 p.m.
4:00 - 4:15 p.m.	4:16 - 4:30 p.m.	4:31 - 4:45 p.m.	4:46 - 5:00 p.m.
5:00 - 5:15 p.m.	5:16 - 5:30 p.m.	5:31 - 5:45 p.m.	5:46 - 6:00 p.m.
6:00 - 6:15 p.m.	6:16 - 6:30 p.m.	6:31 - 6:45 p.m.	6:46 - 7:00 p.m.
7:00 - 7:15 p.m.	7:16 - 7:30 p.m.	7:31 - 7:45 p.m.	7:46 - 8:00 p.m.
8:00 - 8:15 p.m.	8:16 - 8:30 p.m.	8:31 - 8:45 p.m.	8:46 - 9:00 p.m.
9:00 - 9:15 p.m.	9:16 - 9:30 p.m.	9:31 - 9:45 p.m.	9:46 - 10:00 p.m.

APPENDIX F

CODING SHEET OF 3DPAR SURVEY

After-School Activity Codes

Old Code	New Code	Activity	Old Code	New Code	Activity	Old Code	New Code	Activity
1	1	Basketball	22	2	Exercise	43	4	Drawing
2	3	Dance	23	3	Skateboarding	44	7	Church
3	2	Bike	24	5	Napping	45	1	Karate
4	1	Football	25	3	Throwing/catching	46	1	Baseball/softball
5	4	Reading	26	2	Walking	47	2	Stretching
6	2	Running	27	1	Volleyball	48	2	Sit-up
7	6	Watching TV	28	3	Shopping	49	2	Fitness
8	5	Eating	29	3	Kickball	50	1	Ping pong
9	5	Sleeping	30	2	Climbing	51	3	Trampoline
10	4	On bus	31	2	Pushup	52	5	Cooking
11	4	Homework	32	4	Music instrument	53	1	Hockey
12	6	Listen to the music	33	3	Soccer	54	7	Horse riding
13	7	Scooter	34	1	Badminton	55	6	Magic smart youth
14	7	Phone	35	1	Tennis	56	6	Baby-sitting
15	6	Games	36	6	Taps	57	1	Lacrosse
16	5	Shower	37	6	Wall ball	58	1	Golf
17	7	Chatting/family time	38	1	Tae Kwon Do	59	4	Drama practice
18	1	Gymnastics	39	1	Swimming	60	7	Hanging out with friends
19	6	Playing cards	40	3	Chore/yard work	61	4	Choir
20	2	Jumping rope	41	6	Video game	62	7	After-school activity
21	6	Computer	42	6	Party	63	6	Circus
						64	2	Step

SPSS Recode: 1 = Sport 2 = Fitness 3 = Other Physical Activity 4 = Sedentary – Academic 5 = Rest
6 = Sedentary – Entertainment 7 = Sedentary – Socializing

APPENDIX G

PERCEIVED LOCUS OF CAUSALITY SCALE

Now read the sentence below carefully and think about yourself. Circle the number that best fit your feeling about Physical Education (PE).
Why Do You Participate In PE?

0= Not at all true for me	2= Sometimes true for me	4= Most times true for me	6= Absolutely true for me

1	Because it is important to me to do well in PE	0	1	2	3	4	5	6
2	Because in this way I will not get a low grade	0	1	2	3	4	5	6
3	Because PE is enjoyable	0	1	2	3	4	5	6
4	Because it is important to me to improve in the drills we do in PE	0	1	2	3	4	5	6
5	Because PE is exciting	0	1	2	3	4	5	6
6	So that the teacher won’t yell at me	0	1	2	3	4	5	6
7	Because it would bother me if I didn’t	0	1	2	3	4	5	6
8	Because it is important to me to be good in the sports we practice in PE	0	1	2	3	4	5	6
9	Because that’s the rule	0	1	2	3	4	5	6
10	Because it is important to me to try in PE	0	1	2	3	4	5	6

	0= Not at all true for me		2= Sometimes true for me		4= Most times true for me		6= Absolutely true for me
11	Because I would feel bad if the teacher thought that I am not good at PE	0	1	2	3	4	5	6
12	Because I enjoy learning new skills	0	1	2	3	4	5	6
13	Because I would feel bad about myself if I didn’t	0	1	2	3	4	5	6
14	Because PE is fun	0	1	2	3	4	5	6
15	Because I would feel bad if the other students thought that I am not good at PE	0	1	2	3	4	5	6

APPENDIX H

KNOWLEDGE TEST

Knowledge Test Questions

1. Regularly exercising at an overload pace makes my body become used to that level of work, which is called:
    - □ rate of exertion □ physiological adaptation
    - □ intensity □ circulation
2. An application of the principle of progression applied to pushups can be:
    - □ from regular pushup to wall pushup to knee pushup
    - □ from wall pushup to knee pushup to regular pushup
    - □ from knee pushup to regular pushup to wall pushup
    - □ pushups performed in a random order
3. When I do 36 situps in a row, I am demonstrating:
    - □ cardiorespiratory fitness □ muscular strength
    - □ muscular endurance □ flexibility
4. In static stretching, I can increase my flexibility by reaching-and-holding the stretch to the point where:
    - □ I can no longer go further. □ I can easily move my body back and forth
    - □ I don’t feel tension in my muscle □ I feel a slight pain in my muscle
5. One short term benefit of exercise can be:
    - □ increased energy □ immediate enlargement of muscles
    - □ muscle soreness □ better sleep after a workout
6. Physical activity in which the body can supply adequate oxygen to allow performance to continue for long periods of time is called:
    - □ aerobic activity □ anaerobic activity
    - □ rate of perceived exertion □ fast contractions
7. The formula to calculate my maximum heart rate is 220 minus ___
    - □ my height in inches □ my weight in pounds
    - □ my grade in school □ my age
8. I can measure my exercise intensity using my ___
    - □ Heart rate □ Time □ Steps □ Fitness level
9. To allow yourself to recover from muscular strength exercises, you should exercise the same muscle group
    - □ everyday □ every other week □ twice a day □ every other day
10. To receive optimal benefits, I must exercise at an intensity my heart rate is at
    - □ 100% of the maximum heart rate □ 50% - 85% of the maximum heart rate
    - □ 3220 beats per minute □ the resting heart rate
11. A SMART goal strategy that enhances my self-esteem is to __

□ break long-term goals into specific short-term goals.
□ add many short-term goals to achieve at once.
□ think about success all the time.
□ win at all costs.

12. When I reach a fitness goal, I should overcome the principle of adaptation using the ______.
□ principle of specificity □ principle of progressive overload
□ principle of adaptation □ principle of recovery

13. I know I am working at a high rate of intensity when my heart rate
□ does not change. □ goes up. □ comes down.

14. Application of the Overload Principle involves an increase in
□ physical activity or exercise above what I normally do.
□ improvement I would normally expect.
□ the changes that normally occur in my body.
□ the negative effects that occur in my body.

15. The principle that states that to improve fitness, I need to do more physical activity than I normally do is called
□ principle of progression □ principle of specificity
□ principle of overload □ principle of determination

16. Which of the following activities will produce high intensity measured in heart rate?
□ Capture the Flag game □ sit-and-reach exercise
□ volleyball bumps □ butterfly stretches

17. The Principle of Progressive Overload states that to increase my fitness, I need to
□ workout only the muscles I want to strengthen
□ workout every day
□ gradually increase how hard I work
□ overload my body until I am completely exhausted

18. The Principle that states that you must overload a specific body system (cardiorespiratory, for example) or muscle group to improve the performance of that targeted body system or muscle group is
□ Principle of progression □ Principle of specificity
□ Principle of overload □ Principle of determination

19. If I want to strengthen my upper body, one of the best exercise I could choose is
□ jump rope □ situps □ shoulder stretches □ medicine ball toss

20. If I want to strengthen my cardio-respiratory capacity, I need to
□ jump rope □ situps □ shoulder stretches □ pushups

21. Lifting a heavy medicine ball that I can lift only once is an example of
□ cardiorespiratory fitness □ muscular strength
□ muscular endurance □ flexibility

22. The ability to move a joint through a sufficient range of motion is called
□ cardiorespiratory fitness □ muscular strength
□ muscular endurance □ flexibility

23 To enhance my physical fitness, I need to increase my

□ exercise time □ hours of resting □ calories in diet □ time watching TV

24. I should participate in physical activity each day for

□ random time □ 60 minutes □ 15 minutes □ 5 minutes

25. One long term benefit of regular exercise is to

□ live forever □ avoid all diseases □ control body weight □ play pro sports

APPENDIX I

IRB APPROVED LETTER, CONSENT AND ASSET FORMS

THE UNIVERSITY *of* NORTH CAROLINA
GREENSBORO

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To: Yubing Wang
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2312 Golden Gate Dr., Apt. E, Greensboro, NC 27405

From: UNCG IRB

Authorized signature on behalf of IRB

Approval Date: 10/31/2017
Expiration Date of Approval: 10/30/2018

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Submission Type: Initial
Expedited Category: 7.Surveys/interviews/focus groups
Study #: 17-0488
Study Title: Effects of the Concept-Based Physical Education on Middle School Students' After-School Physical Activity

This submission has been approved by the IRB for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Study Description:

The purpose of this study is to identify whether eighth grade students who have taken the concept-based physical education curriculum have higher level of knowledge about physical activity, motivation toward physical education and physical activity, and after-school physical activity behavior. In this study, I will also determine the relationship between students' knowledge, motivation toward physical education, motivation toward physical activity, and after-school physical activity behavior.

Study Regulatory and other findings:

- This research, which involves children, meets criteria at 45 CFR 46.404 (research involving no greater than minimal risk). Permission of one parent or guardian is sufficient.
- If your study is contingent upon approval from another site (school district), you will need to submit a modification at the time you receive that approval.

Investigator's Responsibilities

Signed letters, along with stamped copies of consent forms and other recruitment materials will be scanned to you in a separate email. **Stamped consent forms must be used unless the IRB has given you approval to waive this requirement.** Please notify the ORI office immediately if you have an issue with the stamped consents forms.

Please be aware that valid human subjects training and signed statements of confidentiality for all members of research team need to be kept on file with the lead investigator. Please note that you will also need to remain in compliance with the university "Access To and Retention of Research Data" Policy which can be found :http://policy.uncg.edu/university-policies/research_data/.

CC:
Ang Chen, Kinesiology, Dept of

page 1 of 1

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT FOR A MINOR TO ACT AS A HUMAN PARTICIPANT

Project Title: Effects of the Concept-Based Physical Education on Middle School Students' After-School Physical Activity

Principle Investigator: Yubing Wang
Faculty Advisor: Dr. Ang Chen

Participant's Name:_______________

What is the study about?

The purpose of this study is to assess whether prior learning experience in physical education will still have impact on eight grade students' knowledge about exercise and fitness, motivation for physical education, motivation toward exercise, and after-school physical activity. This study is a dissertation study in University of North Carolina at Greensboro. This study is not sponsored by the school district. Your child's participation is voluntary.

Why are you asking my child?

As an eighth grade student, your child and all his/her classmates in his/her school and in other five middle schools are invited to participate.

What will you ask my child to do if I agree to let him or her participate in the study?

As a participant, your child will be asked to respond to four short paper-pencil surveys: one knowledge test about exercise and fitness, one motivation survey for physical education, one motivation survey for exercise, one physical activity recall survey. During the physical education class time, approximately 20 minutes will be allocated for responding to the knowledge test, 10 minutes for motivation survey for physical education, 10 minutes for motivation survey for exercise survey, 15 minutes for physical activity recall survey. Physical activity recall survey will be administered three times on three different school days. No stress, pain (physical, psychological, or emotional), or any other unpleasant reaction will be caused by completing these surveys.

What are the dangers to my child?

The Institutional Review Board at the University of North Carolina at Greensboro has determined that participation in this study poses minimal risk to participants. Your child's decision to participate will not affect his/her grades at the school. You child may spend 10-20 minutes of six physical education class time to complete the surveys. The specific survey time will be discussed with their PE teacher to minimize the interruption of the lesson plan.

If you have any concerns about your child's right, how they are being treated or if you have questions or other information or have suggestions, please contact the Office of Research Integrity at UNCG at (855)-251-2351. Questions about this project or benefits or risks associated with being in this study can be answered by Dr. Ang Chen or Yubing Wang who can be contacted at (336)-500-9555 (or email: y_wang27@uncg.edu/a_chen@uncg.edu).

Are there any benefits to my child as a result of participation in this research study?

There are no direct benefits for participating in this research study.

UNCG IRB
Approved Consent Form
Valid from:

10/31/17 to 10/30/18

Are there any benefits to society as a result of my child taking part in this research?

Implications of the findings pertinent to effects of physical education will be synthesized and shared with participating teachers, Guilford County Schools (GCS), Asheboro City Schools (ACS), and researchers/practitioners in physical education and education. Results may inform professional educators and schools about the effect of current physical education for future improvement.

Will my child get paid for being in the study? Will it cost me anything for my kid to be in this study?

There are no costs to you or payments to you or your child as a result of participation in this study.

How will my child's information be kept confidential?

All information obtained in this study is strictly confidential unless disclosure is required by law. Identification numbers, rather than personal information, will be assigned to each student participant and used throughout the research to protect privacy. All collected data will be stored in a locked file cabinet in the Pedagogical Kinesiology Laboratory at UNCG. The electronic data will be kept in a password protected data computer on campus with access only to the researchers. All the data will be de-identified when disseminated.

What if my child wants to leave the study or I want him/her to leave the study?

You have the right to refuse to allow your child to participate or to withdraw him or her at any time, without penalty. If your child does withdraw, it will not affect you or your child in any way. If you or your child chooses to withdraw, you may request any data that has been collected be destroyed unless it is in a de-identifiable state.

What about new information/changes in the study?

If significant new information relating to the study becomes available which may relate to your willingness about your child's continual participation, this information will be provided to you.

Voluntary Consent by Participant:

By signing this consent form, you are agreeing that you have read the information provided above or it has been read to you, you fully understand the contents of this document and consent to your child taking part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are the legal parent or guardian of the child who wishes to participate in this study described to you by Mr. Yubing Wang.

Participant's Parent/Legal Guardian's Signature:______________________

Date:______________________

UNCG IRB
Approved Consent Form
Valid from:

10/31/17 to 10/30/18

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

ASSENT FORM TO ACT AS A HUMAN PARTICIPANT

Study Title: Effects of the Concept-Based Physical Education on Middle school Students' After-School Physical Activity

My name is Yubing Wang

What is this about?

I am a graduate student at UNCG. As an assignment, I would like to do a study about eight graders' knowledge about exercise and fitness, motivation for physical education and exercise, and physical activity.

Did my parents say it was ok?

Your parents said it was ok for you to be in this study and have signed a form like this one.

Why me?

We would like you to take part because your class is one of those eighth grade classes that are selected to participate in this project. All your classmates have been invited to participate in the study, too.

What if I want to stop?

You do not have to say "yes", if you do not want to take part. You will not be punished if you say "no". It will not affect your grades or standing at the school. Even if you say "yes" now and change your mind later, you still can stop. You will not be punished and no one will be mad at you.

What will I have to do?

As a participant, you will be asked to respond to one knowledge test and three surveys.

Will anything bad happen to me?

There is nothing bad that will happen to you.

Will anything good happen to me?

You will have the opportunities to think about your knowledge about exercise and fitness and its benefits. It may benefit you to use the knowledge in making healthful behavioral decisions.

Do I get anything for being in this study?

No incentives will be given to you directly.

What if I have questions?

You are free to ask questions at any time.

If you understand this study and want to be in it, please write your name below.

Your name:____________________________________

Your signature:________________________________

Date:_________________________

UNCG IRB
Approved Consent Form
Valid from:

10/31/17 to 10/30/18

APPENDIX J

OFFICIAL APPROVAL LETTER FROM GCS AND ACS

Guilford County Schools

November 22, 2017

Yubing Wang
2312 Golden Gate Drive #E
Greensboro, NC 27405

Re: 171818

Dear Yubing Wang:

I am pleased to inform you that the Guilford County Schools Research Review committee has concluded that your proposal *Effects of Concept-Based Physical Education on Middle School Students' After-School Physical Activity* meets the requirements of state legislation and the current research policy of Guilford County Schools. This decision does not constitute an establishment of a joint research program between the researcher or university and Guilford County Schools.

Committee approval does not guarantee access to schools or to individuals, nor does it imply that a study can or will be conducted. School principals make the final decision regarding the participation of their school in the research. Students/parents decide independently whether they wish to participate and they may withdraw at any time. The committee expects that the identities of individuals, the school, and the district will remain anonymous throughout all stages of the project.

Please present this letter upon initial contact with principals. Thank you.

Sincerely,

CGilbert

Carolyn Gilbert, Ph.D.
Chair, Research Review Committee

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Asheboro
CITY SCHOOLS
A learning community of excellence!

Curriculum and Instruction
Dr. Aaron Woody, Assistant Superintendent

1126 South Park Street
Asheboro, NC 27203
Phone 336.625.5104
Fax 336.625.9238
awoody@asheboro.k12.nc.us

November 27, 2017

The Office of Research Integrity
The University of North Carolina at Greensboro
2714 MHRA Building, 1111 Spring Garden Street
Greensboro, NC 27412

To Whom It May Concern:

As Assistant Superintendent of Curriculum and Instruction with Asheboro Schools, I, Dr. Aaron Woody, have reviewed Mr. Yubing Wang's proposal for a research study titled *Effects of the Concept-Based Physical Education on Middle School Students' After-School Physical Activity*. I am aware of the research purpose, timeline, and data collection and analysis procedures. Demands on student and teacher time have also been made clear. This letter states that Mr. Wang has the approval of Asheboro City Schools to conduct the research study for his dissertation work at the University of North Carolina at Greensboro (UNCG) and any publications that may result from that work. I understand the project proposal will be reviewed and approved by the UNCG Institutional Review Board for Research prior to data collection.

If you need further information regarding support of this project please contact me at awoody@asheboro.k12.nc.us.

Sincerely,

Aaron M. Woody

Dr. Aaron Woody
Assistant Superintendent of Curriculum and Instruction
Asheboro City Schools