Fitness-Specific Epistemic Beliefs, Effort Regulation, Outcomes, and Indices of Motivation in High School Physical Education

by Ken R. Lodewyk, Brock University, Canada and Zan Gao, University of Minnesota

Abstract

Epistemic beliefs are deeply held convictions about the nature of knowledge, knowing, and learning. In this study, approximately 500 ninth and tenth-grade physical education (PE) students completed fitness-specific measures assessing their epistemic beliefs in the simplicity and stability of knowledge and the speed of its acquisition along with their effort regulation, fitness outcomes (grade, level, and frequency), and indices of fitness motivation (goal orientation, value, perceived autonomy support). Participants completed three surveys during their regular PE class. Exploratory and confirmatory factor analyses revealed two reliable epistemic belief factors similar to those previously reported in PE (the simple-integration of fitness knowledge; stable-and-useless fitness knowledge). This provided some support for the generality of epistemic beliefs across PE and fitness. As expected, epistemic beliefs related negatively to indices of motivation and effort regulation. An intrinsic goal orientation and a view for the simplicity of fitness knowledge predicted fitness outcome and a statistically significant pathway was observed from simple and stable epistemic beliefs and indices of motivation to fitness outcomes through effort regulation. The study provides particular fresh insights into the nature of epistemic beliefs, their relations to effort regulation and indices of motivation, and their potential influence on fitness outcomes in PE and beyond.

Keywords: adolescents, exercise, goal orientation, path analysis

Compared to most educational domains, physical education (PE) has a rather distinct and interrelated body of knowledge (e.g., biology, exercise physiology, fitness, psychology, dance, biomechanics) and ways of knowing that includes important knowing-related experiences like sensory-motor experiences and conceptual operations (Welk, Eisenmann, & Dollman, 2006). Such knowledge is reflective of what PE experts assert as important for students to master in order to meet the recommended knowledge, skills, and dispositions to be optimally active and healthy for life (National Association for Sport and Physical Education [NASPE], 2004). Fitness is defined as maintaining a lifestyle of capable performance in moderate-to-vigorous physical activity without experiencing unwarranted fatigue (America College of Sport Medicine [ACSM], 1998). The development of fitness knowledge, attitudes, and requisite physically active lifestyles for improved health (e.g., body composition, cardiorespiratory endurance, muscular strength and endurance, and muscular flexibility) remains a key curricular aim of most school PE programs (Harris, 2005; NASPE, 2004; Welk et al., 2006) including those in Canada (Lorusso, Francis, & Kilborne, 2013). Despite this aim, too few middle and secondary students enrolled in PE, are motivated for PE, or meet recommended physical activity levels in PE (Barr-Anderson, Young, Sallis, et al. 2008; Ridgers, Fazey, & Fairclough, 2007). This may be partially due to their negative fitness experiences during PE (Cale & Harris, 2009).

PE and classroom-based research has reported positive associations between epistemic beliefs – deeply held convictions about the nature of knowledge, knowing, and learning – and less availing motivation, strategic learning, and indices of achievement (Buehl & Alexander, 2005; Cothran & Kulinna, 2006; Hare & Graber, 2000; Lodewyk, 2009; Paulsen & Feldman, 1999). While it is clear that students need motivating fitness experiences in PE (Wallhead & Buckworth, 2004) and should learn the principles and benefits of fitness (Dodds, Griffin, & Placek, 2001; McKenzie, 2003), little is known about how students' epistemic beliefs might align with their fitness-specific motivation, effort, and outcomes during PE and beyond. For example, how might believing that fitness knowledge is ambiguous and unrelated to health, PE, and other academic domains relate to students' motivation, effort, and performance? Such transactional epistemic beliefs and indices of motivation-behavioral investigation of both PE and fitness in PE has lagged behind other academic content areas like science and mathematics, and is also warranted because epistemic and motivational beliefs collectively exert their positive or negative effects rather synergistically (Hofer, 2001; Solmon, 2006). Hence, this study investigates the relations between fitness-specific epistemic beliefs, effort regulation, outcomes, and indices of motivation in a high school PE setting.

Cognitive mediation theory undergirds the study (Doyle, 1997). It stems from social cognitive theory (Bandura, 1986) proposing that learners are self-regulating agents who continually respond to the reciprocal interaction of personal, social, and environmental factors on behavioural outcomes. In other words, an individual's thoughts and behaviors are highly influenced by memory systems and methods that individuals use to exercise self-regulated control over their behaviors and environment. More specifically, cognitive mediation posits that mental learning processes such as cognitive beliefs, motivation, and use of strategies influence academic learning and mediate instruction with student achievement (Solmon & Lee, 1997). Classroom-based research has supported the cognitive mediation theory by reporting, for example, positive associations between the epistemic convictions and a non-availing motivational and achievement profile that includes lower levels of academic performance, motivation (i.e., self-efficacy, task values, intrinsic motivation), problem-solving, comprehension, conceptual change, reflective judgments, and use of learning strategies such as elaboration (e.g., Buehl & Alexander, 2005; Paulsen & Feldman, 1999). In PE, cognitive processes like self-regulation, attention-confidence, willingness to engage, and use of learning strategies, relate more to a mastery (task) goal orientation and to attributing success to motivation and effort (Solmon & Lee, 1997).

Epistemic Beliefs

Epistemic beliefs are personal convictions about the nature,

sources, and limits of knowledge (Hofer, 2001). Educational research supports four dimensions of students' epistemic beliefs; namely, the source, simplicity, and stability of knowledge, and the speed of its acquisition (for a review, see Bendixen & Feucht, 2010). The source of knowledge reflects how much a learner believes that knowledge is self, or socially-constructed, rather than passed down from authoritative sources, such as books or experts like teachers or coaches. Individuals can believe that knowledge is more-or-less simple (made up of easily understood isolated facts) or complex (comprising ambiguous, difficult, and interrelated concepts). To illustrate, a student who believes in the simple-integration of fitness knowledge views relevant information and understanding as relatively isolated from concepts, activities, and information in other courses (e.g., math, science) or disciplines in PE (e.g., dance, games). Stable knowledge reflects the view that knowledge is rather unchanging, certain, inflexible, or absolute rather than adaptable, relative, or evidence-based. Finally, learners can believe more or less that the knowledge can be accrued quickly or not at all. Although not necessarily in a linear pattern, epistemic beliefs tend to mature with age, especially during high school (Schommer, 1993). They progress from a rather dualistic perspective (e.g., knowledge as absolute and/or simple), through a relativistic or highly individualistic phase, to what is considered a more reasoned capacity to evaluate, synthesize, and justify numerous conflicting viewpoints according to context (Hofer, 2001). For example, students' with more advanced epistemic beliefs about fitness would understand the complexity and interrelated nature of an issue or concept, such as weight control and formulate judgments and opinions that are reasoned and justified while appropriately accounting for emotion, culture, and alternative views.

A few studies have investigated epistemic beliefs in PE. Cothran and Kulinna (2006) reported that middle school students with higher beliefs in the source and stability (see the aforementioned explanations of these) of knowledge in PE were more skeptical about the worthiness of the teacher using indirect teaching strategies like peer and inquiry-based styles, and were more prone to relying on the teacher as the sole source of knowledge. Lodewyk (2009) found that a belief in simple knowledge can stifle learners' critical outcomes with learning tasks in PE that often require them to think, move, relate to others, and apply knowledge from several domains (e.g., science, mathematics, psychology) and disciplines (e.g., fitness, dance, games). Hare and Graber (2000) also suggested that such misconceptions about the simplicity of knowledge in PE relate to students' level of motor skill and strategic outcomes with different tasks in PE. These and other researchers (Bendixen & Feucht, 2010; Solmon, 2006) have welcomed more study into the nature of epistemic beliefs in more fine-grained PE settings such as fitness.

Despite the noted importance of knowledge in PE disciplines like fitness, the only known epistemic belief studies relative to fitness in a PE setting are by Placek et al. (2001) and Bonello (2008) who qualitatively examined the naivety of middle-school students' mental conceptions and models of physical changes through fitness. Placek et al. (2001) found that the fitness conceptions reflected an incomplete understanding of the types, purpose, and principles of fitness, and that students generally equated fitness with looking good and being thin. Bonello (2008) indicated that students' fitness explanations were generally diverse, integrated, evolving, and reflective of the complexity of the fitness concept, and were highly influenced by contextual factors such as the teacher's values and beliefs. Little is known about how epistemic beliefs relate to motivational beliefs, learning strategies like effort regulation, and outcomes like outcomes in a fitness setting.

Indices of Motivation

Since motivation is a signal of one's motives or will to perform (Bandura, 1986), indices of motivation for this study are constructs with consistently significant positive associations to an enhanced will and successful performance of fitness outcomes in PE. The three used in this study are goal orientation, task value, and perceived autonomy support. Students with such an intrinsic goal orientation in PE are more prone to strive to demonstrate ability and the attainment of goals aligned more with mastery, learning, improvement, understanding, and effort as an end (intrinsic value) in itself. Conversely, extrinsically goal-oriented individuals in PE strive more for goals aligned with outward (performance) incentives such as grades, praise or recognition from others, appearance, and surpassing others (Ommundsen, 2004). Duncan and McKeachie (2005) reported that the extrinsic and intrinsic goal orientation corresponds closely to the ego and task oriented goal orientation (Xiang, Chen, & Bruene, 2005). Task values refer to students' perceptions of interest, use, and importance towards a learning task (Pintrich, Smith, Garcia, & McKeachie, 1991). Finally, perceived autonomy support refers to one's feelings of support, choice, guidance, and autonomy by significant others (e.g., teachers) in their lives (Ntoumanis, 2005). While each aligns with cognitive mediation theory (Doyle, 1997), goal orientations and task value have strong roots in social cognitive theory (Bandura, 1986) whereas perceived autonomy support originated from self-determination theory (Deci & Ryan, 2002). For example, perceived autonomy support contributes to the explanation of achievement within self-determination theory primarily through an intrinsic need to actualize personal potential and through positive experiences of competence, autonomy, and relatedness.

Each of these indices of motivation has been consistently and empirically linked to each other, positive fitness outcomes, and a host of fitness-achievement factors. To illustrate, since goals prompt students to organize their volition in order to meet those goals, goal orientation is an important determinant of successful cognitive mediation through its association to a deeper approach to studying (Ferrer-Caja & Weiss, 2000). In other words, students who tend to pursue goals that are more intrinsic tend to put forth the necessary strategic and purposeful effect to accomplish those goals (Pintrich, Marx, & Boyle, 1993). Although intrinsic goal orientation has been more highly associated with learning in PE, both intrinsic and extrinsic goal orientations can be considered availing especially if the motivational climate of the class is mastery-oriented (Chen & Ennis, 2004). In regards to task value, although related to achievement in PE (Zhang, Solmon, & Gu, 2012), task values have more strongly predicted achievement-related learning constructs such as individuals' task choice, intentions, effort, and persistence in PE and physical activity during and out of school (Gao, Newton, & Carson, 2008). In relating task values to fitness knowledge, Chen and Chen (2012) found that high

school students lacked conceptual knowledge about health-fitness and a deep understanding of its relevance and application to their lifestyles. They attributed this in part to students' lack of value for the knowledge and reported links between task values and in-class physical activity. Among many correlates of students' perceived autonomy support from teachers, researchers have noted particular links to need satisfaction, value beliefs, self-efficacy, persistence/effort, concentration, autonomous motivation, and being more physically active in school and in early adulthood (Haerens et al., 2010; Ntoumanis, 2005; Zhang et al., 2012). Little is known about how adolescent students' indices of motivation relate to their epistemic beliefs in conjunction with their effort regulation and fitness outcomes in a fitness setting.

Effort Regulation

Effort regulation during learning – defined as strategically managing attention, persistence, and the overcoming of obstacles such as competing distractions, disinterest, and boredom in the pursuit of particular goals – has been effectively measured using self-report survey items (Pintrich et al., 1991). Regulating effort is a critical indicator of motivation and self-regulated learning particularly through its mediation of understanding, learning, and achievement in academic settings (Duncan & McKeachie, 2005). Effort regulation has been associated with improved performance in PE (Luke & Hardy, 1999; Solmon & Lee, 1997) and fitness (Vansteenkiste, Simons, Soenens, & Lens, 2004). It has also been linked to mastery and performance-approach goals in high school PE (Agbuga & Xiang, 2008), availing learning strategies (elaboration and help seeking), and believing that ability is alterable or learned rather than inflexible (Ommundsen, 2003). More needs to be discovered about the path relations between students underlying fitness-specific epistemic beliefs, effort regulation, indices of motivation, and their performance in a fitness setting. Such understanding would help researchers and practitioners to account for such constructs when designing interventions to improve students' outcomes in fitness.

Objectives

There were four specific objectives and corresponding hypotheses for this study. First, the factor structure of epistemic beliefs about fitness was determined. Underlying worldview-like epistemic beliefs tend to remain consistent across domains, whereas other epistemic beliefs, including the belief in simple and stable knowledge, differ between domains such as math, science, social studies, history, and psychology (Bendixen & Feucht, 2010; Buehl & Alexander, 2005; Buehl, Alexander, & Murphy, 2002). These domain differences may be explained in part by variant structure of these domains or the specificity of the measures being used. For example, math and physics domains tend to rely on more algorithmic or computational procedures compared to less-structured domains like history and science which may require more use of critical thinking processes (Buehl et al., 2002; Hofer, 2002). Since the structure and importance of knowledge and learning in fitness as a discipline within PE does not appear to differ dramatically from PE as a domain, we expected the epistemic belief factor structure for fitness in this study to be the similar to those found earlier in high school PE (Lodewyk, 2009). In that study the four items representing the source of knowledge failed to load onto a factor. Since no valid and reliable quantitative assessments for the source of knowledge dimension of epistemology applicable to PE are evident; and, because developing such a measure was beyond the scope of this study, we did not assess it herein. It would be helpful if future research developed such a quantitative measure for the source of knowledge to complement some of the existing qualitative methods for assessing aspects of it in PE (Cothran & Kulinna, 2006) and fitness (Bonello, 2008; Placek et al., 2001).

The remaining objectives of this study involved the assessment of construct relations. Second, bivariate relations were explored between fitness-specific epistemic and motivational beliefs, effort regulation, and fitness outcomes in PE. Indices of motivation (intrinsic and extrinsic goal orientation, perceived autonomy support, fitness value), effort regulation, and fitness outcomes were expected to relate positively whereas relations between these constructs and epistemic beliefs were hypothesized to relate negatively. Third, the prediction of fitness outcomes by the epistemic beliefs and indices of motivation was assessed. We proposed that epistemic beliefs would predict fitness outcomes, yet not when adding the variance accounted for by the indices of motivation. Finally, path analyses procedures in classroom-based research have revealed that effort regulation is both a function of motivational and cognitive beliefs and predicts academic achievement (Pintrich 1994). This and the aforementioned relationships between this study's constructs in PE and fitness, warrant our fourth objective and hypothesis predicting a significant pathway (Figure 1) between students' epistemic beliefs, indices of motivation, effort regulation, and outcomes in fitness.

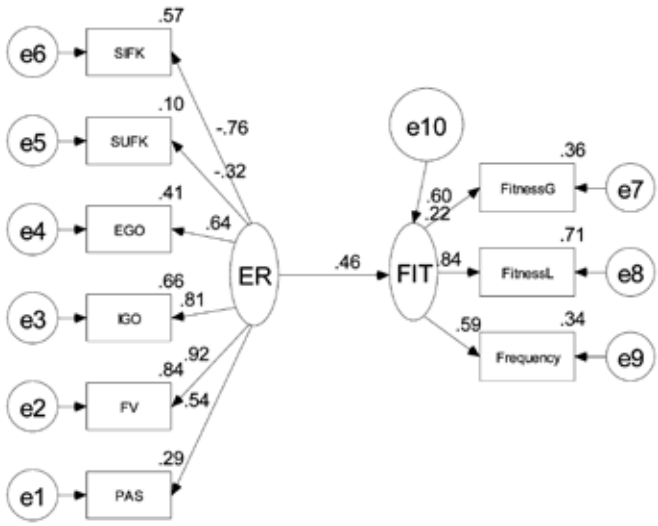

Figure 1

Notes. Simple integration of fitness knowledge=SIFK; Stable and useless fitness knowledge=SUFK; Intrinsic goal orientation-IGO; Extrinsic goal orientation=EGO; Fitness value=FV; Perceived autonomy support=PAS; Effort regulation = ER; FIT = fitness; FitnessG = z score mean of PE grade; FitnessL = z score mean of fitness level; Frequency = frequency of weekly exercise beyond PE. All paths are significant. The coefficients on the straight lines are the standardized regression weights; the coefficient right above the rectangles of dependent variable is squared multiple correlation (.22).

Method

Participants and Procedure

The sample consisted of 513 voluntary students (261 males, 252 females; mean age = 15.25) in grade nine (n = 376 students) and ten (n = 137 students) out of a possible 731 students (70% participation rate). The sample was from seven public high schools (n = 353) and one independent high school (n = 91) in mainly south-western Ontario (Canada), and one independent high school (n = 69) in south-western British Columbia (Canada). The majority of the students were from middle-class socioeconomic status and Caucasian (85.4%). The sample completed three short questionnaires assessing their demographics (e.g., gender, estimated fitness level, exercise frequency, and fitness grade), epistemic beliefs about fitness, and motivation for fitness. Surveys were administered in each school during their regular semester-long (five-month) PE classes and from November to February, which was just past the midway point of their course. Thus, students had completed over half of the curricular fitness content of their PE course. Surveys were administered by the principal investigator using a prepared script, except for in one school wherein the vice-principal administered the survey, using the same script. However, those surveys (n = 69) were returned without the demographic measure attached to the survey with the other measures. Since completing the exploratory and confirmatory factor analyses to fulfill the first research question one was not dependent on this alignment, those participants were only included in the first analysis. This resulted in a final sample of 441 (221 boys, 220 girls; 73.6% Caucasian) for all other analyses.

Health fitness is emphasized in health and PE courses in the curriculum of each province and territory of Canada with an average of 7% of course level expectations attributed to it (Lorusso et al., 2013). For example, the ninth and tenth grade PE course in Ontario is titled Healthy Active Living Education (Ontario Ministry of Education and Training [OMET], 1998) and primarily houses the fitness outcomes in the active living strand of the curriculum. These include both knowledge-based outcomes (i.e., being aware of the benefits of health-related fitness and how it relates to health and well-being) and applied outcomes (i.e., the design, participation, and monitoring of daily personal health-related fitness status, plans, activities, and goals). Applied outcomes were typically integrated into lessons with other content whereas most of the knowledge-based outcomes were typically taught more discretely within classroom-based fitness theory lessons when the gymnasium or outside fields were not available and/or during inclement weather. To confirm that teachers' practices in the ninth and/or tenth-grade PE courses in this study were generally coinciding with such curricular aims, 16 (8 males, 8 females; all Caucasian, mean age 42.7) PE teachers whose classes participated in this study voluntarily completed a survey asking (among other items) the percentage of time during the year they taught fitness, the percentage (weight) of the students' PE grade that they allotted to fitness, and how much (on a scale from 1 = *strongly disagree* to 5 = *strongly agree*) their primary goal in those PE courses was to develop fitness in students. Results revealed that 16.75% (SD = 10.28) of the course was used to teach fitness; 11.88% (SD = 4.43) of the students' PE grade was for fitness; and fitness was generally a noteworthy aim in PE (M= 3.31, SD=1.08).

Measures

Fitness outcomes. Similar to others using self-reported physical activity levels (Shen, McCaughtry, & Martin, 2007), fitness outcomes in this study was a composite (mean) reflection of each student's self-reported fitness grade, fitness level, and frequency of active exercise. This data was compiled from the *Demographic Questionnaire* on which students were asked to report information such as their grade level, gender, ethnicity, usual grade for fitness in PE (%), level of fitness compared to others their age and gender (rated from 0 = *very poor*, to, 4 = *very good*), and frequency of active exercise at least 30 minutes per day (rated from 0 = *never*, to, 4 = *everyday*). Responses to the last two items were coded using the actual ratings (0-4). A fitness grade was included as a fitness outcome because of the noted importance of students' mastery of the fitness knowledge, skills, and dispositions taught in physical education (OMET, 1998; see also the results of the teacher survey reported earlier) that have also been associated with active and healthy lifestyle outcomes (Harris, 2005; NASPE, 2004; Welk, et al., 2006). The other two items representing fitness outcomes (level of fitness and frequency of active exercise) reflect important fitness outcomes in PE (McKenzie, 2003) and are staple and valid self-report questions of health-related fitness on established surveys like the *Healthy Physical Activity Questionnaire* that is part of the most commonly used health-fitness assessment tool in Canada called the *Canadian Physical Activity, Fitness, and Lifestyle Approach* (Warburton, Nicol, & Bredin, 2006). The frequency of active exercise item has also been used to similarly assess physical activity level in ninth-graders (Haugen, Ommundsen, & Seiler, 2013).

Epistemic beliefs about fitness. Epistemic beliefs about fitness were assessed using the 16-item *Beliefs about Epistemology in Physical Education Questionnaire* developed and validated by Lodewyk (2009) in high school PE. In that study, epistemic beliefs had a suitable factor structure, confirmatory fit statistics, internal consistency reliability coefficients, and criterion validity through anticipated relations with ability conceptions and achievement in PE. That measure was re-named the *Epistemic Beliefs for Fitness in PE Questionnaire* for this study and each of the items was slightly altered for relevance to fitness (e.g., replacing "PE" with "fitness in PE"). A 5-point Likert scale ranging from 1 or "*strongly disagree*" to 5 or "*strongly agree*" was used. The measure assesses three epistemic scales: simple integration of fitness knowledge ("I try my best to link the different information about fitness that we are taught in PE and health."), stable fitness knowledge ("Information learned about fitness is useless outside of school."), and quick learning ("Knowing how to get fit and why it is important is something that can be learned quickly"). Scale scores consisted of the computed mean for the set of items comprising that scale.

Effort regulation and indices of motivation for fitness. To assess students' perceived autonomy support for fitness in PE, the short form (six items) of the *Learning Climate Questionnaire* commonly used in PE research and demonstrating high internal reliability (e.g., .82 in Ntoumanis, 2005; .91 in Zhang et al., 2012), was used. A sample item is: "I feel that my PE teachers provide me choices and options in how to work on my fitness in PE." Relevant scales from the *Motivated Strategies for Learning Questionnaire* (MSLQ; Pintrich et al., 1991) were used to assess fitness-specific

intrinsic goal orientation (IGO; four items), extrinsic goal orientation (EGO; four items), fitness value (six items), and effort regulation (four items). These scales of the MSLQ have sound validity reflected in their expected associations to numerous achievement and its related constructs in a host of studies across educational domains (for a review, see Duncan & McKeachie, 2005). For example, Ommundsen (2003) found that effort regulation had a positive predictive relationship to incremental ability conceptions and a negative one to entity ability conceptions in PE. Satisfactory internal reliability has also been reported for effort regulation (.83) by Ommundsen (2003), and for EGO (.80), IGO (.81) and task value (.86) by Lodewyk, Winne, and Jamieson-Noel (2009). The measures for effort regulation and indices of motivation used a 7-point Likert scale ("1 = *not at all true of me*" to "7 = *very true of me*"). Sample items include: "In a PE class like this, I like fitness material and activities that make me more curious, even if it is hard to learn." (IGO); "I want to do well in the fitness part of PE because it is important to show my fitness ability to my family, friends, teacher, or others." (EGO); "It is important for me to learn the fitness information taught in PE." (Fitness Value); and, "I work hard to do well in the fitness activities in PE even if I don't like what we are doing" (Effort Regulation).

Data Analysis

The size of the sample was sufficient (Schumacker & Lomax, 2010; Tabachnick & Fidell, 2001) for each of the following analyses. To answer the first research question, an exploratory factor analysis with oblique rotation (Delta = 0), a minimum eigenvalue of 1.0, and a factor loading cut-off of .46 was performed, followed by a confirmatory factor analysis to verify the fit of the epistemic belief data. The cut off score of .46 that we set for the factor loadings was based on Tabachnick and Fidell's (2001) recommendation that a minimal value of .32 is required and any above .45 is considered fair. The loadings are also consistent with other loadings in educational research assessing epistemic beliefs (e.g., Braten & Stromso, 2004; Schommer, 1993). Following an analysis of multivariate outliers using Mahalanobis Distance ($p < .001$) as the criterion, three students were deleted from the overall sample, resulting in a final sample of 510. The sample was divided into two randomly selected groups of 255 cases, with one group for the exploratory factor analysis and the other group for the confirmatory factor analysis. Indicators of goodness of fit for the confirmatory factor analysis model were the Chi square/d.f., comparative fit index (CFI), the Goodness of Fit Index (GFI); and (d) the root mean square error of approximation (RMSEA).

To answer the remaining three research questions, data cleaning and preparation procedures were performed on the motivational and indices of fitness data. Any observations with invalid data values or missing values from these measures were removed, if they could not be verified and fixed as were cases with standard deviations greater than three (Tabachnick & Fidell, 2001), which culminated in the deletion of 47 cases and a sample of 394 for the remaining analyses. In order to place all the three items representing fitness outcomes (estimated fitness grade, level, and exercise frequency) on an equivalent scale for the eventual computation of their mean to represent fitness outcomes, each was standardized by converting it to a Z score (i.e., a mean of 0 and a standard deviation of 1).

For the second research question, Pearson product-moment correlations and internal consistency reliability coefficients were calculated. A hierarchical regression analysis was used to test the prediction of fitness outcomes by epistemic beliefs (step one) and by epistemic beliefs and indices of motivation (step two). For the fulfillment of the third research question, a path analysis was employed using Amos 5.0 (Arbuckle, 2003) to test the predictive utility of effort regulation to fitness outcomes. In this study, effort regulation and fitness outcomes were the latent variables. Specifically, SIFK, SUFK, EGO, IGO, fitness value, and PAS were indicators of effort regulation; whereas fitness grade, fitness level, and exercise frequency were indicators of fitness outcomes (see Figure 1). Maximum likelihood estimation was used to evaluate the fit of the model to the empirical data. Acceptable model fit was assessed using multiple indices. The overall fit of the model to the data was examined through the chi-square test (χ^2). A non-significant χ^2 indicates acceptable model fit (Tabachnick & Fidell, 2001). Root mean square error of approximation (RMSEA) represents closeness of fit, and values approximating .06 and zero demonstrate close and exact fit of the model (Schumacker, & Lomax, 2010). The comparative fit index (CFI), the Tucker-Lewis index (TLI), and the normed fit index (NFI) test the proportionate improvement in fit by comparing the hypothesized model (over identified model) with a just identified model. Acceptable model fit represents CFI, TLI, and NFI values higher or equal to .95 (Schumacker, & Lomax, 2010).

Results

To fulfill the first objective, an exploratory factor analysis extracted 11 items across three factors explaining 36.81% of the variance (see Table 1). The first factor was identified as simple-integration of fitness knowledge (SIFK), and loaded on five items accounting for 22.22% of the variance. The second factor, called stable and useless fitness knowledge (SUFK), consisted of four items and explained 10.54% of the variance. The third factor (quick learning of fitness knowledge) loaded only two items, explained 4.06% of the variance, and had a low internal consistency reliability coefficient (.48) so it was omitted from further analysis in this study. Since each SIFK item had a positive valence they were recoded to reflect the negative connotation of the SIFK title and that of the SUFK. The confirmatory factor analysis was subsequently performed with the second data set and revealed a suitable fit (Tabachnick & Fidell, 2001) for the factor model (Chi square/d.f. =2.93; $p < .05$; CFI = .93; GFI= .92; SRMEA = .06). Therefore the two-factor structure was retained and used for further analysis. Internal consistency reliability coefficients were .75 (SIFK) and .68 (SUFK).

The second objective of the study was to explore relations between fitness-specific epistemic beliefs, indices of motivation, and outcomes in PE. Descriptive statistics, scale internal consistency reliability coefficients, and bivariate correlations are presented in Table 2. The reliability coefficients for each scale was satisfactory for scales under 10 items (Loewenthal, 1996). The means (with standard deviations in parenthesis) for the three fitness outcome variables were 81.15 (10.42) for fitness grade, 2.76 (.91) for fitness level, and 2.38 (1.03) for frequency of actively exercising. These values were averaged to generate an overall z-score to

Table 1. ***Factor Loadings Epistemic Beliefs for Fitness in PE (N = 255)***

Items and Factors *(α)*	SIFK	SUFK	QL
1. Knowing about fitness relates to day to day life.	.68		
2. I can use what I learn about fitness in PE in other areas of my life.	.62		
3. I try my best to link the different information about fitness that we are taught about in PE.	.59		
4. It is important for students to connect the new ideas learned about fitness to what they already know.	.59		
5. There are connections between what we learn about fitness in PE and information that is taught in other courses.	.53		
6. It is a waste of time to try to get fit if you are already out of shape.		.74	
7. Information learned about fitness is useless outside of school.		.64	
8. If I cannot quickly understand how to be fit, it usually means I will never understand it.		.63	
9. The information we learn in PE about how to be physically fit mainly consists of isolated facts rather than concepts that relate to each other.		.46	
10. Most things worth knowing about fitness are easy to understand.			.68
11. Knowing how to get fit and why it is important is something that can be learned quickly.			.48
Total Variance Explained (36.81%)	22.22	10.54	4.06

Notes. Based on an exploratory principal axis factor analysis with oblique rotation; SIFK = Simple Integration of Fitness Knowledge; SUFK = Stable and Useless Fitness Knowledge; QLFK = Quick Learning of Fitness Knowledge. Each SIFK item had a positive valence, which was recoded to a negative valence to match that of SUFK and QL and its title.

Table 2. ***Descriptive Statistics, Internal Consistency Reliability Coefficients, and Scale Correlations (N = 394)***

Scales	SIFK	SUFK	IGO	EGO	FV	ER	PAS	FITE
Alpha	.75	.68	.76	.69	.84	.75	.84	.70
M	2.33	2.05	4.75	4.98	4.97	5.16	3.42	0
SD	.65	.70	1.07	1.13	1.02	1.12	.77	1.00
SIFK	-							
SUFK	.31*	-						
IGO	-.59*	-.20*	-					
EGO	-.45*	-.18*	.52*	-				
FV	-.70*	-.30*	.75*	.59*	-			
ER	-.43*	-.43*	.53*	.36*	.53*	-		
PAS	-.46*	-.17*	.42*	.34*	.48*	.36*	-	
FITE	-.30*	-.14*	.42*	.30*	.33*	.37*	.22*	

Notes. * $p < .01$. Fitness outcomes (z score mean of PE grade, fitness level, and frequency of weekly exercise beyond PE = FITE; Simple integration of fitness knowledge=SIFK; Stable and useless fitness knowledge=SUFK; Intrinsic goal orientation-IGO; Extrinsic goal orientation=EGO; Fitness value=FV; Effort regulation=ER; Perceived autonomy support=PAS.

represent students' fitness outcomes. The bivariate correlations were as hypothesized. For example, the indices of motivation related positively to each other and to effort regulation and fitness outcomes. Both SIFK and SUFK related negatively to each of the other constructs; however, except for effort regulation, relations to SIFK were notably higher than those to SUFK.

A hierarchical regression analysis was used to answer the third objective; namely, the hypothesized predictive utility of the epistemic followed by the epistemic belief and motivational variables on fitness outcomes. The results revealed that epistemic beliefs predicted fitness outcomes in the first step, F (2, 364) = 18.44, $p < .001$, with only SIFK ($p < .001$) not SUFK ($p = .37$) emerging as a predictor. Only intrinsic goal orientation was significant when each of the epistemic beliefs and indices of motivation were entered into the second step of this model, F (6, 360) = 14.27, $p < .001$ signaling that when the variance accounted for by epistemic beliefs was controlled for in the model, only an intrinsic goal orientation accounted for a statistical additional portion of the variability attributed to fitness outcomes. SUFK, extrinsic goal orientation, fitness value, and perceived autonomy support did not add significantly to the prediction.

Finally, a path analysis was used to test the relationships among students' fitness specific epistemic beliefs, indices of motivation, effort regulation, and their outcomes in fitness. The model demonstrated a good fit to the data, χ^2 (26, N = 394) = 1.822, CFI = .983, TLI = .97, NFI = .963, RMSEA = .046. Figure 1 shows the path diagram and standardized path coefficients of the model. All path coefficients were statistically significant at $p < .05$. Students' effort regulation positively predicted fitness outcomes ($\Upsilon_{ER\text{-}fitness}$= .46). All the indicators of effort regulation had significant effect on effort regulation (Υ = -.32 to .92), and indicators of fitness outcomes had significant effect on fitness outcomes (Υ = .59 to .84). The overall variance in fitness outcomes explained by the model was 22%.

Discussion

The study investigated the factor structure of epistemic beliefs about fitness along with relations and a pathway between fitness-specific epistemic beliefs, effort regulation, outcomes, and indices of motivation in a high school PE setting. Study limitations include two scales with moderate reliability (.68, .69), the reliance on only quantitative self-report data, and the obvious lack of direct transfer of implications from the setting (e.g., demographics and curriculum) of this study to other rather unique contexts. We also note with caution that fitness outcomes might be evident in other ways than the mean of three self-report items (fitness level, grade, and frequency of weekly exercise outside of PE) used in this study and highlight the need for caution in over-generalizing the results pertaining to epistemic beliefs across cultures since these have been shown to vary in some (Benedixen & Feucht, 2010). We welcome new research in various PE setting to further enhance the epistemic measure used herein. Despite these concerns, several novel implications stem from this study about the teaching of fitness with the hope that more students will better engage in health-fitness pursuits.

The results revealed two theoretically and statistically credible epistemic belief factors through conceptual similarities to those reported in a more general study of epistemic beliefs in PE (Lodewyk, 2009; Lodewyk & Sullivan, 2010), a confirmation of

their fit to the factor model, and satisfactory numbers of factor items and statistical values (i.e., variance accounted for by each factor, factor loadings, and internal consistency reliability coefficients). These two factors were also logically and statistically related to indices of motivation and fitness engagement in this study. The similarity of the structure and name for these epistemic factors to those in other educational domains like history or math (Buehl & Alexander, 2005; Hofer, 2002) supports the generality of beliefs about the simplicity and stability of knowledge beyond fitness to across PE (Lodewyk, 2009) and several other educational domains (Hofer, 2001; Schommer, 1993). It appears that in each of these curricular contexts, knowledge can be viewed by students as more or less simply integrated (ambiguous, isolated, not interconnected with or relevant elsewhere), and stable or useless (unchanging or changeable and of little value). This domain-generality is noteworthy because of some evidence supporting the specificity of epistemic beliefs in domains like science. As noted earlier, epistemic beliefs may be relatively generalized or specialized, depending on the structure of the domain, task, or assessment which explains the invariant configurations of epistemic beliefs across some domains (Buehl & Alexander, 2005). The results herein validly indicate that students are often not aware of the value of fitness knowledge, its complexity and malleability relative to their overall health and well-being, or the degree of their empowerment to set and adhere to personal fitness goals through the design and monitoring of their fitness status, plans, and activities.

New evidence of statistical links between fitness-specific epistemic beliefs, outcomes, and indices of motivation has been generated from this investigation. Similar relations between effort, fitness outcomes, and indices of motivation have been reported previously in PE (e.g., Ntoumanis, 2005; Ommundsen, 2003; Solmon & Lee, 1997; Xiang et al., 2005) and within fitness (Gao et al., 2008; Cale & Harris, 2009). Another contribution of the study was the realization that students with an elevated belief in the simplicity (relatively isolated from concepts, activities, and information in other courses or disciplines in PE) and stability of fitness knowledge in PE (unchanging, certain, inflexible, or absolute) were prone to having lower intrinsic and extrinsic goal orientation, value, perceived autonomy support, effort regulation, and outcomes relative to fitness. These associations were particularly stronger between these variables and the simplicity of knowledge than the stability of knowledge. Similar associations to epistemic beliefs have been reported in classroom-based research; for example: perceived autonomy support (Weinstock & Roth, 2011), goal orientation (Braten & Stromso, 2004), effort (Paulsen & Feldman, 1999), task values, and performance (e.g., Buehl & Alexander, 2005). Further, along with a maladaptive belief in the simplicity of fitness knowledge (SIFK), an intrinsic goal orientation predicted lower outcomes in fitness. This corroborates educational research linking simple epistemic beliefs (e.g., Schommer, 1993; see also Bendixen & Feucht, 2010) and goal orientation (e.g., Ommundsen, 2004; Xiang et al., 2005; see also Chen & Ennis, 2004) to academic achievement and a host of achievement-related factors.

The study also revealed was a satisfactory fit of the data to a proposed pathway from fitness-specific epistemic beliefs and indices of motivation to fitness outcomes through effort regulation. This result reinforces the multi-dimensional and integrated nature of cognitive mediation theory of learning and achievement that epistemic beliefs and indices of motivation beliefs serve as cognitive conditions of self-regulated learning which interact with task, instructional, and social dynamics in setting the stage for strategic learning responses (e.g., regulation of effort) on the pathway to fitness outcomes (Doyle, 1977; Winne & Hadwin, 1998). For example, rather than strongly predicting achievement, it appears that epistemic beliefs and indices of motivation operate rather meta-cognitively within a personal belief system that influences their achievement and regulation of learning (Hofer, 2001; Paulsen & Feldman, 1999; Winne & Hadwin, 1998). Similar to the effect of beliefs in the simplicity of knowledge in other domains (Buehl et al., 2002), perhaps holding non-availing epistemic beliefs in the simplicity of fitness knowledge may prompt students to be less prone to understanding conceptual links and ambiguities between fitness concepts (e.g., aerobic, anaerobic, and muscular endurance), how it links to other knowledge in PE (e.g., fitness for health) and in other domains (e.g., fitness effects on physiology).

Increased fitness outcomes in PE and in life might be enhanced if physical educators also design the fitness content and tailor their instruction to foster students' fitness-specific effort regulation and indices of motivation (value, perceived autonomy support, intrinsic and extrinsic goal orientation). In regards to the application of motivating instructional behaviours such as autonomy-support (giving students choices and opportunities for independent, cooperative, and lower anxiety tasks), this works much better than controlling styles to promote present and future effort and persistence in a youth exercise setting (Motl, Dishman, Saunders, Dowda, & Pate, 2002; Ntoumanis, 2005; Vansteenkiste et al., 2004). Finally, the noteworthy relationships of this study further reinforce the critical role of effort regulation as a learning strategy in PE (Guan, Xiang, McBride & Bruene, 2006; Ommundsen, 2004; Solmon & Lee, 1997). Positive fitness outcomes appear more likely when instructors foster in students "a valuing of effort and a commitment to effort-based strategies through the design of mastery-oriented classroom structures" that can also include some extrinsic motivators (Ames, 1992, p. 268).

Although the negative experiences of fitness in PE (Cale & Harris, 2009) might be buffered somewhat by one's epistemic beliefs, indices of motivation, and effort regulation, it is important to recognize the role that instructors might have in propagating maladaptive beliefs in students. For example, the collective relations noted in this study signal that physical educators should consider how the fitness content they teach is simplistic when it is perceived by students to lack clear integration with other educational domains and lifestyle concepts or to be static and stale with little usefulness. Teachers might also instruct to help students understand the complex, integrated, evolving, and useful nature of fitness content and how malleable fitness can be when effortful and strategic learning is applied. Finally, another likely factor is the way that teachers' personal beliefs about fitness align with the structure of the fitness learning tasks they design and assign in PE. For example, Harris (2005) notes that teachers tend to promote fitness to enhance students' performance in sport rather than health and well-being. To elaborate, teachers often hold narrow interpretations of fitness as attributes to be developed through

vigorous training and testing along with pressure to raise activity levels. Such beliefs have prompted teachers to use methods and activities that compromise objectives so critical to active living like the attainment of knowledge, skills, and dispositions through positive activity experiences. Harris (2005) adds that teachers often implement "forced fitness regimes, directed activity with minimum learning, inactive PE lessons involving excessive theory or teacher talk, and dull and uninspiring drills... or activity-based units (e.g., blocks of work on aerobics, cross-country running, circuit-training) delivered with minimal learning and limited pupil involvement" (p. 89). Pintrich et al. (1993) reports that classroom teachers too often assign tasks that lack authenticity (application), the need for critical thinking, and ambiguity in the final product or answer that "can promote misconceptions such as a false understanding that the domain is fundamentally simple and stimulate superficial outcomes with the task" (p. 181).

In conclusion, this study goes beyond recent investigations of links between motivation, effort, and physical activity performance in PE (e.g., Agbuga & Xiang, 2008; Chen & Chen, 2012; Zhang et al., 2012) by heightening awareness as to the nature of fitness-specific epistemic beliefs and their relation to effort regulation, indices of motivation, and outcomes in fitness during PE. Future research could build on this study by, for example, studying these constructs in conjunction with a trichotomous (Agbuga & Xiang, 2008) or 2 x 2 achievement goal orientation along with social goals (Guan et al., 2006). We also encourage research that uses qualitative methods (e.g., interviews) in conjunction with those used herein to explore if students' epistemic knowledge convictions about other disciplines within PE (i.e., dance, educational gymnastics, and games) are also consistent with their epistemic beliefs about fitness.

References

Agbuga, B., & Xiang, P. (2008). Achievement goals and their relations to self-reported persistence/effort in secondary physical education: A trichotomous achievement goal framework. *Journal of Teaching in Physical Education, 27*, 293-310.

American College of Sports Medicine (ACSM). (1998). Position stand: The recommended quantity and quality of exercise for developing and maintaining cardio-respiratory and muscular fitness, and flexibility in healthy adults. *Medicine & Science in Sports & Exercise, 30*(6), 975-991.

Ames, C. (1992). Classroom goals, structures, and student motivation. *Journal of Educational Psychology, 84*, 261-271.

Arbuckle, J. L. (2003). *Amos 5.0 update to the Amos user's guide*. Chicago, IL: SPSS.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Barr-Anderson, D. J.,Young, D. R., Sallis, J. F., Neumark-Sztainer, D. R., Gittelsohn, J., Webber, L., ... & Jobe, J. B. (2007). Structured physical activity and psychosocial correlates in middle-school girls. *Preventive Medicine, 44*, 404–409.

Bendixen, L.D., & Feucht, F.C. (2010). *Personal epistemology in the classroom: Theory, research, and implications for practice*. New York, NY: Cambridge University Press.

Bonello, M. (2008). *Sixth grade students; mental models of physical education concepts: A framework theory perspective* (Doctoral dissertation, University of Maryland, College Park). Retrieved from http://books.google.ca/books?hl=en&lr=&id=_GCM3L6u_vsC&oi=fnd&pg=PR11&dq=Marina+Bonello&ots=CgkONs4IJI&sig=VSEnhsHY7ZmCPWyfh0EokJzOpxo#v=onepage&q=Marina%20Bonello&f=false

Braten, I & Stromso, H.I. (2004). Epistemological beliefs and implicit theories of intelligence as predictors of achievement goals. *Contemporary Educational Psychology, 29*, 371-388.

Buehl, M.M. & Alexander, P.A. (2005). Motivation and performance differences in students' domain-specific epistemological belief profiles. *American Educational Research Journal, 42*(4), 697-726.

Buehl, M.M., Alexander, P. A. & Murphy, P.K. (2002). Beliefs about schooled knowledge: Domain specific or Domain General? *Contemporary Educational Psychology, 27*, 415-449.

Cale, L., & Harris, J. (2009). Fitness testing in physical education – a misdirected effort in promoting healthy lifestyles and physical activity? *Physical Education and Sport Pedagogy, 14*(1), 89-108.

Chen, S., & Chen, A. (2012). Ninth-graders' energy balance knowledge and physical activity behaviour: An expectancy-value perspective. *Journal of Teaching in Physical Education, 31*, 293-310.

Chen, A., & Ennis, C. (2004). Goals, interests and learning in physical education. *Journal of Educational Research, 97*, 329-338.

Cothran, D.J., & Kulinna, P.H. (2006). Students' perspectives on direct, peer, and inquiry teaching strategies. *Journal of Teaching in Physical Education, 25*, 166-181.

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

Dodds, P., Griffin, L.L., & Placek, J.H. (2001). A selected review of the literature on development of learners' domain-specific knowledge [Special Issue]. *Journal of Teaching in Physical Education, 20*, 301-313.

Doyle, W. (1977). Paradigms of research for teacher effectiveness. *Review of Research in Education, 5*,163-198.

Duncan, T.G., & McKeachie, W.J. (2005). The making of the motivated strategies for learning questionnaire. *Educational Psychologist, 40*, 117-128.

Ferrer-Caja, E., & Weiss, M.R. (2000). Predictors of intrinsic motivation among adolescent students in physical education. *Research Quarterly for Sport and Exercise, 71*, 267-279.

Gao, Z., Newton, M., & Carson, R.L. (2008). Students' motivation, physical activity levels, and health- related physical fitness in fitness class. *Middle Grades Research Journal, 3*(4), 21-39.

Guan, J., Xiang, P., McBride, R. & Bruene, A. (2006). Achievement goals, social goals, and students' reported persistence and effort in high school physical education. *Journal of Teaching in Physical Education, 25*, 54-67.

Haerens, L., Kirk, D., Cardon, G., De Bourdeaudhuij, I., & Vanstenkiste, M. (2010). Motivational profiles for secondary school physical education and its relationship to the adoption of a physical active lifestyle among university students. *European Physical Education Review, 16*(2), 117-139.

Hare, M., & Graber, K. (2000). Student misconceptions during two invasion game units in physical education: A qualitative investigation of student thought processing. *Journal of Teaching in Physical Education, 20*, 55-77.

Harris, J. (2005). Health-related exercise and physical education. In K. Green & K. Hardman (Eds.), *Physical education: Essential issues* (pp. 78-97). New York, NY: Sage

Haugen, T., Ommundsen, Y., & Seiler, S. (2013). The relationship between physical activity and physical self-esteem in adolescents: The role of physical fitness indices. *Pediatric Exercise Science*, 25, 138-153.

Hofer, B. (2001). Personal epistemology research: Implications for learning and teaching. *Journal of Educational Psychology Review, 13*, 353-383.

Hofer, B.K. (2002). Dimensionality and disciplinary differences in personal epistemology. *Contemporary Educational Psychology, 25*(4), 378-405.

Lodewyk, K.R. (2009). Exploring relations among achievement and beliefs about epistemology and ability in high school physical education students. *The Physical Educator, 66*(3), 124-138.

Lodewyk, K.R., Jamieson-Noel, D. & Winne, P. H. (2009). High school students' motivation and use of learning strategies during work on differently structured tasks. *Educational Psychology, 29*(1), 1-25.

Lodewyk, K. R., & Sullivan, P. (2010). Considering beliefs about epistemology, ability, and the need for cognition as achievement-related factors in university physical education students. *Phenex, 2*, 1-21.

Loewenthal, K. M. (1996). *An introduction to psychological tests and scales*. London: UCL Press Limited.

Lorusso, J., Francis, N., & Kilborne, M. (2013, April). *Analysis of PE curricula: National trends from northern neighbors*. Paper presented at the meeting of the American Alliance for Health, Physical Education, Recreation, and Dance, Charlotte, North Carolina.

Luke, I., & Hardy, C.A. (1999). Cognitive strategies. In C.A. Hardy & M. Mawer (Eds.), *Learning and teaching in physical education* (pp. 59-79). Philadelphia, PA: Falmer Press.

McKenzie, T.L. (2003). Health-related physical education: Physical activity, fitness, and wellness. In S.J. Silverman & C.D. Ennis (Eds.), Student learning in physical education: *Applying research to enhance instruction*. (2nd Ed.). (pp. 207-226). Champaign, IL: Human Kinetics.

Motl, R.W., Dishman, R.K., Saunders, R.P., Dowda, M., & Pate, R.R. (2002). Perceptions of physical and social environment variables and self-efficacy as correlates of self-reported physical activity among adolescent girls. *Journal of Pediatric Psychology, 32*, 6–12.

National Association for Sport and Physical Education (NASPE). (2004). *Moving into the future: National standards for physical education* (2nd ed.). Reston, VA: NASPE.

Ntoumanis, N. (2005). A prospective study of participation in optional school physical education using a self-determination theory framework. *Journal of Educational Psychology, 97*, 444-453.

Ommundsen, Y. (2003). Implicit theories of ability and self-regulation strategies in physical education classes. *Educational Psychology, 23*, 141-157.

Ommundsen, Y. (2004). Self-handicapping related to task and performance-approach and avoidance goals in physical education. *Journal of Applied Sport Psychology, 16*, 183-197.

Ontario Ministry of Education and Training (OMET) (1998). *The Ontario curriculum grades 9- 10: Health and physical education*. Toronto, ON: Ministry of Education and Training. Retrieved from http://www.edu.gov.on.ca/eng/curriculum/secondary/health910curr.pdf

Paulsen, M.B., & Feldman, K.A. (1999). Epistemological beliefs and self-regulated learning. *Journal of Staff, Program, and Organizational Development, 16*, 83-91.

Pintrich, P. R. (1994). The dynamic interplay of student motivation and cognition in the college classroom. In K.A. Feldman & M. B. Paulsen (Eds.). *Teaching and learning in the college classroom* (3rd Ed.) (pp. 431-439). Needham Heights, MA: Simon and Schuster.

Pintrich, P.R., Marx, R.W., & Boyle, R.A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63*, 167-199.

Pintrich, P.R., Smith, D.A., Garcia, T., & McKeachie, W.J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ)* (Technical Report No. 91-B- 004). Ann Arbor, MI: University of Michigan, School of Education.

Placek, J., Griffin, L., Dodds, P., Raymond, C., Tremino, F., & James, A. (2001). Middle school students' conceptions of fitness: The long road to a healthy lifestyle. *Journal of Teaching in Physical Education, 20*, 413-323.

Ridgers, N. D., Fazey, D. M. A., & Fairclough, S. J. (2007). Perceptions of athletic competence and fear of negative evaluation during physical education. *British Journal of Educational Psychology, 77*, 339-349.

Schommer, M. (1993). Epistemological development and academic performance among secondary students. *Journal of Educational Psychology, 85*, 406-411.

Schumacker, R. E., & Lomax, R. G. (2010). *A beginner's guide to structural equation modeling* (3rd ed.). New York: Routledge.

Shen, B., McCaughtry, N., & Martin, J. (2007). The influence of self-determination in physical education on leisure-time physical activity behavior. *Research Quarterly for Sport and Exercise, 78*, 328-338.

Solmon, M.A. (2006). Learner cognition. In D. Kirk, D. MacDonald, & M. O'Sullivan (Eds.). *The handbook of physical education* (pp. 226-241). London, England: Sage.

Solmon, M.A., & Lee, A.M. (1997). Development of an instrument to assess cognitive processes in physical education classes. *Research Quarterly for Exercise and Sport, 68*, 152-160.

Tabachnick, B.G., & Fidell, L.S. (2001). *Using multivariate statistics* (4th ed.). Needham Heights, MA: Allyn & Bacon.

Vansteenkiste, M., Simons, J., Soenens, B., & Lens, W. (2004). How to become a persevering exerciser? Providing a clear, future intrinsic goal in an autonomy supportive way. *Journal of Sport & Exercise Psychology,* 26, 232–249.

Wallhead, T.L., & J. Buckworth. 2004. The role of physical education in the promotion of youth physical activity. *Quest, 56*, 285-301.

Warburton, D.E., Nicol, C.W., & Bredin, S.D. (2006). Prescribing exercise as preventive therapy. *Canadian Medical Association Journal*, 174(7), 961-974.

Weinstock, M., & Roth, G. (2011). Teachers' personal epistemologies as predictors of support for their students' autonomy. In J. Brownlee, G. Schraw, & D. Berthelsen (Eds.). *Personal epistemology and teacher education*, (pp. 165-179). New York, NY: Routledge.

Welk, G.J., Eisenmann, J.C., & Dollman, J. (2006). Health-related physical activity in children and adolescents: A bio-behavioural perspective. In D. Kirk, D. MacDonald, & M. O'Sullivan (Eds.). *The handbook of physical education* (pp. 665-684). London, England: Sage.

Winne, P. H. & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277-304). Hillsdale, NJ: Erlbaum.

Xiang, P., Chen, A., & Bruene, A. (2005). Interactive impact of intrinsic motivators and extrinsic rewards on behavior and motivation outcomes. *Journal of Teaching in Physical Education, 24*, 179- 197.

Zhang, T., Solmon, M.A., & Gu, X. (2012). The role of teachers' support in predicting students' motivation and achievement outcomes in physical education. *Journal of Teaching in Physical Education*, 31, 329-343. ■