Prior knowledge determines interest in learning in physical education: A structural growth model perspective

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Abstract:

Research has shown that interest in knowledge facilitates students' academic achievement in learning. Because individual interest is often based on how much one knows, in other words existing or prior knowledge, studying adolescents' interest in health-enhancing physical activity and its benefits should address the relation between the interest and their existing or prior physical activity knowledge. Understanding this relationship may help us facilitate students to not only develop interest in knowing more about but also actual adopt a healthy, active lifestyle. This study used a large-sample structural equation design to identify the relationship between middle school students' interest in physical activity knowledge and their prior physical activity knowledge, and to assess the change of this relationship over time. Guided by the declarative-procedural knowledge framework, latent growth models were developed and tested on data collected from a random sample of 3882 students from ten middle schools. The latent growth curve model indicated that, 1) on average, students experienced a significant interest decline in both procedural and declarative knowledge; 2) prior knowledge helped slow the decline and facilitated interest growth in knowledgeable students. The results suggest that existing knowledge determined the interest change.

Keywords: Interest in knowledge | Prior physical activity knowledge | Latent growth model | Declarative knowledge | Procedural knowledge

Article:

1. Introduction

Due to unprecedentedly high rates of hypokinetic diseases, it has become a consensus that mastery of physical activity knowledge can assist individuals in making healthy lifestyle decisions, which in turn will improve their health (Sallis et al., 1986a, Sallis et al., 1986b). Research findings suggest that knowledge about active lifestyle and physical activity is a strong predictor for healthy lifestyle development (Dominick et al., 2013, Nguyen et al., 2011, Sallis et al., 1986a, Sallis et al., 1986b, Staiano et al., 2012, Tolvanen et al., 2012). Therefore, to achieve a healthy lifestyle, people should become knowledgeable about the benefits of physical activity, healthy diet, and healthy lifestyles.

In physical education, it is expected that school students learn knowledge, skill, and behavior for a healthful, active lifestyle (U.S. Institute of Medicine, 2013). The learning of physical activity knowledge, however, is influenced by many factors. As one major factor, interest in knowledge motivates students to learn. However, a lack of interest in knowledge has been identified as a concern in American public schools (Jones, Howe, & Rua, 2000). It has been reported that interest in scientific knowledge gradually declines during middle school years (George, 2000). As a domain of scientific knowledge, knowledge about physical activity is related to physical movement and its benefits to human health and performance (Whitehead, 2010). However, the condition of students' interest in physical activity knowledge and its changing trajectory are largely under investigated. Consequently, it is not clear that to what extent the interest in physical activity knowledge will facilitate or hinder the development of the knowledge itself and behavior.

Declining interest in physical activity knowledge may lead to the development of undesired behavioral changes in adolescents. Facing nationwide obesity epidemic, it is urgent to navigate middle school students' interest in physical activity knowledge and to possibly change the trajectory of their interest in the knowledge. The purpose of this study was to identify the relationship between changes in interest in physical activity knowledge and existing physical activity knowledge. Specifically, the study was attempted to determine the role of prior knowledge of physical activity in predicting changes of interest in physical activity knowledge.

2. Theoretical framework

2.1. Conceptualization of interest

According to the domain learning theory (Alexander, Jetton, & Kulikowich, 1995), interest in the content to be learned plays an increasingly strong role in motivating learners moving from the acclimation learning stage to the competence and proficiency stages. Learner motivation in these learning stages is likely to rely on personal or individual interest in the content and the extent to which the individual's prior knowledge supports the interest (Chen & Hancock, 2006). The role of prior-knowledge in interest growth and learning achievement has been documented in many classroom studies (e.g., Alexander et al., 1994, Cook, 2006). It can be hypothesized that prior knowledge serves as a necessary and sufficient condition for the development of learners' interest in continuing to learn the knowledge further.

Cognitive psychologists (Alexander et al., 1994, Dai and Sternberg, 2008) believe that interest is where motivation and cognition meet to impact learning. As Dai and Sternberg (2008) put it, “To be interested in something is to have a subjective feeling for it (affect), to be drawn to it (conation), and to have some degree of knowledge about the object or activity in question (cognition)” (p. 14). In addition, a strong interest in a knowledge domain can facilitate students to adopt different learning strategies to further learn new knowledge (Shen, Chen, Tolley, &

Scrabis, 2003). Thus, helping students become interested in a knowledge domain is critical to their learning.

As a psychological construct of motivation, interest is multi-dimensional. It exists on both cognitive and affective dimensions (Hidi, Renninger, & Krapp, 2004). In other words, interest actively interacts with an individual's cognition and conation during the person-object/task interaction (Hidi, 1990). From a temporal perspective, interest could be conceptualized as personal and situational. Personal interest is a relatively stable motivation state that drives a learner to interact with a task of personal preference (Hidi, 2001). In other words, this interest is personal in that it is an individual's disposition of enduring preference for a particular object or activity. Personal interest is acknowledged as the basis for intrinsic motivation for its "important directive role in intrinsically motivated behavior in that people naturally approach activities" (Deci & Ryan, 1985, p.34). The existence of personal interest relies in large part on prior knowledge (Hidi, 1990, Schiefele, 1991). From this perspective, personal interest in any knowledge domain motivates the individual to learn not only because it provides compatibility between personal preferences and knowledge to be learned, but also because it prepares the individual with a necessary existing association between mental readiness and anticipation of achievement (Krapp & Prenzel, 2011).

Situational interest, on the other hand, is a highly temporal motivation state created by an individual's instant appreciation of appealing characteristics in a task that the individual is being or is about to be engaged in. In educational settings, situational interest often "arises spontaneously due to environmental factors such as task instructions" (Schraw, Flowerday, & Lehman, 2001, p. 211). Therefore, motivation driven by situational interest is also highly intrinsic. Although situational interest can also be utilized to facilitate students' learning, it is highly spontaneous, transitory, and environmentally activated (Krapp, Hidi, & Renninger, 1992). Therefore, situational interest does not derive from or rely on one's prior knowledge about the task. Nevertheless, the boundary between situational interest and personal interest is not rigid. Repeatedly evoked by some environmental stimuli, one can internalize situational interest and eventually develop it into a long lasting individual interest (Hidi & Harackiewicz, 2000).

Research on interest in particular knowledge domains is characterized by a topological model conceptualizing interests in terms of three personally defined scopes of knowledge (Haeussler, 1987, Haeussler and Hoffmann, 2000). The first scope of interest is the focus on a narrow topic in a knowledge domain. For example, a student may hold strong interest in knowledge about circulating angiogenic cells, a narrowly defined topic in the domain of exercise physiology. The second scope is the interest in a particular context where a narrowly defined topic is presented. For instance, a student can display a strong interest in the physically-active environment/context the teacher created to help the student understand the topic of circulating angiogenic cells. The third scope is the interest in particular actions in discovery. For example, a student is interested in exploring how the level of circulating angiogenic cells responds to acute and/or chronic exercise and relates to cardiovascular diseases. This scope of interest usually goes beyond what the classroom instruction can offer and is strongly associated with the individual's subjective beliefs or values about the knowledge being learned.

Extended from the above conceptualization of interest and its relation with prior knowledge, it can be assumed that although students' interest in knowing general science or knowledge about physical activity is declining, they may be still interested in knowing specific, personally meaningful knowledge components such as how to follow scientifically sound principles in exercise or the context in which they can use physical activity knowledge to enhance their own health. The above conceptualization of interest in relation to knowledge scopes implies that personal interest can also be understood in two dimensions, interest in knowing factual information (declarative knowledge) and interest in taking actions (procedural knowledge). Exploring and developing this conceptualization is particularly important in the field of physical education because factual/declarative knowledge is only relevant when it can be internalized into executable forms, that is, procedural knowledge.

2.2. Knowledge and interest

Knowledge refers to one's understanding of a given domain in either a declarative (factual) or procedural (skillful execution) form (Alexander, Schallert, & Hare, 1991). Declarative knowledge is conceptual understanding about facts (i.e., knowing what), whereas procedural knowledge is conceptual understanding about applying the factual knowledge (i.e., knowing how) (Lawless & Kulikowich, 2006). Associated with procedural knowledge is conditional knowledge, which is the conceptual understanding about conditions required for one to successfully act upon declarative knowledge (i.e., knowing when and why). Thus, in the framework of declarative/procedural knowledge, students who are particularly interested in activities of using physical activity knowledge are attracted to procedural knowledge. Additionally, due to the fact that physical activity knowledge is one specific knowledge domain, students' interest in declarative and procedural knowledge about physical activity could be highly correlated.

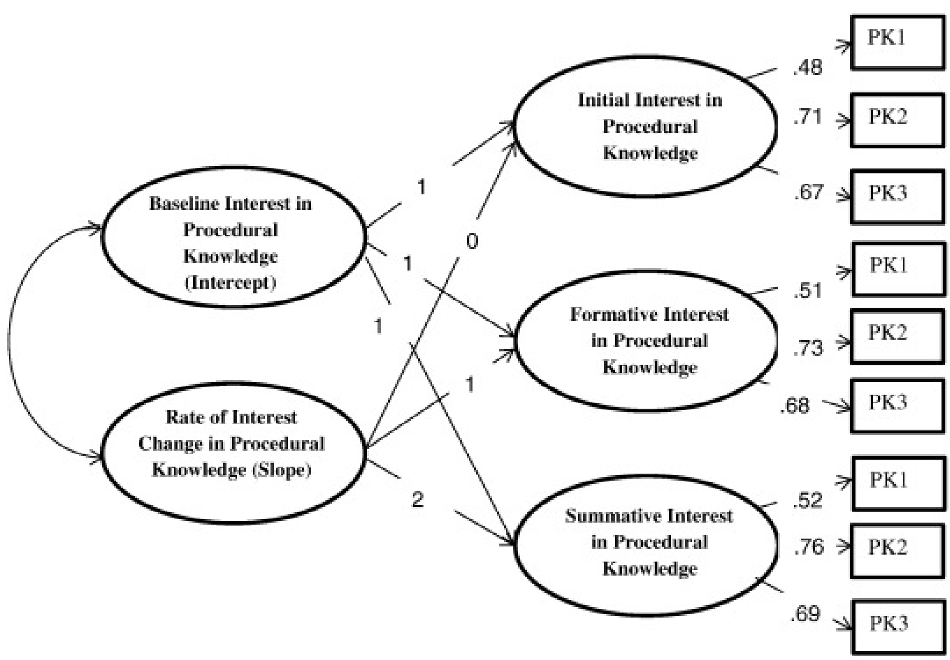

Fig. 1. Latent growth model for students' interest in procedural knowledge.
Note: PK1–PK3 = Item 1 to Item 3 adopted from the ROSE survey to measure students' interest in procedural knowledge about physical activity.

Scholars have investigated the relationship between knowledge and interest. Students with high personal interest in a knowledge domain are likely to continue to acquire additional knowledge in that domain, because they are naturally drawn to the subject and willing to spend more time and effort on knowing more about the subject (Tobias, 1994). In turn, increased knowledge in a domain is likely to strengthen the interest, because the expanded knowledge affords the individual to extend the knowledge base on which interest is developed and sustained. Alexander et al. (1994) once described the linear interest-knowledge relationship: the relationship is weak in students with low and intermediate levels of knowledge and is becoming stronger with knowledge growth and is stronger in knowledgeable students. Studies conducted on various populations and domains have confirmed this relationship (see Carnine and Carnine, 2004, Morris et al., 1985, Schneider and Bjorklund, 1992, Willingham, 2007).

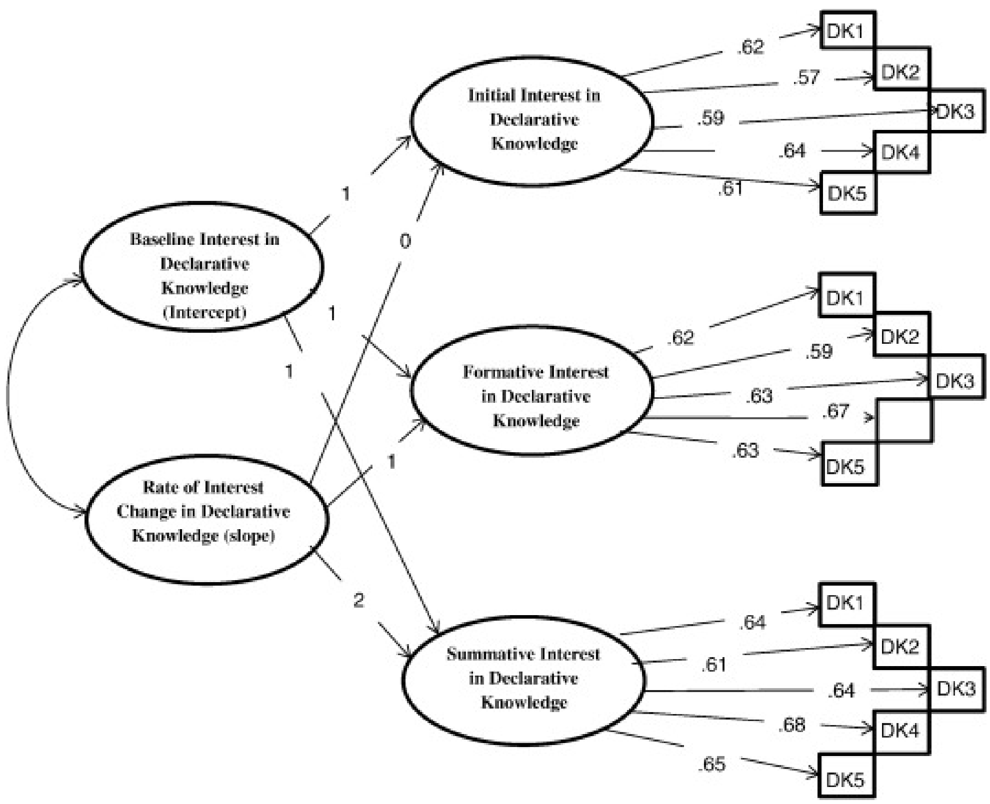

Fig. 2. Latent growth model for students' interest in declarative knowledge.
Note: DK1–DK3 = Item 1 to Item 3 adopted from the ROSE survey to measure students' interest in declarative knowledge about physical activity.

2.3. The current study and a priori model

The above articulation led to the a priori structural growth models displayed in Fig. 1(interest in declarative knowledge) and Fig. 2 (interest in procedural knowledge). The models hypothesized a change of interest from its initial status over time (formative and summative stages) which was likely to take place in learning declarative or procedural physical activity knowledge in physical education. In this study, to trace the change of students' interest in declarative and procedural knowledge, the interest in physical activity knowledge was measured three times throughout the academic year: the beginning of the year (initial interest), the middle of the academic year (formative interest), and the end of the academic year (summative interest). Thus, the conceptual a priori model consisted of five components: the baseline interest in declarative and procedural knowledge (intercept), and the rate of change for interest in declarative and procedural knowledge (slope), initial interest, formative interest, and summative interest in declarative and procedural physical activity knowledge. It was hypothesized that the interest change over the course of the year would be reflected in variations of growth curves (slopes) in the latent growth models.

In addition to the a priori models, an alternative model was also specified. The alternative model hypothesized that the initial interests and the rate of interest change were determined by prior knowledge levels. This pre-determined relationship would be manifested in relatively strong associations between prior knowledge level, initial interest (intercept in the structural model) and interest change patterns (variations of slopes). The hypothesized alternative model is included in Fig. 3.

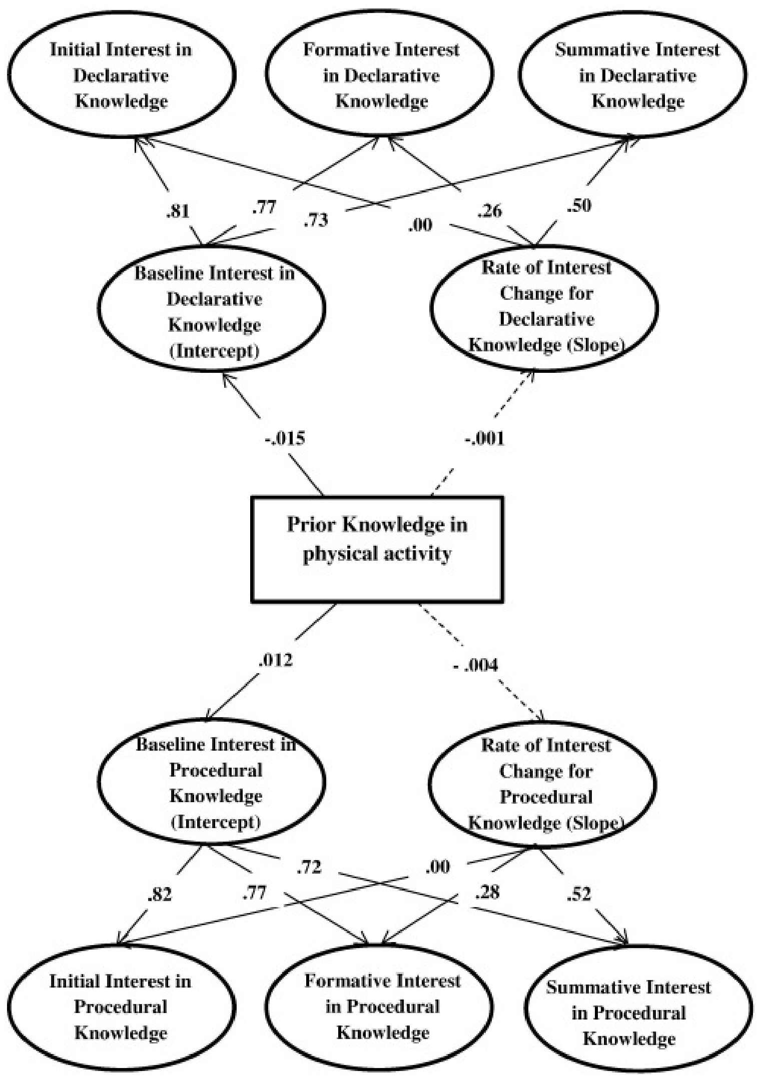

Fig. 3. The alternative latent growth model by having prior knowledge as the predictor of initial interest and interest growth.

3. Methods

3.1. Setting and participants

This study was conducted in 10 randomly selected middle schools in the south-east of the U.S. The study was part of a larger physical education curriculum intervention study, but the data have never been reported elsewhere. The data were collected in the baseline year of the five-year study. During this period, a sports- and recreation-based curriculum was taught to the students. Choosing the moment to study the relation between existing knowledge about physical activity and interest to learn the knowledge allowed us to determine the relation without interference of new knowledge input.

Student participants who fully completed the study included 3882 6th, 7th, and 8th grade students. There were 1842 boys (47.4%) and 2040 girls (52.6%). A majority of the students were ethnic minorities (Arabic American = 29, 0.7%; Asian = 213, 5.5%; African American = 1059, 27.3%; American Indian = 49, 1.3%; Hispanic = 441, 11.4%; Mixed Race = 387, 10.0%; and White = 1704, 43.9%). Their participation in the study was permitted by their parents/guardians. Parental consent and child assent forms approved by the university IRB were signed by the parents/guardians and the students, respectively and were received prior to data collection.

3.2. Variables and measures

3.2.1. Prior knowledge

Testing for both declarative and procedural knowledge, a 20-question standardized knowledge test about cardiorespiratory system, diet, and exercise benefits and principles was used to assess student physical activity knowledge. All the 20 test items were validated in previous pilot studies with acceptable difficulty index (ranging between 45% and 65%) and discrimination index (> 0.40). All the items were in the multiple choice format. An example of declarative knowledge question is “Regularly exercising at an overload pace makes my body become used to that level of work, which is called: …” Students can choose from four choices – “rate of exertion,” “physiological adaptation,” “intensity,” and “circulation.” An example procedural knowledge question is “An application of the principle of progression applied to pushups can be: ….” The answer choices are “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;” and “pushups performed in a random order.”

3.2.2. Interest in physical activity knowledge

The students' initial (beginning of the school year), formative (mid-year), and summative (end of year) interests in declarative and procedural knowledge were assessed using a self-report instrument. The survey items were selected from the Relevance of Science Education Scale (ROSE) created and validated by Schreiner & Sjöberg (2004). ROSE has been used in different cultural and international research settings to assess students' interest in scientific knowledge. The master version of the instrument, containing 106 items, was created in English, but it has been translated into many other languages (Schreiner & Sjöberg, 2004) (see http://roseproject.no/?page_id=16). ROSE was designed to measure middle school students' interests in various science knowledge domains including astrophysics, earth/geo science, human biology, zoology, botany, chemical, light and radiation, sounds, energy and electricity and technology (Schreiner & Sjöberg, 2004). The original version of ROSE provided flexibilities for users to make small modifications to target different knowledge domains. In this study, items were slightly modified to focus on both declarative and procedural knowledge that covers a broad range of content relevant to physical activity, health, nutrition, and fitness relevant for middle school students. An example item for interest in declarative knowledge is "I am interested in how the human body is built and functions." An example item for interest in procedural knowledge is "I am interested in how to exercise to keep the body healthy and fit." The modified ROSE included eight items on a 4-point scale (1 = not at all; 2 = not sure; 3 = somewhat interested; and 4 = very much interested); three items measure interest in procedural knowledge while five items measure interest in declarative knowledge. The internal consistency reliability coefficients (Cronbach α), based on the current sample, was 0.74 for the declarative dimension, 0.69 for the procedural dimension, and 0.81 for the entire scale.

3.2.3. Data collection procedure

Both the prior knowledge test and ROSE survey were transported to a web-based survey platform named Qualtrics to generate a hyperlink. All data collection sessions were conducted in participating school computer labs during scheduled physical education lessons. Physical education teachers, who were trained in the data collection protocols, were responsible for reserving the computer rooms for the data collection, organized the students, monitored them completing the knowledge test and interest survey, and maintained the order of data collection. The hyperlink was sent to physical education teachers on the testing day for them to insert in the web browser of the computers. The students were instructed to complete the test and survey independently. During data collection each student was working on a computer independently. Laptop computers were brought in in a few occasions where there were more students than the desktop computers to ensure that every student could respond to the survey independently.

A "forced response" function was selected in that the student had to respond to the current item before the computer screen allowed him/her to move to the next item. This function allowed students to self-pace their response and prevented missing data. As students proceed on the test and survey, their responses were saved in the Qualtrics server automatically. Qualtrics reported information on the duration that students took to complete the knowledge test and ROSE survey for reliability check.

The students took the knowledge test and the ROSE survey three times with even intervals throughout the school year to measure (initial, formative and summative) knowledge and interest in both declarative and procedural knowledge. The responses to the all three knowledge tests were graded according to pre-determined correct answer keys. All scores from the correct answers were summed and divided by the total number of questions (20) to generate percentage correct scores for analyses. The validity of ROSE measures was determined in this study. The results were reported in Results below. It was determined that the threat to data reliability could come from the comfort level of the testing setting and possible participant fatigue. The research team and the teachers made concerted effort to ensure the computer labs used in data collection provided comfortable seating and lighting. The students were allowed to take breaks during the testing. With the self-pacing mechanisms no students reported any fatigue during all testing sessions.

3.3. Data analysis

3.3.1. Construct validation analysis

A confirmatory factor analysis was used to test the construct validity of the survey items to determine the integrity of their psychometric properties in relation to the latent constructs they are intended to measure (Hancock, Kuo, & Lawrence, 2001). As delineated in the a priori models, students' interests in physical activity knowledge were constituted according to the two types of knowledge: declarative and procedural. Thus, in the confirmatory factor analysis, two latent interest constructs, interest in declarative and interest in procedural knowledge, were specified for testing. Fig. 4 shows the model tested in the confirmatory factor analysis.

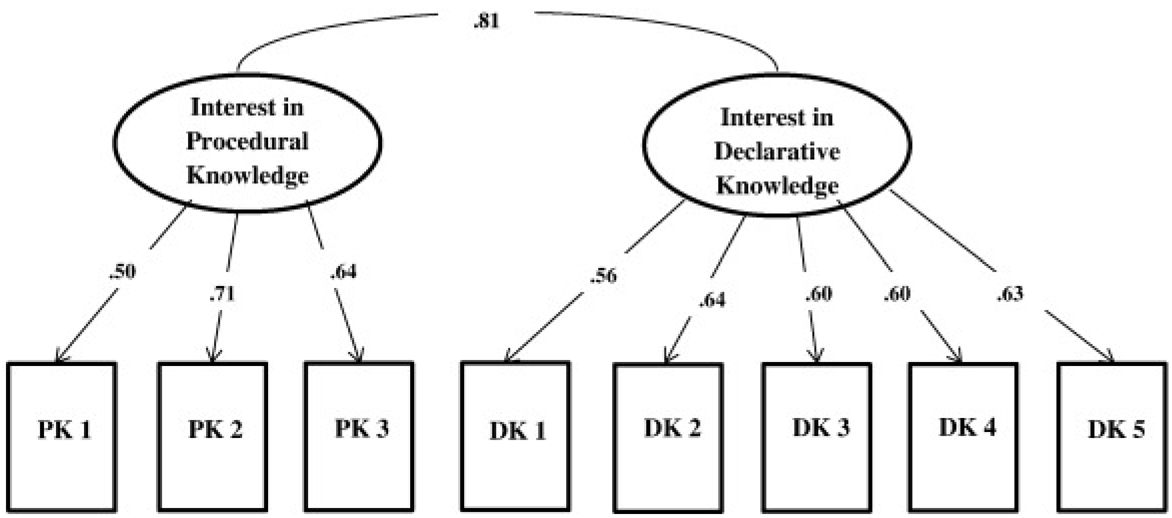

Fig. 4. The confirmative factor analysis model.

3.3.2. Analysis on interest change and knowledge-interest relation

To determine the structural relations between knowledge and interest in knowledge and the changes of this relation over time, a latent growth model was built according to the theoretical specifications. As a special parameterization of Structural Equation Modeling, "LGM provides estimates of many substantively important aspects of change, such as the status of individuals at some substantively interesting temporal reference (e.g., initial measurement point), their growth or change trajectory over time, and the amount of individual variability at a reference point and in rates of growth" (Hancock & Buehl, 2008, p. 39).

By using the IBM SPSS Amos 22.0, the a priori models (Fig. 1, Fig. 2) were specified and tested first. As it is shown in Fig. 1, Fig. 2, interests in declarative and procedural knowledge measured at three different time points were specified as the latent factors, named as initial, formative, and summative interest, respectively. Baseline interest in declarative and procedural knowledge and the rate of interest change were determined using two latent growth factors: Intercept (initial status) and Slope (change). The unstandardized loadings of the interests measured at the three times were fixed at 1.0 to represent the intercepts at these measurement points. The loadings from the Slopes were fixed at 0, 1, and 2 respectively to represents the average change per unit of time (i.e., between pre-term and midterm, midterm-end of the year). The models were then tested with these specifications. If tenability was not achieved, the models were subject to modifications that would generate alternative models for further testing. If the models were tenable, it could be concluded that the interests did change over time. Then a model re-specification would take place to incorporate the prior knowledge in the models to determine the nature and magnitude of the prior knowledge impact on the interest change (see Fig. 3).

3.3.3. Model evaluation analysis

Both the confirmatory factor analysis model and the latent growth models were evaluated using the standard model evaluation approaches and criteria. Although the χ^2 model fit index was calculated, the model-data fit evaluation relied on the following additional approaches and corresponding indexes due to the high sensitivity of χ^2 with sample size. The Comparative Fit Index (CFI) was used with Bentler (1990): acceptable > 0.90 and good fit > 0.95. The Mean Square Error of Approximation (RMSEA) was used based on Browne and Cudeck (1993) recommendations; acceptable < 0.08, good fit < 0.05; excellent fit < 0.02. Finally, the Standardized Root Mean Square Residual (SRMR) recommended by (Hu & Bentler, 1999) was also included with the acceptable criterion of < 0.08. Collectively, these indexes should provide reliable assessment and evaluation of the theoretical models.

4. Results

Table 1 reports the mean composite scores for students' initial, formative, and summative interest in procedural and declarative knowledge and the percentage of correct answers in the prior knowledge test. The mean scores were calculated as the average of the scores students gave to the three items that measured interest in procedural knowledge and five items that measured interest in declarative knowledge.

Table 1. Descriptive statistics for interest in procedural/declarative knowledge and prior knowledge ($N = 3882$).

	Mean	**SD**
Prior knowledge	0.28	0.11
Interest in declarative knowledge		
Initial	2.67	0.69
Formative	2.63	0.72
Summative	2.53	0.74
Interest in procedural knowledge		
Initial	3.03	0.71
Formative	2.94	0.74
Summative	2.86	0.77

4.1. Construct validation

The confirmatory factor analysis yielded a valid model with two latent factors, interest of procedural knowledge and interest of declarative knowledge. All the corresponding items initially specified to each were loaded according to the specification. In other words, each item has a non-zero loading, ranging from 0.50 to 0.71 (see Fig. 4), on the latent factor it was intended to measure and a zero loading on the other latent factor. The error/uniqueness terms associated with the item measurements are uncorrelated. The model fit indexes suggest a good fit of the model: CFI = 0.92, RMSEA = 0.09 (with a good, tight confidence interval of 0.09–0.10), and SRMR = 0.05. The results also show that there was a positive, high correlation (0.81) between the two factors, suggesting a shared variance of 64% between the interest in declarative and procedural knowledge. The correlation indicates that the interests in the two types of knowledge are highly likely to be related and change together.

4.2. Interest in declarative and procedural knowledge

The parameter estimates of the a priori structural equation models and the re-specified model are reported in Table 2. The LGM fit indexes for the a priori structural equation models and the re-specified model with the prior knowledge incorporated are reported in Table 2. The model fit indexes indicate excellent fit for all the models.

Table 2. The parameter estimates for interest in procedural and declarative knowledge (a priori and alternative models).

	Interest in procedural knowledge						Interest in declarative knowledge					
	A priori model			Prior knowledge as predictor			A priori model			Prior knowledge as predictor		
	Estimate	SE	P	Estimate	SE	P	Estimate	SE	P	Estimate	SE	P
Mean intercept	2.619	0.016	0.000	2.554	0.030	0.000	2.586	0.014	0.000	2.667	0.031	0.000
Mean slope	− 0.063	0.011	0.000	− 0.042	0.019	0.026	− 0.051	0.010	0.000	− 0.043	0.019	0.020
Group effect on intercept				0.012	0.004	0.010				− 0.015	0.005	0.003
Group effect on slope				− 0.004	0.003	0.180				− 0.001	0.003	0.648
Intercept variance	0.175	0.012	0.000	0.175	0.012	0.000	0.222	0.013	0.000	0.221	0.013	0.000
Slope variance	0.023	0.006	0.000	0.023	0.006	0.000	0.026	0.006	0.000	0.026	0.006	0.000
Intercept/slope covariance	− 0.008	0.007	0.271	− 0.008	0.007	0.265	− 0.003	0.007	0.664	− 0.003	0.007	0.701

In the structural equation model for the interest in declarative knowledge, results show that the middle school students overall have the average starting value of 2.586 for interest in declarative knowledge. The mean slope value, the average growth of interest in declarative knowledge was, − 0.051 ($p < 0.001$), indicating students' interest in declarative knowledge declined over time by 0.051 unit during each measurement time period. The variances of the intercept (0.222; $p < 0.001$) and slope (0.026; $p < 0.001$) are both statistically significant, suggesting there is significant variation in students' interest in declarative knowledge at the initial time point and following rates of change. The non-significant ($p = 0.664$) covariance between intercept and slope − 0.003 suggests that the students' interest in declarative knowledge at the initial time of measurement appeared to be unrelated to the rates of change over time.

For the latent growth model for the interest in procedural knowledge, the estimates show an intercept of 2.62, suggesting a modest level of initial interest in procedural physical activity knowledge. The slope value is − 0.06, indicating a decline in the interest over time. The intercept variance (0.18) is statistically significant ($p < 0.001$), suggesting a significant variability in the initial interest in procedural knowledge. In addition, the variance in slope value (0.02) is also statistically significant ($p < 0.001$), indicating different rates of interest change among the students. The non-significant covariance between intercept and slope − 0.008 ($p = 0.271$) suggests that the variability in initial interest appeared to be unrelated to the later changes.

The re-specified structural equation model with the prior knowledge incorporated a time-invariant covariate (explanatory factor) for both intercept and slope for interest in procedural knowledge, rendering an equally well model-data fit (Table 3). The parameter estimates show (reported in Table 2) that the prior knowledge was significant in slowing down the over-time decline of interest in both declarative (mean slope = − 0.043, $p = 0.02$) and procedural knowledge (mean slope = 0.042, $p = 0.026$) suggesting that the students with higher prior knowledge might be able to slow the pace of the interest decline. In addition, for every one unit increase of prior knowledge score, the students might increase the interest in procedural knowledge by 0.012 units ($p = 0.01$), but this relation becomes negative in the interest in declarative knowledge (− 0.015, $p = 0.003$). The significant variances of intercept and slope in both original and prior knowledge incorporated models reveal that students' initial interest in physical activity knowledge and the rate of their interest change are meaningful.

Table 3. The LGM Fit Index for Interest in Procedural and Declarative Knowledge (a priori and alternative models).

	Fit statistics					
Model	χ^2	**Df**	p	**CFI**	**RMSEA (CI)**	**SRMR**
Procedural						
A priori model	27.677	25	0.000	0.921	0.083(0.078–0.088)	0.0599
Prior knowledge as predictor	22.38	32	0.000	0.919	0.074(0.070–0.079)	0.0552
Declarative						
A priori model	9.009	90	0.000	0.957	0.045(0.043–0.048)	0.0308
Prior knowledge as predictor	8.377	103	0.000	0.955	0.044(0.041–0.046)	0.0303

To verify the impact of prior knowledge, a follow-up analysis was conducted by re-impose the verified model on students who scored in the highest quartile of the prior knowledge test ($n = 1266$). Results show that their initial interest in procedural knowledge was significantly higher with an intercept of 2.691 ($p < 0.001$) and a much smaller interest decline – a slope of − 0.043 ($p < 0.001$). Similar results were observed in students' interest in declarative knowledge: an intercept of 2.684 ($p < 0.001$) and a slope of − 0.022 ($p = 0.242$), suggesting a non-significant decline of interest in declarative knowledge.

5. Discussions

The purpose of the study was to identify the role of prior physical activity knowledge in changes of interest in physical activity knowledge in students in middle school, a critical age when their motivation for physical activity seems to steadily decline. Specifically, the study was focused on answering two research hypotheses: that the interests in declarative and procedural physical activity knowledge would change over time and that students' prior physical activity knowledge played a role in the changes in the interests. Two structural equation models were theorized and tested following a specified steps of model testing sequences.

There are three major findings from the analysis. One, the interests in both declarative and procedural knowledge steadily declined over a period of one school year. Not only did the students experienced significant decline in interest in knowing the science of physical activity as facts (declarative knowledge) but also in interest in knowledge how to safely and effectively exercise (procedural knowledge). At a time when the knowledge has become important contributor to health and quality of life (Whitehead, 2010), this decline should sound an alarm for all health and physical educators and allied health professionals.

The second important finding is the explicitly high association between the interests of declarative and procedural knowledge. Although the interests were tested separately in the structural equation models, the link was implicated in the inner connection as specified in Fig. 3. In addition, the strong relationship (0.81 in Fig. 4) is clearly observable in the confirmatory factor analysis model which is the appropriate analytical context in which the relationship should be tested. The types of knowledge can be likened as two sides of a coin. They look separate but function together. But recent arguments about the relation assert that the sides of the coin can be very different because one type of knowledge may depend on the other. For example, Anderson (2007) convincingly argues that all procedural knowledge starts as declarative knowledge. In other words, before one can act, he/she must have declarative knowledge, no matter how vague or unstable it is. The findings seem to support the argument with parallel estimates in the intercepts (initial status of the interest) and slopes. This relationship is also implied by the mirrored resemblance of the estimates with the prior knowledge (see Fig. 3). The results have raised a new question for us to study: to what extent this relation will be actualized in students' behavior? In other words, how much declarative physical activity knowledge will lead to effective mastery of procedural knowledge and be turned into action of actual participation in health-enhancing physical activities in schools and communities?

The third important finding is the role of prior knowledge in the interest in physical activity knowledge. The estimates in Table 2 show clearly that when prior knowledge was incorporated in both models, the interest decline rate (mean slope) slowed from − 0.063 to − 0.042, and from − 0.051 to − 0.043. The result indicates that high prior knowledge reduced the rate of interest decline in both types of knowledge.

When coupled with the results from the follow up analysis, the above findings seem to confirm what Alexander et al. (1994) have been arguing: prior knowledge determines the strength of personal interest and its change rate. Our findings, although preliminary in this regard, suggest that the positive relationship between interest in physical activity knowledge and the actual prior knowledge level can be weak in students with low and intermediate levels of prior knowledge. The relationship, however, will be strong in students with high level of prior knowledge. Taking into account the longitudinal nature of the data based on which the analyses were performed, we probably can conclude that with increased knowledge over time, the interest in the knowledge (and learning the knowledge) will become stronger.

Previous research suggests that physical skill levels work as a basis for youth's physical activity participation (Williams et al., 2008). Nevertheless, the development of physical skill often takes many years and requires specific instruction (Clark, 2007). As a result, students with low physical skills are more unlikely to become motivated to participate in physical activities. The above findings provide informative insights for an alternative approach through which students can possibly develop interest in participating in physical activities. By teaching physical activity knowledge strategically, we can potentially improve students' interest in learning both declarative (e.g., the fact about human bodies and physical activities) and procedural (how to perform appropriate activities for health benefits) knowledge. The improved interests have the potential to contribute to students' participation in physical activity.

The evidence suggests that it is necessary to consider students' prior knowledge as a basis for developing a strong interest in physical activity and knowledge associated with physical activity and health. It is safe to state that the low interest in physical activity may be attributed to the deficit of prior knowledge in the domain of physical movement, regardless declarative or procedural. The continuous decline of interest in physical activity knowledge may be due to the fact that students lack opportunities to systematically accumulate the knowledge. Consequently, students with relatively low prior knowledge may not be able to maintain their interest and may lose it entirely over time.

6. Conclusions

The significant decline of the interest in physical activity knowledge found in this study calls for scholars and educators' attention on the change of students' interest in physical activity knowledge and the possible factors that may influence to the change. The findings indicate that students' prior knowledge can be one of such factors worth further studying, and suggest that systematically providing necessary knowledge to students through effective teaching in physical education has the potential to address the decline of interest. For practice, the findings call upon physical educators to balance their content knowledge – promoting students' engagement and interests on both procedural and declarative dimensions.

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