Study on learning strategies in elementary school physical education

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Abstract:

Problem Statement: The Japanese elementary school's Course of Study, having been fully implemented in April 2020, aims to create high-quality learning and enable people to actively engage in such learning throughout their lives. Though the importance of potential future benefits and the need to develop optimal approaches to learning emphasizing "how learners learn" and learning strategies in physical education have been suggested, the conditions for learning strategies in elementary school physical education, however, have not been adequately researched. **Approach:** A pilot survey was conducted and was followed by a main survey conducted with 1,450 public elementary school students across Japan, using the questionnaire survey method. **Purpose:** This study examines learning strategies employed by Japanese elementary school students in physical education through the development of the Learning Strategies in Elementary School Physical Education scale. It also examines students' characteristics according to grade and sex. **Results:**The results indicated that learning strategies in elementary school physical education consist of five factors (15 items): emphasis on learning discipline, challenging work, importance of teachers' instructions, cooperative effort between peers, and thinking and judgment. The reliability and validity of the learning strategy scales were confirmed by internal consistency and construct validity. We examined differences between grades but found no significant differences for any factor. Regarding sex differences, scores were significantly higher for boys than girls for challenging work. **Discussion:** Elementary school learners' strategies in physical education can be understood in terms of five factors, but the factors we identified vary substantially from those identified in previous research. This may have resulted from our collection and selection of items through a pilot free-text study. Learning strategies of elementary school learners did not include factors such as "creation of fun" or "fair work," which were identified for older students. Such learning strategies may be acquired later in their educational progression. **Conclusions:** The use of a variety of learning strategies in elementary school physical education enhances learning and shapes subsequent physical education performance. These strategies may evolve as students progress through later educational stages.

Key Words: learning strategies, Japanese elementary school, physical education, grade differences, sex differences

Introduction

The Japanese elementary school's Course of Study¹ (Ministry of Education, Culture, Sports, Science and Technology, 2018a), fully implemented in April 2020, aims to realize high-quality learning and enable people to actively engage in it throughout their lives. The method of qualitatively enhancing the learning process can be found in the perspectives and ideas section of each subject.

The perspectives for physical education are summarized as "to understand exercise and sports regarding their role in improving physical fitness, providing enjoyment and pleasure, paying attention to their values and characteristics, and relating that to diverse ways of doing, seeing, supporting, and knowing according to one's strengths and other qualities" (Ministry of Education, Culture, Sports, Science and Technology, 2018b, p.18). Hence, the aim is to promote proactive, interactive, and authentic learning while making use of these perspectives and ideas. This suggests the importance of future benefits and optimal approaches such as the process learning strategies in physical education.

This study focuses on learning strategies in physical education, defined as "mental processes or activities intended to increase learning effects" (Tatsuno, 1997, p.11). These strategies may propose a variety of roadmaps to learning and are classified into three main categories: 1) cognitive strategy that draws attention to the learning content and devises ways to retain it, 2) metacognition strategy that draws attention to the status of your cognition, and 3) external resource strategy that utilizes external resources such as tools and other people (Uesaka, 2010). Each learning strategy can be further divided into subcategories (e.g., Pintrich et al., 1993, Weinstein and Mayer, 1986; Zimmerman and Martinez-Pons, 1986)

Based on this, we assume that learners tackle learning using various learning strategies. Considering the centrality of learning strategies in discussions on the learning process, their evaluation in physical education should be highly meaningful for deepening learning in that subject.

Japanese studies on learning strategies have mainly focus on individual subjects, specifically in mathematics (Hirose et al., 2013; Ichihara & Arai, 2005, 2006; Oshimi, 2017; Teranishi, 2008), English (Akamatsu & Fujioka, 2015; Shinogaya, 2014), Japanese, (Ichihara & Arai, 2005; Oshimi, 2017), geography, and history (Murayama, 2003). These studies reveal that learners use various learning strategies that reflect the characteristics of the relevant educational stage and subject.

Two studies that discuss the strategies in physical education are by Ito (2001) and Ono et al. (2018). Ito (2001) examined the association between learning motives and strategies for elementary school physical education and found that different strategies are used depending on the motivation. He also examined them in elementary school physical education by developing an elementary school physical education learning strategy scale and focusing on three factors (general, purpose-oriented, and effort-based). The scale was based on items in the self-regulated strategies scale developed by Hayami (1993) that were closely related to physical education, including factors with low alpha coefficients. Ito (2001) included these factors provided that they had valid content and the primary aim was not the development of a learning strategy scale. Moreover, the developed scale has not been validated.

Ono et al. (2018) examined the association between learners' views and learning strategies in junior high school physical education and revealed that diverse strategies are used to develop knowledge and acquire skills related to the subject through an acquaintance with various views on learning in physical education. In this study, a junior high school physical education learning strategy scale was developed with seven factors of learning strategies: emphasis on learning discipline, cooperative effort between peers, creation of fun, challenging work, fair work, engagement with teachers, and thinking and judgment.

The abovementioned studies clarify that learners use various learning strategies that reflect the characteristics of the relevant educational stage and subject in Japanese physical education. Moreover, they use strategies unique to the subject while relating them to learning motives and views. Based on these studies, we may infer that the conditions of learning strategies can be examined in detail by focusing on specific educational stages and subjects.

Nonetheless, we can also point out the following limitations of past research.

First, only a few studies focus on Learning Strategies in Japanese Elementary School Physical Education. Considering the aim of the Course of Study, the importance of learning strategies increases. Based on this, we can conclude that there is a need for a more detailed examination of Learning Strategies in Elementary School Physical Education.

Second, there are issues with scale development. As mentioned above, Ito (2001) did not conduct any pilot study with elementary school students to collect scale items, and instead, based them on existing scales that were considered to be closely related to physical education. Therefore, it is difficult to claim that they were able to identify learning strategies that reflect the actual conditions of physical education. Moreover, it is necessary to reexamine the scale's development, such as the inclusion of factors with low reliability and its validity.

This study collects and carefully chooses statements through a pilot study that allows free-text responses. We believe this makes it possible to collect scale items that reflect the actual conditions of elementary school physical education.

Thus, the Learning Strategies in Elementary School Physical Education have not been clarified. Their clarification promotes learning tailored to individual learners and improves the quality of educational practices.

This study aims to assess the Learning Strategies of Japanese Elementary School Students in Physical Education by developing an elementary school student physical education learning strategy scale and examine the characteristics of the learning strategies according to grade and sex.

Material & methods

Pilot study

For this research project, a pilot study was conducted to collect and select statements on Learning Strategies in Elementary School Physical Education.

The pilot study was conducted in January 2018 at three public elementary schools in Tokyo, Japan. The subjects were 309 children (150 boys and 159 girls) in the fifth and sixth grades of elementary school. The survey was carried out in groups during school hours and according to class.

It consisted of a questionnaire asking, "How do you engage with physical education?" and sought a free-text response.

The questionnaire was administered anonymously, and consent was obtained by explicitly stating that all questions were voluntary and that there was no compulsion to answer any question. We used the same method for both grades.

With the free-text responses, we first excluded responses that were not related to the question and subsequently extracted 246 statements about Learning Strategies in Elementary School Physical Education.

Next, the statements were classified based on the similarity with the help of three graduate students specializing in physical education pedagogy. Following repeated discussions, we agreed on the following five concepts for Learning Strategies in Elementary School Physical Education: emphasis on learning discipline, cooperative effort between peers, importance of teacher's instruction, challenging work, and thinking and judgment. We prepared scale items based on statements classified into the identified concepts. We also tried to clarify by merging statements with similar content. With the help of eight current elementary school teachers, we revised and modified the items prepared to make them easy to understand.

Next, we verified content validity by asking eight undergraduate students specializing in physical education to classify 15 items related to learning strategies into one of the abovementioned five concepts and assessing their rate of agreement. Items with lower than 60% agreement were removed.

As a result, we selected 15 items to measure Learning Strategies in Elementary School Physical Education. The pilot study was approved by the research ethics committee of the university to which the primary author belongs.

Main survey

The main survey was conducted in 13 public elementary schools in Tokyo, Saitama, and Kanagawa Prefecture, Japan, from January to March 2019. There were 1,450 participants (705 boys and 745 girls), with 742 fifth graders (344 boys and 398 girls) and 708 sixth graders (361 boys and 347 girls). After excluding incomplete and incorrect responses, 1,217 valid responses (594 boys and 623 girls) were included in the analysis. The survey was conducted in groups during school hours and class by class. Moreover, all classes were a mix of boys and girls.

For the statistical processing, we used SPSS (Version 25.0).

As with the pilot study, we obtained consent for the survey by explicitly stating that all questions were voluntary, and there was no compulsion to answer a question. We used the same method for both grades.

Along with grade and sex, respondents were asked to answer the question, "Do you like or dislike physical education?" for scale validation. The reasons are as follows.

Previous studies on other subjects (e.g., mathematics and Japanese) have shown that learning strategies are used in various ways (Oshimi, 2017). Moreover, those studies on physical education have shown that learners who dislike physical education are more passive toward or avoidant of the subject (Sasaki and Suko, 2016). Also, those with a positive attitude toward it use more diverse learning strategies (Ito, 2001).

Hence, attitudes toward physical education may result in differences in the use of learning strategies. Thus, as a hypothesis for validity testing, we predicted that the more a student likes physical education, the higher they will score on items that measure learning strategies in physical education and vice versa.

Moreover, for the 15 items selected through the pilot study, respondents were asked to choose one of the following options: "very true (4 points)," "true (3 points)," "somewhat true (2 points)," and "not true at all (1 point)."

Results

Exploratory factor analysis

Item analyses were conducted on 15 items measuring Learning Strategies in Elementary School Physical Education. To investigate item bias, we examined items with a mean value of ≤ 1.5 , or ≥ 3.5 , those with extremely small standard deviations, and with 70% aggregation around specific frequencies in the normal frequency distribution. No relevant items were identified. We calculated the correlation coefficients for all the items. There were no values above .70.

Next, we performed an exploratory factor analysis (EFA; maximum likelihood, promax rotation) of the 15 items, resulting in the extraction of five factors (Table 1). Furthermore, looking at factor loads, there were no items with a load $<.40$, and no two items $\geq .40$.

Table 1. Elementary school students' physical education learning strategy scale (promax rotation) and inter-factor correlations

Items	I	II	III	IV	V
I Emphasis on learning discipline ($\alpha=.81$)					
In physical education, we prepare and tidy up properly.	.73	-.12	.06	.12	.03
In physical education, we are serious and do not joke around.	.72	-.02	-.01	.05	-.04
In physical education, we pace ourselves and move quickly.	.70	.04	-.11	.05	.12
II Challenging work ($\alpha=.81$)					
In physical education, we aim to do better.	-.08	.78	-.02	.11	.05
In physical education, we do our best to achieve our goals.	-.03	.71	.05	.03	.11
In physical education, we practice repeatedly until we can do it.	.04	.71	.08	-.09	-.04
III Importance of teacher's instruction ($\alpha=.80$)					
In physical education, we listen carefully to what the teacher says.	.14	-.04	.86	-.02	-.07
In physical education, we remember the points we learn from teachers.	-.07	.12	.73	.06	.04
In physical education, we do as the teacher says.	-.13	.05	.67	-.03	-.03
IV Cooperative effort between peers ($\alpha=.80$)					
In physical education, we get advice from friends.	-.09	-.11	.03	.82	.18
In physical education, we give advice to friends.	.24	.23	-.15	.66	-.23
In physical education, teamwork is important.	.15	-.07	.23	.58	.04
V Thinking and judgment ($\alpha=.79$)					
In physical education, we imitate the movements of others who are good.	-.17	-.01	-.06	.18	.79
In physical education, we think about what we should do to become better.	.21	.08	-.03	-.07	.68
In physical education, we think about how to use the body correctly.	.29	.07	.04	-.21	.56
	I	-	.13	.30	.55
	II		-	.44	.51
Factor correlation	III			-.56	.19
	IV				-.23
	V				-

The five factors were named based on their items' characteristics. Factor 1 is named "emphasis on learning discipline" because it contains items such as "In physical education, we prepare and tidy up properly" that relate to discipline for smooth learning. Factor 2 includes items such as "In physical education, we aim to do better" that relate to challenging yourself and is hence, named "challenging work." Factor 3 was named "importance of teachers' instructions" as it includes items such as "In physical education, we carefully listen to what the teacher says" that relates to learning while observing the teacher's instructions. Factor 4 includes items such as "In physical education, we get advice from friends" that relate to learning through cooperation with peers, and is hence, named "cooperative effort between peers." Factor 5 was named "thinking and judgment" because it contains items such as "In physical education, we imitate the movements of others who are good" that relate to learning while thinking and observing.

Subsequently, we calculated Cronbach's alpha as the reliability coefficient for the five factors to examine the scale's internal consistency. The results showed the coefficient alpha was .81, .81, .80, .80, and .79 for factors 1 to 5, respectively. We calculated the coefficient alpha of .70 or more for all factors, confirming a certain degree of internal consistency.

The scale developed for this study was called the Learning Strategies in Elementary School Physical Education scale.

Validity verification

To test the construct validity, we conducted a one-factor analysis of variance (Table 2) on the subscales of the scale, dividing the respondents' attitude toward physical education into three categories: "like," "neither like nor dislike," and "dislike."

The results showed significant main effects for "emphasis on learning discipline" ($F(2,1416)=5.49$, $p<.01$), "challenging work" ($F(2,1416)=48.73$, $p<.001$), "importance of teacher's instruction" ($F(2,1416)=5.02$, $p<.01$), "cooperative effort between peers" ($F(2,1416)=17.31$, $p<.001$), and "thinking and judgment" ($F(2,1416)=21.47$, $p<.001$). Multiple comparisons showed that the scores of students in the "like" group were significantly higher for "challenging work," "cooperative effort between peers," and "thinking and judgment," than of those in the "neither" and "dislike" groups ($p<.001$). Moreover, the scores of those in the "like" group were significantly higher for "emphasis on learning discipline" and "importance of teacher's instruction" than of those in the "dislike" group ($p<.01$).

These findings reveal that learners who like physical education have significantly higher scores on items that measure Learning Strategies in Physical Education. Thus, the predicted results support our hypothesis for validity.

Table2. Differences in learning strategies based on attitudes toward physical education

	(A) Like (N = 790)		(B) Neither (N = 338)		(C) Dislike (N = 89)		F Value	Multiple comparisons
	M	SD	M	SD	M	SD		
Emphasis on learning discipline	3.00	.82	2.91	.74	2.73	.80	5.49 **	A > C
Challenging work	3.05	.79	2.77	.76	2.26	.87	48.73 ***	A > B, C B > C
Importance of teacher's instruction	2.96	.75	2.89	.73	2.70	.88	5.02 **	A > C
Cooperative effort with peers	2.96	.84	2.78	.82	2.47	.82	17.31 ***	A > B, C B > C
Thinking and judgment	2.98	.81	2.79	.77	2.45	.84	21.47 ***	A > B, C B > C

** $p < .01$, *** $p < .001$

Examination of fundamental statistics, and grade and sex differences in the scale

To calculate the basic statistics of the physical education learning strategy scale as well as the grade and sex differences, we conducted a two-factor analysis of variance with grades (fifth- and sixth graders) and sex (boys and girls) as the factors (Table 3). No interaction was observed in the results. A significant main effect of sex was found in “challenging work” ($F(1,1213) = 7.43, p < .01$), with boys scoring significantly higher than girls.

Table3. Scale basic statistics and grade and sex differences

	Fifth-year (<i>N</i> = 462)				Sixth-year (<i>N</i> = 404)				<i>F</i> Value			Multiple xomparisons
	Boys (<i>N</i> = 216)		Girls (<i>N</i> = 246)		Boys (<i>N</i> = 209)		Girls (<i>N</i> = 195)		Years	Sex	Interaction	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Emphasis on learning discipline	2.94	.80	2.96	.83	2.98	.78	2.96	.78	.30	.01	.18	
Challenging work	2.95	.80	2.89	.83	3.02	.77	2.82	.85	.01	7.44 **	1.95	Boys > Girls
Importance of teacher' s instruction	2.89	.76	2.98	.74	2.89	.76	2.93	.78	.23	2.22	.29	
Cooperative effort with peers	2.82	.84	2.89	.86	2.91	.83	2.88	.85	.65	.08	1.15	
Thinking and judgment	2.89	.81	2.84	.81	2.96	.82	2.86	.80	1.01	2.34	.33	

** $p < .01$

Discussion

Factor structure of elementary school physical education learning strategies

An EFA examined the factor structure of Learning Strategies for Physical Education in Japanese Elementary Schools. We demonstrated that these learning strategies can be understood as the five factors (15 items): emphasis on learning discipline, challenging work, importance of teacher's instruction, cooperative effort between peers, and thinking and judgment.

First, we extracted “emphasis on learning discipline.” The items of the factor are related to securing learning time and none are related to preventing injuries such as warm-up or cooldown exercises, which is occurs in junior high school students. Since the one-hour unit in Japanese elementary schools is 45 minutes, it is necessary to include warm-up and cooldown exercises as well as prepare and remove equipment in the limited time. Specifically, some time is required to prepare and remove equipment that is bigger than the students (e.g., vaulting boxes) as elementary school students are still developing physically. This suggests that learning discipline is emphasized to ensure sufficient exercise in the limited time.

Second, we extracted “challenging work.” We consider this to be similar to “rehearsal strategy,” a strategy included in general learning. It is responsible for retaining information in short-term memory and converting it into long-term memory through repeated recitation or copying (Tatsuno, 1997). Specifically, in physical education, teaching materials based on units are effective for acquiring basic skills. Similar factors were also extracted for physical education learning strategies among junior high school students, and there were no major differences in item content. This can be attributed to the development of a rehearsal strategy from pre-school to the upper grades of elementary school (Tatsuno, 1997). Third, we extracted “importance of teacher's instruction.” It consists of learning items with awareness of teacher instructions. However, physical education learning strategy for junior high school students, where a similar factor (“engagement with teachers”) was extracted, includes not only passive learning behaviors such as “listening to the teachers” but also behaviors through which the learners engage with the teacher such as “asking questions” (Ono et al., 2018). Elementary school students view teachers in more absolute terms than junior high school students, and the latter can be friendly with the teacher more easily than elementary school students (Misumi and Yamori, 1989; Murakami et al., 2012). This suggests that a difference in how learners view teachers influences their engagement with

learning. Fourth, we extracted “cooperative effort between peers.” We think this corresponds to “help-seeking strategy,” a strategy used in general learning. This refers to receiving assistance from teachers and friends and is considered a key opportunity to learn problem-solving skills from others (Uesaka, 2010). In physical education, small-group learning is employed according to the learning content, so there are many opportunities for peer learning. Learning deepens through cooperative efforts between peers. Meanwhile, a similar factor was extracted for physical education learning strategies among junior high school students, although the elementary school factor consisted of simpler items. This indicates that cooperative approaches become more diverse in the latter stages of education.

Fifth, we extracted “thinking and judgment.” This factor appears similar to “comprehension monitoring strategy,” a strategy used in general learning. This is an approach to establish learning goals, assess progress toward those goals, and modify strategies if needed (Seo et al., 2008). Since the development of motor skills is defined as a learning task in physical education, we may infer that learners engage in learning while deepening their understanding of their performance and that of others. A similar factor can also be found in the physical education learning strategies of junior high school students, with no major differences in item content. However, with school-stage progression, there should be an increase in knowledge about exercise, so that junior high school students engage in the subject with a deeper understanding of exercise than those in elementary school.

Thus, we have shown that elementary school learners’ learning strategies in physical education can be understood in terms of five factors. The factor structure revealed in this study significantly differs from that of Ito (2001). This may be due to our collection and selection of items through a pilot free-text study. At the same time, although we conducted a pilot free-text study, the learning strategies of elementary school learners did not include factors such as “creation of fun” or “fair work,” which we have seen for junior high school students. This suggests that these learning strategies among junior high school students are acquired through school-stage progression.

Regarding grade and sex differences

First, when examining grade differences, we found no significant differences in any of the factors. For junior high school students, this has been observed as differences in learning accumulation (Ono et al., 2018), suggesting that this is characteristic of elementary school students. The guidance content for physical education in elementary school, as defined in the Course of Study, changes every alternate school year (Ministry of Education, Culture, Sports, Science and Technology, 2018b). Therefore, it is reasonable to classify the teaching content into two-grade pairs. Next, we examined sex differences and found that the scores of “challenging work” were significantly higher for boys than for girls. There was no significant sex difference in the corresponding factor among junior high school students (Ono et al., 2018), and hence, this seems to be characteristic of elementary school students. This could be because of differences in confidence in performing physical activity and exercise in the upper grades of elementary school. According to Sato et al. (2011), boys in the upper grades of elementary school have longer periods of high-intensity physical activity during school holidays than girls. According to Ono and Kaji (2020), boys in the upper grades of elementary schools are more confident than girls that they can “do” exercises and sports if they are allowed to practice. Hence, boys who are more active on a daily basis are more tenacious in physical education as well.

Conclusions

The results of this study clarified that learners use various Learning Strategies in Elementary School Physical Education. Among them, we identified factors related to proactive, interactive, and authentic learning. For example, “challenging work” is thought to relate to “proactive learning,” which is linked with tenacious engagement with foresight. Moreover, “cooperative effort between peers” is related to “interactive learning,” which extends and deepens the learners’ thinking through peers’ advice. Similarly, “thinking and judgment” is related to “authentic learning,” which is about detecting and resolving issues in your movements.

Moreover, we assume that the learning strategies revealed in this study are similar to those used in junior high school physical education, with the strategies becoming more complex and advanced with the progression of school-stage. Based on these findings, we believe that the use of a variety of Learning Strategies in Elementary School Physical Education not only deepens learning but also shapes the way they learn physical education. Hence, teachers need to grasp learners’ Learning Strategies in Physical Education to support their learning. The physical education learning strategy scale developed in this study is useful for grasping such strategies and can be applied in teaching physical education. Through this, teachers can better understand Learning Strategies in Physical Education, which allows them to envision teaching that is aimed at realizing independent, interactive, and in-depth learning more clearly. Finally, we discuss the limitations of this study.

First, this is a longitudinal perspective. The present study was cross-sectional in nature. Therefore, changes in the use of learning strategies through grade progression need to be analyzed longitudinally.

Second, the development of a simpler scale that can be used in teaching physical education is required. As learners would use this scale in a limited amount of time, the development of a simpler scale is required.

Finally, there is a need for examining the correlations with other concepts. In this study, we focused solely on learning strategies due to a dearth of previous studies, but future research needs to investigate the relationships by keeping in mind learning and motives as well.

Notes - In Japan, the Ministry of Education, Culture, Sports, Science, and Technology provides national standards for the organization of educational curricula based on the School Education Act. These standards are termed the “Course of Study,” wherein objectives for each academic subject, as well as rough educational content, are defined for each educational stage, from elementary school to junior high school and high school.

Conflicts of interest - The authors have no conflicts of interest to declare.

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