

Developing teaching materials that integrate judo games for physical education lessons targeting lower elementary students (7-year-olds)

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Abstract:

From 2012 onward, judo has been a compulsory element in physical education lessons in junior high school in Japan. However, because judo is only introduced in junior high school, it is not part of the systematic curriculum that considers the stages of child development from elementary school on does not exist, unlike other sports, such as apparatus gymnastics and swimming, to which students are exposed in elementary school. Therefore, this study seeks to develop a set of teaching materials that incorporate judo games teaching basic judo moves into the physical education lessons of lower-elementary-school students (7-year-olds), and evaluate its usefulness in ensuring systematic progression between physical education lessons in elementary school and junior high school. The practical implementation of these lessons took place at an elementary school affiliated with a national university in Kagoshima Prefecture. The target students were 18 boys and 17 girls, for a total of 35 second-grade students. Six lessons were planned and implemented in February 2020. When evaluating the usefulness of the teaching materials developed, objective evaluation and subjective evaluation were considered together with tests of physical skills and motor ability. The results of this study show that in formative evaluation, used as a form of objective evaluation (Takahashi, 2003), there was an increase in assessment scores for the three elements—outcome, learning method, and cooperation—together with the total assessment scores. When students were asked to subjectively evaluate themselves in seven categories, including showing more awareness of their own bodies, adjusting the force used, and showing more awareness of other people's bodies, six categories received higher scores in the second half of the teaching unit. In the test of physical skills and motor ability, at the end of the sixth lesson, both male and female students achieved higher scores in all three categories tested. Thus, the teaching materials developed in this study, which incorporate judo games that teach basic judo movements, have a strong possibility of being useful for physical education lessons targeted at 7-year-olds. The learning content developed in this study can be used beyond physical education lessons as it is generic and practical enough to be used as an instructional program in judo clubs targeted at children of similar age.

Key Words: Judo, judo instruction, physical education lessons, development of teaching materials

Introduction

In Japan, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) stipulates a set of curriculum standards to ensure that all schools in the country can maintain and provide education at a certain level. This set of standards is referred to as the Courses of Study, which are revised approximately every 10 years, considering social changes, such as globalization, rapid informatization, and technological innovation, among other factors, as a reconsideration of the qualities and skills essential for students to survive in today's world (MEXT, 2011). For physical education, both versions, 2008 and 2018, of the Courses of Study (MEXT, 2008a, 2018a) emphasize the cultivation of a foundation that will allow students to be enriched with sports for life beyond their schooling years; they call for a systematic approach spanning the 12 years of education, from elementary school to high school. More specifically, students' developmental stages are divided into three periods of four years each: the years between 6 and 9 are for the development of a foundation for various sports; between 10 and 13, students experience sports across various areas; and the last four years, between 14 and 17,

are positioned as a period to connect students to lifelong enjoyment of sports. For students attending junior high school (ages 12 to 14), the learning objectives are categorized on the basis of each of the three school years and explicitly stated. In particular, it is clearly stated that for the first and second years of junior high physical education, it is important to ensure continuity with elementary school physical education.

However, martial arts, such as judo, are only introduced in junior high school, which means that a systematic curriculum from elementary school that considers students' developmental stages does not exist, unlike sports in other areas, such as apparatus gymnastics and swimming. As the basic attitude of the Courses of Study revised in 2018 (MEXT, 2018c) clearly refers to "systematic instruction throughout 12 years of schooling, which is based on students' developmental stages," the fact that such a curriculum does not exist must be seen as a problem. Martial arts lessons, including judo, became compulsory in physical education from 2012 onward. Based on a report by Ryutsu Keizai University (2020), judo is the most common martial art taught in Japanese junior high schools, followed by kendo and sumo in that order. Simultaneously, bearing in mind the mandatory nature of the judo lessons, Uchida (2011) points out the danger to students because of the higher occurrence of serious injuries or incidents leading to death in this sport than that in others. Other studies related to accidents in judo also exist (Murata, 2011; Hamada & Mizuochi, 2010; Fujisawa et al., 2016). According to MEXT (2012), a notable feature of serious injuries in judo is their relatively higher frequency in first-year junior high students and first-year high-school students. To improve this situation, it is important to construct a systematic curriculum based on students' developmental stages.

Miyashita (1984) indicates that the best time to learn physical movements in sports is from middle elementary school (ages 8 and 9) to higher elementary school (ages 10 and 11), when annual growth reaches its peak. It has also been reported that it is essential for students to acquire various kinds of physical movements before reaching this stage. MEXT (2008b) produced a pamphlet that explicitly states that lower-elementary-school years and junior-high-school years, due to the rapid development of the brain and the nervous system, are the best time to acquire basic physical movements, where the various senses, such as looking, listening, touching, and feeling, are put to work, participating in sports where students have to maintain physical balance while moving their locomotive organs, such as arms and legs, adjust how much force to use, and so on. If we consider the points noted by Miyashita (1984) and MEXT (2008b), it is crucial to develop teaching materials for students beginning lower elementary school in the case of a sport such as judo that does not have a systematic curriculum in place.

In judo, participants attempt to directly tackle each other to throw their opponent off balance while defending themselves against being thrown (MEXT, 2013). Both noncontact sports, such as track and field, swimming, and apparatus gymnastics, and contact sports, such as ball games in the forms of basketball, soccer, and handball, have been implemented as mandatory sports in Japanese physical education. From 2012 onward, the martial arts judo, kendo, and sumo have been added to the mix. These sports require participants to physically tackle their opponents, attack, and execute techniques, while defending themselves from their opponents' techniques, with a high level of direct body contact. When considering a systematic curriculum for judo under the existing curriculum, the most appropriate method of establishment would be to develop teaching materials that encourage the acquisition of basic movements associated with junior high school judo within "sports games that aid in the acquisition of various types of physical movements" under the "general physical fitness" category of elementary school physical education, which specifies that students discover their own mental and physical conditions and experience various kinds of physical movements such as testing their physical strength enjoyably, while engaging with other people.

After judo became a mandatory sport in physical education, research on junior-high-school students and judo has been conducted (Ozawa et al., 2014; Ozaki & Suganami, 2014; Kawato, 2015; Yogi & Kyan, 2021b). However, other than the report by Yogi et al. (2020), there does not seem to be any research that sees the existing lack of a systematic curriculum between elementary school and junior high school as a problem and therefore focuses on developing teaching materials for physical education in elementary school. Yogi & Kyan (2021a) conducted a survey that targeted physical education teachers in junior high schools, demonstrating that many teachers are concerned about the dangers that accompany judo instruction. Moreover, it also found that many teachers consider it desirable to provide systematic instruction for judo in elementary school.

The above study from Yogi et al. (2020) attempted to develop teaching materials that focus on the basic judo movements of gripping and falling to be put to use under the category of general physical fitness in physical education in elementary school. However, given that teaching materials for physical education in elementary school should be generic and widely transferrable to other domains, it is necessary to develop teaching activities that include learning contents stipulated under the category of general physical fitness in the Courses of Study for elementary school physical education (2018b). Therefore, this study develops teaching activities that incorporate judo games, teaching basic judo movements under the component of sports games,

which build various kinds of physical movements in the category of general physical fitness, targeted at lower-elementary-school students (7-year-olds), and evaluates their usefulness.

Material & methods

(1) *Learning content for physical education that incorporates judo games*

In the Courses of Study section on physical education in elementary school (MEXT, 2018b), students are expected to experience basic physical movements enjoyably through moving, manipulating various equipment, maintaining balance, and testing their own strength and physical abilities, while also being aware of their own mental and physical condition and engaging and interacting with other people.

This is to be achieved through sports games that build various physical movements aimed at lower-elementary-school students under the category of general fitness ability. Four kinds of sports games are described: games involving maintaining balance (posture, rotating, lying down, standing up, and so on), games involving moving (crawling, walking, running, etc.), games involving manipulating equipment (gripping and holding equipment, and so on), and games to test physical strength (pushing or pulling another person, and so on). It is important to develop teaching materials for sports games suited to students' developmental stages that connect these four kinds of game with the basic movements of judo, such as posture, sparring, slide stepping, and breaking falls, as mentioned in the Courses of Study section on physical education in junior high schools (MEXT, 2018c).

This study is a collaboration among five researchers who specialize in physical education pedagogy and two teachers from the collaborating school implementing the developed lessons. This team of seven planned six lessons of 45 minutes each, where basic judo movements could be incorporated into the four kinds of sports games, i.e. games about maintaining balance, moving, manipulating equipment, and testing physical strength, while considering issues such as child developmental stages and safety (Table 1). The lessons were planned for all four kinds of sports games to be experienced in each lesson. They were conducted by dividing the activity location (gymnasium) into four activity areas, among which the students rotate, spending 10 minutes in each area.

The rag walk, an activity related to slide stepping, a movement taught in junior-high-school judo classes, was incorporated into games about moving. The students were instructed on how to execute the rag walk. First, the student stands on two rags, with one foot on each. They then have to move forward and backward with their feet never leaving the rags they are standing on (Table 1, Photograph 1). For games about maintaining balance, the judo games incorporated were rolling touch and standing balance, related to the judo movements to be learned in junior high school (side break fall and posture/sparring, respectively). For rolling touch, cone markers with a diameter of 15 cm were placed on either side of a 1.8 m mat. Students were instructed to roll sideways and touch the markers on each side in quick succession (Table 1, Photograph 4). For standing balance, the students were asked to stand facing a partner while holding a ball as shown in Photograph 2. They had to maintain their balance and move the ball vertically and horizontally without dropping the ball (Table 1, Photograph 2). When learning throwing techniques in junior-high-school judo lessons, students are instructed not to release their hands (neither the lifting hand nor the pulling hand) in the process of throwing their opponents, to prevent injuries and accidents.

The game of belt pulling (grip strength) is related to this, so it makes sense to incorporate the activity into games regarding testing physical strength in elementary school. During this activity, students are instructed to adjust the amount of force used (tugging or loosening) while holding on to a judo belt (Table 1, Photograph 3). Games related to manipulating equipment included the belt pulling and standing balance activities mentioned above. The students were instructed so as to be able to manipulate equipment, including gripping and holding, through the use of the ball and belt as equipment (Table 1, Photographs 2 and 3).

The elementary school Courses of Study (MEXT, 2018b) section on physical education states that allowing students to enjoy and participate in sports games can lead to the intended outcome of increased physical strength. The four sports games are calibrated at a difficulty level beginning at students' current levels of strength. The level of difficulty can be adjusted according to their progress, allowing them to continue to challenge themselves while enjoying their activities as their lessons progress. In addition, the equipment used in class was as follows: 5 judo belts, 6 soft volleyballs, 20 rags, 4 mats, and 8 cone markers.

Table 1 Lesson plan incorporating judo games

Lesson	1	2	3	4	5	6
Learning activity	Thinking about the future	Having fun with force as of now → Enjoying a challenge				
	Explaining the learning activity	Having fun while working on various movements with classmates				Making use of what was learned to enjoy activities
	Experiencing various kinds of games	[Movements related to <u>slide stepping</u>] (Movements forward/backward/sideways, etc)  (Photograph 1 Rag walk) [Movements related to <u>side break falls</u>] (Balance)  (Photograph 4 Rolling touch)				Experiencing pleasure in improving movements, making connections to subsequent learning
	Encouraging students to try out even more kinds of movements	[Movements related to <u>stance and sparring</u>] (Balance, manipulation of equipment)  (Photograph 2 Standing balance) [Movements related to <u>grip strength</u>] (Testing force, manipulation of equipment)  (Photograph 3 Belt pulling)				
Objective	Go over the exercise content and check that students understand how to play together safely and have fun.	• Able to cooperate with classmates and take part actively. • Able to set goals and work toward solving issues. • Understanding how to execute good movements for belt pulling, rolling touch, and rag walk. • Able to maintain balance, move, and use force. • Able to play so as to enjoy sports games more.				

(2) Target participants and period

To implement the lessons produced by this study, we collaborated with an elementary school affiliated with a public university in Kagoshima Prefecture. The target students were 18 boys and 17 girls, for a total of 35 second-grade students (7-year-olds). All six lessons were conducted within the first two weeks of February 2020.

Regarding ethical considerations, we received informed consent from the school principal and participating teachers. Agreement was gained from the participant students and their parents/guardians based on an explanation that they would not be disadvantaged in any way through cooperation, that they could request explanations of the survey from the researchers, and that the data collected would be analyzed as representative group values without identifying specific individuals.

(3) Survey

Miyashita (1998) notes that in questionnaire surveys targeted at young children, it is necessary to reduce the overall number of items in the survey and to give due consideration to content and format. In addition, Sakurai (1998) emphasizes the importance of making the language used easy to understand. As an assessment method for the usefulness of the teaching materials developed, this study used the formative evaluation tool developed by Takahashi (2003) for physical education, with a scale objectively verified for its appropriateness and reliability used to grasp the changes in the students. In addition to the objective evaluation mentioned above, other questions were generated in reference to the students' level; this form of subjective evaluation was incorporated to grasp the students' changes from multiple perspectives. Furthermore, a test of the students' physical skills and motor ability was created to assess whether any changes occurred in the students' level of physical fitness because of the incorporation of judo games into physical education lessons.

1) *Formative evaluation*

The questions were taken from a formative evaluation tool for lessons developed by Takahashi (2003), with the language used simplified to make it easier for the students to understand the questions. The subscale consists of four factors: outcome, motivation and interest, learning method, and cooperation, for a total of nine questions. In addition, an overall assessment score can be calculated on the basis of the mean value of the four factors. The category “outcome” (three questions) enables evaluation of the degree to which students realized the objectives of physical education with regard to accomplishment, understanding, and emotional effects, as well as their mastery of technical skills. The second category, “motivation and interest,” consists of two questions evaluating the degree of satisfaction of the students’ desire for physical activities. The two questions in the third category, “learning method,” evaluate the level of self-initiative and rationality in learning. The last category, “cooperation,” consists of two questions that evaluate the students’ interpersonal relationships with their peers.

Students selected one of three options to each question (yes, neither yes nor no, and no) by circling the relevant option. During statistical processing, a “yes” response was given 3 points, a “neither yes nor no” response was given 2 points, and a “no” response was given 1 point. The questionnaire was administered at the end of every lesson.

2) *Subjective evaluation*

Tsutsui et al. (2014), considering the educational effectiveness of sumo targeted at elementary-school students from second to fifth grade, used five items: “awareness of my own body,” “awareness of changes in my body,” “force adjustment,” “awareness of other people’s bodies,” and “awareness of other people’s feelings.” This study added two more items (“physical education is fun” and “physical education improves my physical fitness”) for a total of 7 items. The language used in the questions was simplified for easier student understanding.

Students responded to the questions with one among three options (yes, neither yes nor no, and no) by circling the relevant option. In statistical processing, each “yes” was assigned 3 points, each “neither yes nor no” answer was assigned 2 points, and each “no” was assigned 1 point. For each question, students who answered “yes” were asked to write down the reason. This subjective evaluation was performed twice, once in the first half and once in the second half of the learning unit.

3) *Test of physical skills and motor ability*

The test was administered to students from the collaborating school whose aggregate scores for their school physical fitness tests were considered average for their level. A total of 10 students were selected, 5 boys and 5 girls. The test included three items—grip strength, rag walk, and rolling touch. The test was conducted at the end of the second and sixth lessons, of a total of six lessons. The grip strength of both hands was measured and the average score was calculated. The dynamometer used was GRIP-D, made by Takei Scientific Instruments. For the rag walk, students had to stand on top of two rags (27 cm by 18 cm) and walk for 10 m without allowing their feet to lose contact with the rags. The time taken to move 10 m was measured. For the rolling touch, cone markers with a diameter of 15 cm were placed on either side of a 1.8 m mat. The students were given 10 seconds to roll horizontally on the mat and touch the markers on either side alternately as fast as they could. The number of touches was recorded. The two markers were placed 1.5 m apart. A Seiko stopwatch was used to measure time for the rag walk and the rolling touch.

(4) *Analysis*

The mean value for each factor was obtained for the formative evaluation, and the changes from the second lesson to the sixth lesson were calculated. In addition, the second and third lessons were treated as the first half of the lesson unit, and the fifth and sixth lessons were treated as the second half. The mean values of the evaluation results from each half were calculated and a paired t-test was performed. The scores for each question in both halves of the lesson unit were obtained to represent subjective evaluation, and a Wilcoxon test was performed. A paired t-test was also performed between the scores of the three items in the physical skills and motor ability tests conducted at the end of the second and sixth lessons. All statistical processing in this study was performed using Excel 2016 and SPSS Statistics 25. The statistical significance level was set at $P < 0.05$, and $P < 0.1$ was taken as trending toward significance.

Results

(1) *Formative evaluation*

Figure 1 shows the trends in the subscale and aggregate scores of the formative evaluation after each lesson. Generally, it can be observed that outcomes, learning method, cooperation, and overall score show an upward trend as the lesson unit progresses. However, the factor of motivation and interest, while scored highly, remains largely unchanged. In addition, when a t-test was conducted to evaluate any statistical difference in the scores of each factor between the first half (lessons 2 and 3) and second half (lessons 5 and 6), it was found that

the scores in the second half were statistically significantly higher than those in the first half for outcomes, learning method, cooperation, and overall score (Table 2).

Figure 1 Changes in subscale and aggregate scores of the formative evaluation after each lesson unit ($n = 35$)

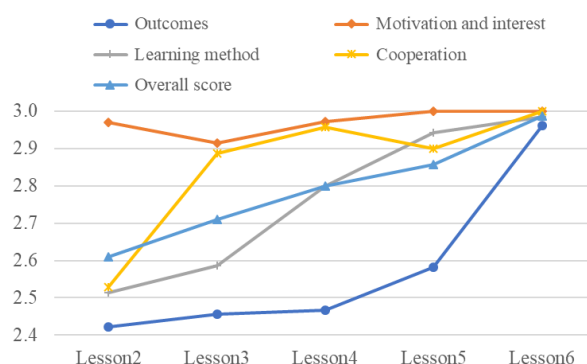


Table 2 Comparison of formative evaluation scores between the first and second halves of the lesson unit ($n = 35$)

Factor	First half of unit		Second half of unit		t value	P value
	Mean	SD	Mean	SD		
Outcomes	2.44	0.71	2.77	0.56	-5.25	< 0.001
Motivation and interest	2.94	0.26	3.00	0.00	-2.58	
Learning method	2.55	0.59	2.96	0.19	-7.25	< 0.001
Cooperation	2.71	0.30	2.95	0.28	-4.21	< 0.001
Overall score	2.66	0.46	2.92	0.26	-7.53	< 0.001

(2) Subjective evaluation

Table 3 shows the scores obtained in each half of the lesson unit for each of the 7 categories under subjective evaluation (awareness of own body, awareness of changes in the body, force adjustment, awareness of other people's bodies, awareness of other people's feelings, enjoyment in physical education, and increased physical fitness due to physical education). For the following six items, the scores in the second half were statistically significantly higher than those in the first half: awareness of own body, awareness of changes in the body, force adjustment, awareness of other people's bodies, awareness of other people's feelings, and increased physical fitness due to physical education. There was no significant difference for enjoyment in physical education: all students answered "yes" (3 points) in the surveys for each half of the unit.

Table 3 Comparison of subjective evaluation scores between the first and second halves of the lesson unit ($n = 35$)

Item	First half of unit		Second half of unit		P value
	Mean	SD	Mean	SD	
Awareness of own body	2.31	0.80	2.77	0.60	< 0.013
Awareness of changes in the body	1.83	0.79	2.80	0.53	< 0.001
Force adjustment	1.86	0.77	2.29	0.96	< 0.030
Awareness of others' bodies	2.40	0.77	3.00	0.00	< 0.001
Awareness of others' feelings	1.83	0.75	2.49	0.82	< 0.002
Enjoyment in physical education lessons	3.00	0.00	3.00	0.00	
Improving physical fitness through physical education	2.29	0.75	2.69	0.68	< 0.008

(3) Physical skills and motor ability test

Table 4 shows the scores for each of the three items (grip strength, rag walk, and rolling touch) in the physical skills and motor ability test conducted after the second and sixth lessons, along with the t-test results. The male students showed an improvement in their scores in all three items after the sixth lesson, with significant differences for all items. The female students showed an improvement in their scores for rag walk, with a statistically significant difference. While their scores for grip strength and rolling touch improved, the difference was not statistically significant. However, the statistical tests demonstrated a trend toward significance.

Table 4 Comparing the results of physical skills and motor ability tests at the end of the 2nd and 6th lessons (n=10)

Gender	Item	First half of unit		Second half of unit		t value	P value
		Mean	SD	Mean	SD		
Male (n=5)	Grip strength (kg)	10.26	1.77	11.04	1.83	-5.75	< 0.005
	Rag walk (seconds)	9.69	1.72	6.16	0.63	4.59	< 0.010
	Rolling touch (number of times)	6.60	0.89	9.00	1.87	-2.95	< 0.042
Female (n=5)	Grip strength (kg)	10.48	1.34	11.28	0.82	-2.27	< 0.086
	Rag walk (seconds)	10.68	1.67	7.63	2.93	3.50	< 0.025
	Rolling touch (number of times)	5.80	0.84	6.60	1.14	-2.14	< 0.099

Discussion

(1) Formative evaluation

The results of the formative evaluation show that the scores for the three factors of outcomes, learning method, and cooperation, along with the overall score, improved as the lesson unit progressed, with a statistically significant improvement between the first and second halves of the lesson unit.

The factor “outcomes” evaluates the students’ degree of accomplishment and understanding and the emotional effects thereof (Takahashi, 2003). The four games (rag walk, standing balance, belt pulling, and rolling touch) were designed to develop progressively from simple movements to more complicated ones according to the students’ progress, enabling them to continue enjoying participation in these activities. Through this process, students are thought to understand and master the relevant movements for these four games they are experiencing for the first time, allowing them to feel strong affirmative emotions and a sense of achievement.

“Learning method” assesses the students’ self-initiative and rationality with regard to learning (Takahashi, 2003). Because this study targets young children, it was decided that instead of focusing only on one game every lesson, the lessons should adopt the format of a rotating system, where the students spend 10 minutes at each of four stations to allow reasonable development in the activities. This is to ensure that the students do not get bored, considering their developmental stage. From the responses of the students during the reflection held at the end of each lesson, and from the comments in parent–teacher journals, the following can be seen: “We get to play different kinds of games every lesson, so I look forward to them,” “PE is exciting,” “It was fun because I got to play a lot.” This suggests that the format of rotating through various learning activities for sports games targeted at young children may be able to improve their “learning methods.”

The reason why the scores for cooperation were higher in the second half than they were in the first half was likely the effort that was put into the learning format. The lessons had the students initially acquire the basic movements for the sports game individually on their own before moving on to pair or group activities to incorporate more elements of play and competition. Specifically, group activities such as tag or group relays were progressively incorporated into the rag walk. Likewise, in the other games, the students were also first engaged in individual activities before moving on to pair and group activities, a learning format design that is thought to be effective. No statistically significant differences were found between the scores for motivation and interest in the first half and second half. However, an improvement was seen from 2.94 in the first half to 3.00 in the second half. In Hasegawa et al. (1995), the diagnostic criteria for formative evaluation are divided into five levels for each factor (Table 5). Comparing the criteria with the scores obtained in this study during the second half of the lesson unit, we can conclude that this study can be considered an “outstandingly excellent lesson,” based on the scores for all factors and the overall score.

Table 5 Comparison between diagnosis guidelines for formative lesson evaluation (Hasegawa et al. 1995) and scores from the second half of the unit in this study

Factor/evaluation	5	4	3	2	1	This study (n = 35) Score in the second half of the unit
	Particularly outstanding lesson	Good lesson	Normal lesson	Worse than normal lesson	Particularly bad lesson	
Outcomes	3.00–2.70	2.69–2.45	2.44–2.15	2.14–1.91	1.90–1.00	2.77
Motivation and interest	3.00	2.99–2.81	2.80–2.59	2.58–2.41	2.40–1.00	3.00
Learning method	3.00–2.81	2.80–2.57	2.56–2.29	2.28–2.05	2.04–1.00	2.96
Cooperation	3.00–2.85	2.84–2.62	2.61–2.36	2.35–2.13	2.12–1.00	2.95
Overall score	3.00–2.77	2.76–2.58	2.57–2.34	2.33–2.15	2.14–1.00	2.92

Two possible methods can be used to evaluate a lesson: having other teachers observe, record, and evaluate the lesson, and having the participants evaluate it. Yoshino (2021) suggests that it is important for the evaluation of physical education lessons to allow student evaluation. On a related note, Takahashi et al. (1989, 1991) also suggest methods of diagnosis of physical education lessons, including observing and recording the

learning process as well as having the students evaluate their lessons. While it may be desirable to use both methods to evaluate the teaching materials developed, this study chooses to focus on the second method, having lesson participants do the evaluation. Takahashi (1992) notes that it is not a contradiction to use these two different methods to obtain an evaluation. From this, it can be inferred that the learning activities developed in this study, where judo games are incorporated into sports games that create opportunities for diverse physical movements, were excellent lessons well received by their participants.

(2) Subjective evaluation

With the exception of the item on lesson enjoyment, a statistically significant increase was seen in scores between the first half and the second half of the lesson unit for 6 out of 7 items.

The rag walk activity, which requires students to stand with their feet on two rags and walk quickly, was incorporated into the lesson with the intention of helping students acquire physical movements related to slide stepping in judo. Standing on the rags and then walking quickly forward, backward, or sideways without their feet leaving the rags helped to elicit from the students the movements of slide stepping, a basic judo movement connected to various footwork. Because students do not use the slide stepping movement in daily life, it is thought that this sports game helped make them more aware of their own body movements. Moreover, after the students familiarized themselves with the rag walk to a certain extent, the incorporation of hide-and-seek and relay matches also helped them become more aware of others' feelings.

In standing balance, the students hold two balls between their hands while facing partners, without letting the balls fall. This was done to have them acquire movements related to the proper judo posture and sparring practice. Students must sense the force coming from their partner through the ball and adjust their own force to ensure that the ball does not fall. Through moving up and down in a position with a stable center of gravity and keeping their arms horizontal while adjusting to their partner's movements, they acquired the movements connected to sparring in judo. It is thought that this game helped the students become better at adjusting their force, noticing changes in their bodily movements, and becoming more aware of their own bodies and others'.

In the belt pulling game, students hold on to a belt together with a partner, where one pulls and the other is pulled. This activity was done so as to help students acquire the movement of consistent gripping (*hikite* and *tsurite*, the position of the two hands when tackling an opponent) when executing throwing techniques in judo. Students try their best to pull and make their partner move through the belt. This helped them to acquire the movements needed to apply gripping force. In addition, by incorporating variations such as having both students pull the belt like a tug of war, or having groups compete against one another in the format of a match, students were progressively exposed to different ways of pulling on the belt. It is thought that this allowed them to feel that their physical strength had increased, while competing against one another also increased their awareness of others' bodies and feelings.

In rolling touch, students lie on their backs in the middle of a mat and roll toward the markers on their left and right to touch them. The incorporation of this activity was intended to help them acquire the movements related to executing a side break fall in judo. Challenging the students to roll to each side and touch the markers as fast as they could, in competition with others, facilitated the students' acquisition of the movements relevant to executing a side break fall. It is thought that this sports game helped students become more aware of their own bodies and also the changes in their bodies.

(3) Physical skills and motor ability test

For the physical skills and motor ability test, 10 students (5 of each gender) with average aggregate scores were selected and tested after the second and sixth lessons. The test had three items, namely grip strength, rag walk, and rolling touch.

There are two kinds of grip strength: active grip strength, the intentional application of gripping force, and passive grip strength, resistance to an external force (Komata & Miyazaki, 1999; Ono et al., 1964). In the new physical ability test, a dynamometer is used to measure active grip strength. Ueda et al. (2020) reported that after elementary-school students were asked to do exercises such as gripping balls and pushing carts for around 5 minutes before a thrice-weekly physical education class for 5 weeks, both male and female students showed an increase in active grip strength. In this study, after performing the belt pulling activity for 10 minutes per lesson in six lessons over 2 weeks, the male students showed a statistically significant improvement in their grip strength, while the female students showed a trend toward significance. There has been a notable downward trend in the grip strength of elementary-school students and junior-high-school students since the 1990s (Yogi & Kokudo, 2014, 2015). This may be due to the change in daily lifestyle, which has reduced the need to use grip strength to grasp and grab physical objects. Therefore, the game of belt pulling incorporated into this study involves not only providing opportunities to grab and pull a belt as strongly as possible but also creating opportunities for students to use their full strength in pair and group activities. This is probably why students performed well during the test. The rag walk, where students must control rags with their feet while walking, was a little difficult to execute during the first half of the lesson unit, but with repeated practice, it became more manageable. For this activity, through repeated practice, students acquired the movement of walking quickly without lifting their feet, which allowed them to improve their scores for the test. In addition, it was observed

that some students could control the rag with only one foot while moving during this activity. This kind of movement is similar to the footwork of kendo. This suggests that although this activity was developed to have students acquire the basic movements of judo, with some modifications, it can be adapted to teach the slide stepping movements in other kinds of martial arts as well.

For rolling touch, a statistically significant improvement was seen in scores for the male students as well as a trend toward significance for the female students. As with the rag walk, with repeated practice, students became more adept at this exercise. The repeated practice of rolling sideways to touch the cone markers helped students learn how to maintain their balance while rolling, leading to higher performance scores on the test.

Limitations of this study

The survey used in this study employed a self-reported questionnaire. Considering the age of the students, the homeroom teacher explained the questionnaire carefully and monitored the progress of the students; however, it is likely that individual differences in understanding were present. In addition, it is undeniable that their responses on the questionnaire may have included exaggerations and understatements because of the influence of social desirability. Another limitation of this study was the constraints posed by the collaborating school (number of specimens, number of lessons, period, equipment, and so on) within which the lessons had to be conducted. However, a thorough evaluation from multiple perspectives, including both objective and subjective evaluation and a physical skills and motor ability test, was carried out when assessing the usefulness of the teaching materials developed in this study. Therefore, the representativeness of the results in this study is assured to a certain extent.

Conclusions

This study developed and evaluated the usefulness of a set of learning materials and activities that incorporate basic judo movements into four games with opportunities for diverse physical movements over six lessons. The results show an improvement in scores for the three factors of outcomes, learning method, and cooperation as well as the overall scores for formative evaluation as the lessons progressed. When students were asked to subjectively evaluate themselves in seven categories, including showing more awareness of their own bodies, adjusting the force used, and showing more awareness of other people's bodies, six categories received higher scores in the second half of the teaching unit. In the test of physical skills and motor ability, at the end of the sixth lesson, both male and female students achieved higher scores in all three categories tested. The results suggest that the teaching materials developed in this study, which incorporate judo games that can help students acquire basic judo movements, are effective as materials for physical education lessons targeted at 7-year-olds. This study, together with Yogi et al. (2020), an earlier study on developing teaching materials for judo games targeted at lower-elementary-school students, successfully demonstrates the usefulness of incorporating judo games into physical education lessons in elementary school, which had previously not been considered. In addition, it is thought that the learning content developed in this study is broad enough to be put into practice in many areas. Thus, it is useful not just for physical education lessons but also as an instructional program for judo clubs that target children of around the same age.

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Conflicts of interest If the authors have any conflicts of interest to declare.

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