

Effects of a basketball unit in a physical education class on junior high school students' physical fitness

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Abstract : The purpose of this study is to examine the effects of a basketball unit in a junior high school physical education class on participating students' physical fitness. The subjects were 26 male students who were in first year of junior high school. Over six physical-education classes, the participants played mini-basketball games. We measured objective outcomes using a pre- and post-unit skill test (30-second free-throw shooting test) and a pre- and post-unit fitness test (150-meter sprint, comprising six 25-meter sprints with changes of direction, and with 30-second rests in between). At the end of each session, we administered subjective questionnaire surveys to the students regarding technique and tactics technical skills, physical fitness, and psychological aspects. After completing the program, another questionnaire was conducted regarding performance skill, attitude, and knowledge and decision-making. The main results were as follows:

1. The average of scores and shots in the skill test did not significantly differ between the pre- and post-unit tests.
2. Average performance in the fitness test was significantly higher in the post-unit test.

Based on our findings, we conclude that this basketball-teaching program is effective for enhancing physical fitness levels; however, no improvements in technique were observed.

Key words : Ball game, Physical fitness, PE class

1. Introduction

Although there is no longer a decline in children's physical fitness, fitness levels remain low compared to the peak year of 1985 (MEXT, 2017). A report by the Central Council for Education concluded that, to enhance children's physical fitness, improvements in teaching content and methods are needed, and that this should involve education not only regarding physical fitness (Karada tsukuri undō), but also other areas of physical education (PE) (MEXT, 2008). Moreover, the Science Council of Japan (SCJ) (SCJ, 2017) has recently reported that many children have not mastered basic motor skills. If children who are lacking basic motor skills fail to develop

adequate physical fitness by adulthood, they will have an increased risk of developing lifestyle-related disorders in middle age or becoming bedbound in old age (SCJ, 2017). Accordingly, PE, as part of the compulsory school curriculum, can play a vital role in the advancement of children's health.

Many studies have sought to develop and identify PE lessons that can improve students' physical fitness and motor skills. Several studies have been examined. Of these studies, several, including Katoh et al. (2000), Dohi et al. (2004), and Ogata et al. (2001), have examined sports in which individual skills are the primary focus. Katoh et al. (2000) included sprint practice in PE classes for sixth-grade

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elementary school children, and found that this induced an improvement in sprint performance. The authors attributed these effects to the students' developing better form (pitch and stride) during the acceleration phase when commencing the sprint, as well as during the speed-maintenance phase as they neared the finish line. Meanwhile, Dohi et al. (2004) introduced long-jump practice to PE classes for sixth-grade elementary school boys and girls, and found that the children's jump lengths had increased by the end of the classes; this was attributed to the development of a better understanding of the optimal length for the approach run. Finally, Ogata et al. (2001) developed and tested the effectiveness of a learning program for improving the overhand throwing ability of second- and third-grade elementary school children. They consequently found that both the boys' and girls' throwing performance had improved by the conclusion of the program, with the boys who had lower baseline throwing ability showing a more marked improvement. These studies demonstrate how the inclusion of lesson-based units in PE classes can improve elementary students' basic motor skills such as running, jumping, and throwing.

Other research has examined sports in which competitive and group skills play a central role. For example, Tsuda et al. (2013, 2014) focused on the effect of soccer games on physical fitness. More specifically, Tsuda et al. (2013) developed a PE unit that involved children playing soccer games on varying pitch sizes but with a fixed number of players (4 vs. 4). The researchers consequently found that the games, irrespective of pitch size, induced improvements in physical fitness. In later research, Tsuda et al. (2014) developed and tested a PE unit that again comprised soccer games with varying pitch sizes and a fixed number of players (8 vs. 8). In this case, a larger pitch area per player was associated with greater improvements in physical fitness. In essence, these two studies considered, through PE units that incorporated soccer—a

goal-based ball game involving complex on-the-ball skill that is played on a large pitch—how the area covered per player is related to improvements in physical fitness.

The classification of ball games has been revised in the current curriculum guidelines for Japanese schools (MEXT, 2008). Until 2008, ball games were categorized as *soccer*, *basketball*, or *handball*, but are now categorized by type: *goal-based*, *net-based*, or *baseball-based* (MEXT, 2008). Allocating all goal-based games to a single group implies that all goal-based ball games have similar learning contents relating to off-the-ball movements. However, on-the-ball skill and pitch / court size differ among goal-based games (Asai and Nakayama, 2015; Hayashi, 2014; Yoshida, 2015). No research has examined whether the benefits of basketball and handball resemble those of soccer: all three are goal-based games, but the former two are played on smaller courts and involve simpler on-the-ball skill. Further, as basketball teams have fewer players than do soccer teams, a given player may traverse a greater distance per unit time; thus, basketball's benefits in terms of physical fitness could even exceed those of soccer's (Saito et al., 2014; Tsuda et al., 2007).

The purpose of this study was to examine the effects of a basketball unit in a junior high school physical education class on participating students' physical fitness. The outcomes of the introduction of a basketball unit to a junior high school PE class, particularly focusing on improvements in physical fitness.

2. Materials and Methods

2.1. Participants

We conducted our study using a sample of 26 male first-year junior high school students from U Junior High School, Ishikawa Prefecture. Between January 25 and February 25, 2016, these students received a series of basketball lessons from a PE teacher who had 15 years' experience and specialized in

basketball. Before commencing the study, we informed the school principal, teachers (curriculum coordinator, class teacher, and the PE teacher), and students of the purpose, method, and safety of the study, and obtained their consent. The study was approved by the ethics committee of Juntendo University (approval number: 28-17).

2.2. PE unit

The aim of the classes was to enhance the students' physical fitness through improving their basketball performance. The unit comprised a total of eight hours. Six of the eight classes (from the second to the seventh) were devoted to performing actual basketball drills. The first class involved orientation, a pre-unit skill test, and a fitness test, while the eighth class involved a summary and a post-unit skill test and a fitness test (Figure 1).

According to Takahashi (2009), to ensure that students master learning content, it is essential to plan a stepwise progression from the first half of the unit to the second half. With this in mind, we allotted the first three of the six hours to passing and catching drills, and the latter three hours to shooting drills. At the beginning of each of the six sessions, the PE teacher clarified the aims of the session and conducted a warm-up. Then, the students were drilled in the relevant techniques. In the second, third, and fourth sessions, the drills focused on passing / catching, and in the fifth, sixth, and seventh sessions, they focused on passing / catching and shooting. For the final part of each session, the students played a mini-basketball game.

The aim of the passing / catching drills was to help the students master basic passing skills, including how they should position themselves in order to catch the ball securely. At the start of each drill, the students were organized into pairs, stood 4–5 meters apart, and practiced making chest passes (i.e., passing the ball at chest height) to each other. Next, they were organized into groups of three, formed triangular formations, with each

student 3–5 meters apart, and practiced passing and catching. Then, while remaining in groups of three, two members attempted to pass the ball to each other while the third member, who acted as a defender, attempted to intercept it. Individual guidance was provided to any student who appeared to be having difficulties.

The aim of the passing and shooting drills was to help the students master basic shooting skills (set shot, jump shot, and step shot). In these drills, they would dash to the shooting point, receive a pass, and then take the shot. The shooting point varied between the mid-court line and the sidelines. Individual guidance was provided to any student who appeared to be having difficulties.

For each of the mini-basketball games (four matches were held at the end of each session), the court size was 14 × 15 meters, the number of players was 3 vs. 3, and the game was three minutes. The number of players was kept to 3 vs. 3, even when a team had more than the designated number of members. Teams would substitute players at the end of the first half to ensure that all students had a chance to play. In preparing these drills, we referred to a supplementary textbook for junior high school PE (Shimizu, 2011).

2.3. Measurement items and methods

We measured the outcomes of the program using a pre- and post-unit skill test (a 30-second free-throw shooting test) and a pre- and post-unit fitness test (a 150-meter sprint that comprised six 25-meter sprints with changes of direction and with 30-second rests in between). We also conducted questionnaire surveys at the end of each session and at the end of the unit.

2.3.1 Skill test

To assess the students' basic on-the-ball skill within the limited timeframe of the PE unit, we applied a 30-second free-throw shooting test that was described in a supplementary PE textbook (Kimura, 1982). In

Introduction	Early stage			Latter stage			Summary
Understand the purpose of the unit, identify current skill and fitness levels	Learn how to pass/catch, apply this knowledge in games			Learn how to shoot, apply this knowledge in games			Identify learning outcomes, review unit as a whole
1	2	3	4	5	6	7	8
1. Orientation 2. Skill test 3. Fitness test	1. Introduction, warm-up			2. Drill Shooting drill			1. Unit summary 2. Skill test 3. Fitness test
	2. Drill Passing/catching drill						
	3. Game Court size: Half-court (14m × 15m) Number of players: 3 vs. 3 Game time: 3 minutes × 4 matches						
	4. Cool-down, summary						

Fig.1 Plan for basketball unit

this test, students are given 30 seconds to score as many as possible as many baskets as they can from any position they choose. The numbers of shots and scores are recorded separately. Students perform the test in pairs, and record each other's scores and shots.

2.3.2 Fitness test

For the fitness test, which represents one aspect of the physical fitness required in ball games, we evaluated the students' performance in a 150-meter sprint test that featured changes of direction (Tsuda et al., 2013). Specifically, the students ran the perimeter of a 5 × 7.5-meter rectangle (a total distance of 25 meters) six times, resting for 30 seconds between laps. We measured the time it took each participant to complete the cumulative 150 meters (i.e., all six laps). According to Fox (1979), three and a half minutes represents an average time for completing the six laps and, while running, the runner is engaging both his / her aerobic and anaerobic energy systems. Notably, Takamatsu (1991) argued that this test facilitates measurement of the turn-and-dash skill and the physical endurance required in ball games. Thus, as this activity involves speed, agility, and

aerobic capacity, we used performance in this test as a general measure of fitness.

2.3.3 End-of-session questionnaire (formative assessment)

At the end of each session, we administered to the students a self-report questionnaire survey to obtain the students' self-reported formative assessments (Table 2). The questionnaire comprised 14 items across three categories: technique / tactics, physical fitness, and psychological aspects (Tsuda, 2014); we modified the content to relate to basketball use. The technical / tactical items measured on-the-ball skill and off-the-ball movement (i.e., when not in possession of the ball); the physical fitness items measured energetic fitness; and the psychological items measured interest, volition, and attitude, respectively. Students answered all of the questions using a five-point scale (5 = "strongly agree," 4 = "agree," 3 = "neutral," 2 = "disagree," 1 = "strongly disagree"), and responses were converted into overall scores.

2.3.4 End-of-unit questionnaire (summative assessment)

We also conducted a self-report questionnaire survey at the end of the unit

to obtain the students' self-reported summative assessments (Table 3). This questionnaire comprised 15 items across three categories: performance, attitude, and knowledge and decision-making (Tsuda, 2014); again, we modified the content to relate to basketball use. The performance items concerned technique / tactics, physical fitness, and psychology; the attitude items concerned etiquette, performing duties, and working in a team; and the items relating to knowledge and decision-making concerned the history of basketball, the techniques, physical fitness, and etiquette required when playing basketball, and means of identifying personal tasks, developing one's technique, enhancing one's physical fitness, and assessing personal performance. Students answered all of the above questions using a five-point scale (5 = "strongly agree," 4 = "agree," 3 = "neutral," 2 = "disagree," 1 = "strongly disagree"), and the responses were converted into scores.

2.4. Statistical analysis

We used paired t-tests to measure the differences between the averaged item scores for the pre- and post-unit tests. We removed students' data with missing values due to absence from the analysis, and set the statistical significance level at 5%.

3. Results

The average numbers of scores and shots did not significantly differ between the pre- and post-unit tests (Table 1). Students

took 11.8 ± 2.4 shots in the post-unit test compared to 11.4 ± 2.2 in the pre-unit test, and scored 5.7 ± 3.0 in the post-unit test compared to 5.0 ± 3.6 in the pre-unit test.

Regarding the fitness test, the students' average performance was significantly faster in the post-unit test (Table 1). The students ran the 150 meters in 6.8 ± 0.5 seconds in the post-unit test, compared to 7.2 ± 0.6 seconds in the pre-unit test.

For the interim surveys (sessions 2-7) administered during the unit, each survey result was compared and no significant differences were observed for any of the item scores. Scores for the three psychological items—interest (Q12), volition (Q13), and attitude (Q14)—were consistently high (4.7-4.8; Table 2).

For the end-of-unit questionnaire, over 90% of the students responded "strongly agree" or "agree" to all items, with the exception of Q8 (regarding the history of basketball; Table 3).

4. Discussion

4.1. Effectiveness of the teaching plan

We evaluated the educational outcomes of our plan by using the results of the skill and fitness tests as objective measures. Subjective measures (namely, the results of the self-assessed questionnaire surveys) were used to evaluate outcomes that could not be captured by these objective assessments. For the skill test (30-second free-throw shooting test), no significant difference was found when comparing the

Table1 Pre- and post-unit skill test and fitness test results

Test	Pre-unit	Post-unit
Skill test (30-second free throw shooting test)		
Shot	11.4 ± 2.2	11.8 ± 2.4
Score	5.0 ± 3.6	5.7 ± 3.0

Fitness test (150 meter sprint with changes of direction)	7.2 ± 0.6	6.8 ± 0.5 *

Numerical values indicate mean average \pm standard deviation. * : $p < 0.05$.

students' respective performances in the pre- and post-unit assessments (Table 1). In a similar study, Yoshinaga et al. (2009) administered to fifth-year elementary school children a 10-hour soccer unit that incorporated "support learning" in a dominant role. They consequently found that the rate of successful shots increased by the end of the unit. This suggests that our students' lack of improvement in free-throw performance was due to the short time allotted to shooting drills in the second half of the unit (only 10 minutes in each of the fifth through seventh sessions). Interestingly, in all of the end-of-session self-assessments (formative assessments) students consistently ranked their ball-throwing (Q4) and catching (Q5) abilities between 4.5 and 4.8, and their positioning ability (Q8) between 4.1 and 4.4 (Table 2). These high scores may reflect the fact that students were drilled in how to position themselves to receive the ball, as well as how to pass and catch it. Further, in the end-of-unit assessment, the majority of the students ($n = 25$; 96.0%) rated their on-the-ball skill (Q1) and off-the-ball movements (Q2) highly; that is, they responded "strongly agree" or "agree" to the corresponding questions. Moreover, 92.3% of the students ($n = 24$) strongly agreed or agreed that they understood the necessary techniques in basketball (under "knowledge and decision-making"; Table 3).

These results suggest that the students generally felt positively about their performance, despite a lack of corresponding success in the objective data.

The results for the fitness test (150-meter sprint with changes of direction) improved significantly in the post-unit assessment (Table 1). Tsuda et al. (2013) observed a similar improvement in physical fitness after administering a program involving mini-soccer games. Tsuda et al. (2013) consequently argued that the

students' off-the-ball movements contributed to this outcome. Soccer players control the ball with their feet, while basketball players do so with their hands; however, there is little difference in their actions when they do not have the ball (i.e., their off-the-ball movement). In other words, in the present study, during each game the students were repeatedly moving about the court while modifying their speed and changing direction; such movement patterns may have led to their improved performance during the 150-meter sprint with changes of direction. The students' self-reported assessments offer further evidence supporting this supposition: in the end-of-session questionnaires they consistently gave scores ranging from 4.0 to 4.8 for fitness-related items (Q9-11; Table 2). Similarly, in the end-of-unit questionnaires, 92.3% of the students ($n = 24$) strongly agreed or agreed that they understood the level of physical fitness necessary for basketball (under "knowledge and decision-making"; Table 3).

In Japan, PE classes, which focus on improvement of physical fitness, have historically featured practices based on the principles of training (Zenkō taiiku and Gyōkan taiiku). Such practices have caused many students to develop a dislike for PE (Takahashi, 1997). To avoid this, it is important to consider whether students find the content of their PE classes enjoyable. In this regard, in the end-of-session questionnaires for the present study, the students exhibited high scores (ranging from 4.7 to 4.8) for interest (Q12), volition (Q13), and attitude (Q14; Table 2). Thus, despite our modification of the lesson contents to emphasize physical fitness, the students suffered no loss of interest, decrease in volition, or demotivation.

4.2. Implications for schools

The MEXT's "Commentary on

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Table2 End-of-session self-assessments (formative assessments)

		Session number					
		2	3	4	5	6	7
Technique and tactics							
1. Could you play according to the game task?	(Task attainment level)	4.3	4.6	4.5	4.6	4.4	4.3
2. Could you achieve what you were unable to achieve in previous games (techniques, tactics)?	(Outcome)	4.2	4.4	4.6	4.5	4.4	4.2
3. Could you frequently contact the ball?	(Contacting the ball)	4.7	4.8	4.8	4.7	4.7	4.7
4. Could you throw (pass and shoot) the ball in accordance with the situation in the game?	(Throwing)	4.6	4.7	4.8	4.5	4.7	4.7
5. Could you catch the ball in accordance with the situation in the game?	(Catching the ball)	4.5	4.7	4.7	4.7	4.7	4.7
6. Could you dribble in accordance with the situation in the game?	(Dribble)	4.1	4.2	4.2	4.3	4.3	4.2
7. Could you get the ball in accordance with the situation in the game?	(Getting the ball)	4.0	4.2	4.3	4.3	4.6	4.3
8. When you were away from the ball, could you position yourself usefully?	(Positioning)	4.1	4.2	4.4	4.4	4.4	4.2
Physical fitness							
9. Could you have speedy play for a few seconds during the game?	(Anaerobic power)	4.1	4.3	4.3	4.5	4.6	4.3
10. Could you have 10-to-30-second periods of sustained intense activity during the game?	(Anaerobic endurance)	4.0	4.3	4.4	4.4	4.5	4.3
11. Could you keep moving throughout the game?	(Aerobic capacity)	4.5	4.7	4.6	4.8	4.5	4.6
Psychology							
12. Could you enjoy the game?	(Interest)	4.7	4.7	4.8	4.8	4.8	4.8
13. Could you play game with maximal effort throughout the game?	(Volition)	4.7	4.7	4.7	4.8	4.8	4.7
14. Could you play the game in a spirit of cooperation and comradeship?	(Attitude)	4.7	4.7	4.8	4.8	4.8	4.7

Numerical values indicate average score. Students answered all of the above questions using a 5-point scale (5=Strongly agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly disagree).

Table3 End-of-unit self-assessment (summative assessments)

	1	2	3	4	5
Performance					
1. Have you learned how to handle (pass and catch) the ball, and could you apply this knowledge in the games?	0(0)	0(0)	1(3.8)	6(23.0)	19(73.0)
2. Have you learned how to act supportively when you do not have the ball, and could you apply this knowledge in the game?	0(0)	1(3.8)	0(0)	6(23.0)	19(73.0)
3. Have you learned about the fitness necessary for basketball, and could you apply this knowledge in the game?	1(3.8)	0(0)	1(3.8)	5(19.2)	19(73.0)
4. Have you learned about the sportsmanship (competitive spirit, upholding rules) necessary for basketball, and could you apply this knowledge in the game?	1(3.8)	0(0)	0(0)	7(26.9)	18(69.2)
Attitude					
5. When engaging in the games and drills, could you uphold rules and etiquette and consider safety?	0(0)	1(3.8)	1(3.8)	6(23.0)	18(69.2)
6. Could you perform your duties (such as preparing or clearing away equipment)?	0(0)	0(0)	0(0)	10(38.5)	16(61.5)
7. Could you actively discuss tasks with your team?	0(0)	2(7.7)	0(0)	7(26.9)	17(65.4)
Knowledge and decision-making (including how to learn)					
8. Could you understand the history of basketball?	1(3.8)	1(3.8)	6(23.0)	8(30.8)	10(38.5)
9. Could you understand the necessary techniques (dribbling, passing, shooting) for basketball?	1(3.8)	0(0)	1(3.8)	7(26.9)	17(65.4)
10. Could you understand about the physical fitness necessary for basketball (coordination, agility, speed, endurance)?	0(0)	1(3.8)	1(3.8)	4(15.4)	20(76.9)
11. Could you understand the rules and etiquette that you must uphold in basketball?	0(0)	0(0)	0(0)	4(15.4)	22(84.6)
12. Could you understand own task of basketball?	1(3.8)	1(3.8)	0(0)	8(30.8)	16(61.5)
13. Could you understand how to develop the techniques necessary for basketball?	0(0)	0(0)	2(7.7)	4(15.4)	20(76.9)
14. Could you know how to enhance the fitness necessary for basketball?	0(0)	1(3.8)	1(3.8)	7(26.9)	17(65.4)
15. Could you know how to assess (observe and measure) your technique/tactics and fitness necessary for basketball?	0(0)	0(0)	2(7.7)	10(38.5)	14(53.8)

Numerical values indicate the number of respondents (%). Students answered all of the above questions using a 5-point scale (5=Strongly agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly disagree).

curriculum guidelines for junior high schools: Health and physical education edition” provides explicit guidance for ball games: teachers should set team sizes, court / pitch sizes, equipment, and game rules such that learners can easily engage in learning tasks related to attacking and defensive positions in front of a goal (MEXT, 2008). This provision was primarily developed from the standpoint of advancing tactical learning, but is also applicable to enhancing physical fitness. Teachers should establish a court / pitch, team size, and other conditions to optimize the physical fitness benefits achievable within the limited timeframe of a unit. In this study, we examined the benefits of a basketball unit, particularly focusing on enhancements in students’ physical fitness. While the students’ performance did not improve in terms of objective metrics, the students did not lose interest in the educational contents. Our findings suggest that improvement in physical fitness through a customized unit can be achieved not only through soccer—a goal-based ball game played with the feet on a large pitch—but also basketball—a goal-based ball game played with the hands on a small court. This also suggests that similar units for other ball games could enhance students’ physical fitness without a loss of interest.

4.3. Limitations

There are some limitations to this study. Recruiting a control group to compare the outcomes of the class would have provided clearer data regarding the improvements associated with the PE program, but this was not feasible because our study was a field study conducted in an actual school. Another limitation is that we did not introduce variations in all possible parameters of basketball games, including equipment and play restrictions; future research should test new game set-ups that feature differing conditions. Additionally, performance was only assessed objectively,

using a single skill test. To further assess performance, it will be necessary to analyze how the students’ playing of the game changes over the course of the unit. Despite these limitations, we believe that our study findings are valuable, in that they demonstrate that basketball classes are effective for enhancing physical fitness.

5. Conclusion

The purpose of this study was to examine the effects of a basketball unit in a junior high school physical education class on participating students’ physical fitness. The effect of a basketball unit in a junior high school PE class in terms of improving the students’ physical fitness. We consequently concluded that this basketball-teaching program was effective for enhancing physical fitness levels; however, improvements in technique were not observed.

Conflicts of Interests

The authors declare that they have no conflicts of interests regarding the publication of this article.

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