Hindawi Publishing Corporation
Mathematical Problems in Engineering
Volume 2014, Article ID 519291, 6 pages
http://dx.doi.org/10.1155/2014/519291

Research Article

Effects of a Cooperative Learning Strategy on the Effectiveness of Physical Fitness Teaching and Constraining Factors

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Received 8 March 2014; Accepted 7 April 2014; Published 12 May 2014

Academic Editor: Her-Terng Yau

The effects of cooperative learning and traditional learning on the effectiveness and constraining factors of physical fitness teaching under various teaching conditions were studied. Sixty female students in Grades 7–8 were sampled to evaluate their learning of health and physical education (PE) according to the curriculum for Grades 1–9 in Taiwan. The data were quantitatively and qualitatively collected and analyzed. The overall physical fitness of the cooperative learning group exhibited substantial progress between the pretest and posttest, in which the differences in the sit-and-reach and bent-knee sit-up exercises achieved statistical significance. The performance of the cooperative learning group in the bent-knee sit-up and 800 m running exercises far exceeded that of the traditional learning group. Our qualitative data indicated that the number of people grouped before a cooperative learning session, effective administrative support, comprehensive teaching preparation, media reinforcement, constant feedback and introspection regarding cooperative learning strategies, and heterogeneous grouping are constraining factors for teaching PE by using cooperative learning strategies. Cooperative learning is considered an effective route for attaining physical fitness among students. PE teachers should consider providing extrinsic motivation for developing learning effectiveness.

1. Introduction

Studies have proven that a relationship exists between physical fitness and health [1–3]. From a physiological perspective, human organs can remain in normal operation through the simulation of exercises. Engaging in regular physical fitness activities can prevent hypokinetic diseases, reduce stress and depression, boost self-esteem, elicit enjoyment, and enhance social contact [4, 5]. Consequently, regular exercise benefits health.

The curriculum for Grades 1–9 in Taiwan is designed to promote life-long learning and health as well as physical and mental development through humanized, life, adaptive, integrative, and modernized educational activities between people and an individual, people and society, and people and nature. The national education in Taiwan ultimately aims to cultivate healthy and physically fit citizens able to succeed in the new era. Attaining the favorable physical adaption of each student is thus a primary goal for physical education (PE) in schools. Nevertheless, The Norm Study on the Physical Fitness of Elementary and Junior High School Students in Taiwan and Fukien Areas, recently completed by the Ministry of Education, reported that the physical fitness of elementary and junior high school students (aged 7–18 years) remains low; specifically, the physical fitness of Taiwanese students is lower than that of students in Japan, Singapore, and mainland China, and the weights of Taiwanese students are higher. According to the 2005 Asian Physical Fitness Test and Promotion Strategy Summit Meeting announced by the Ministry of Education, the physical fitness of Taiwanese students is lower than that of students in other countries, possibly because of the lack of an effective design for learning situations in the traditional curriculum. Shiu [6] indicated that the physical fitness records of students are mostly kept in schools and managed by city and county departments of education; thus, most students are unaware of their physical fitness conditions. Moreover, the unfavorable learning performance of some students is caused by a lack of motivation rather than poor capabilities [7].

Traditional PE teaching is based on behaviorism, according to which stimulation and responses in the teaching process are translated into the learning of actions and

skills by students. Nevertheless, because of the rigid behavioral objectives in the traditional setting, physical activity is mechanical, coordination is lost, and applied thinking is insufficient. Overemphasizing quantitative and frequent teaching but neglecting knowledge construction and social interaction causes students to experience dullness, anxiety, and discouragement, which can hamper their motivation [8, 9].

Several studies have indicated that students exhibit strong interaction in cooperative learning situations, and subject learning, problem solving, learning motivation, and learning attitudes increase when learning is cooperative [10–14]. In particular, when learning partners encourage each other and instruction is interactive, the learning objectives can be achieved easily [15–17]. Furthermore, emphasizing the cultivation of interpersonal communication and social skills in cooperative learning situations can induce personal intrinsic motivation [14, 18, 19].

Reinforcing PE teaching in cooperative learning involves the active participation of students; thus, the role of students must change [14, 20, 21]. In other words, cooperative learning can reinforce the cognition of students because it can enhance their active learning by replacing traditional passive instruction. A student delivering a message to team members must play an active role to communicate the message. Cognitive efficacy in cooperative learning is based on learners actively delivering messages rather than passively receiving messages [22, 23]. Moreover, cooperative learning can be effective for teachers constructing physical fitness strategies.

In summary, the change of lifestyle in the new century affects national health. The physical fitness of elementary and junior high school students has fallen behind during the past 5 years. Therefore, it is necessary to discuss how teachers can effectively enhance the physical fitness of students to achieve the educational goals set in the Students' Health Body Position Implementing Plan of Taiwan [24]. Research on PE applying cooperative learning is presently insufficient. This study examined the effects of cooperative learning and traditional learning on the physical fitness of students. Therefore, the following problems were proposed in this study:

(1) to compare the differences in the physical fitness of students learning in two teaching situations, namely, cooperative learning and traditional learning;

(2) to understand the constraining factors affecting the physical fitness learning of students in cooperative learning and traditional learning situations.

2. Research Methodology

2.1. Research Participants. This study focused on students in Grades 7-8 taking the Health and PE course in the curriculum for Grades 1–9 in Taiwan. Sixty female students exhibiting low achievement in the physical fitness pretest were randomly sampled and distributed into cooperative learning and traditional learning groups consisting of teams of six students. Before the experiment, 15 participants participated in a pretest to ensure the reliability of the instrument.

2.2. Research Instrument

2.2.1. Physical Fitness Teaching Materials and Test Scale. Our research group and the participating teachers cooperatively designed the physical fitness teaching materials according to the physical fitness training information provided on the website of the Ministry of Education, including an analysis of the present conditions of schools as well as guidelines regarding program design, practice, evaluation and feedback, and supplementary measures. The physical fitness training materials covered body mass index measurements, flexibility, muscular strength, muscular endurance, and cardiorespiratory endurance. The physical fitness curriculum covered cardiorespiratory fitness training and aerobic training (e.g., jogging and rope jumping) to enhance cardiorespiratory endurance, weight training (e.g., push-ups and sit-ups) to enhance muscular strength and muscular endurance, and flexibility training to enhance stretching. A 10-week curriculum was designed. The physical fitness test scale consisted of the fitness test items for elementary and junior high school students used in the 1997 National Fitness Promotion Plan announced by the Ministry of Education, including 800 m running, sit-and-reach, standing long jump, and 60 s sit-up exercises, as well as body mass index measurements. To ensure the feasibility of the physical fitness training program, physical fitness experts and five health and PE teachers were invited to perform validity and reliability tests, aiming at the teaching contents and evaluation indices. The comprehensiveness and integration of various physical fitness teaching contents were established after the analyses.

2.2.2. Guides to Cooperative Skills. The guides to cooperative skills in this study were based on the five steps of D. W. Johnson and R. T. Johnson [14] as follows.

(1) Emphasizing the importance of cooperative skills: each class has a unique atmosphere; thus, the created cooperative behaviors differ. A teacher can use various methods to cause students to perceive the importance of social skills.

(2) Ensuring that students understand cooperative skills: students must recognize clear concepts about such skills and how to acquire such skills.

(3) Arranging cooperative situations and providing opportunities for students to practice repeatedly: cooperative skills must be learned. To familiarize students with cooperative skills, a teacher can encourage students to practice these skills continually.

(4) Arranging group activities and offering introspection opportunities: group activities are designed to provide opportunities for the active feedback of students.

(5) Encouraging students to practice cooperative skills continually until complete internalization: complete internalization is expected when cooperative skills are practiced repeatedly in learning situations.

The students were grouped according to their capabilities, and we focused on students with poor physical fitness.

In the process, the students were ensured to realize the target objective. In addition to these steps, psychological development should be reinforced to prevent frustration and difficulty and to enable cooperative learning to develop smoothly.

2.2.3. Professional Dialogue of the Physical Fitness Teaching Team. All physical fitness teaching teams met with the researchers for professional training during the common time of teachers in the school. The discussion focused on teaching objectives, teaching programs, teaching periods, teaching sequences, evaluation explanations, learner analyses, learner grouping, administrative support (including curriculum arrangement, equipment preparation, and site planning), and random teaching modifications. The curriculum was reviewed after the teaching sessions, in which ideas regarding administrative arrangement, curriculum content, student physical fitness learning and evaluation, and improvement were proposed to understand the demands of the teachers and the constraining factors affecting teaching.

2.2.4. Semistructured Interview. The instrument was constructed according to the research objective and additional proof acquired after the teaching activities. A semistructured interview was conducted after the learning activities were performed, and the interviewed participants were randomly sampled to identify possible restrictions and difficulties in the physical fitness teaching process. The research instrument was designed to be a comprehensive tool for obtaining data. Because physical fitness experts and teachers examined the semistructured interview questions, provided suggestions, and revised these questions, the interview format exhibited expert validity.

2.3. Research Procedure. The evaluation instruments, including the physical fitness materials and health and physical fitness manual, were designed before the experiment was conducted. Fifteen participants were randomly selected to participate in the pretest to revise the instrument. The items and methods provided in the Health and Fitness Instructor Manual [25] developed by the Ministry of Education were followed before the experiment was conducted, and the 60 students exhibiting the lowest physical fitness capabilities (lowest 10% in their respective grades) in the physical fitness pretest were randomly distributed into cooperative learning and traditional learning groups. In addition to the school playground, physical fitness teaching could be performed in classrooms to prevent the experiment from being affected by poor weather. To achieve the research objectives, basic training related to cooperative learning preceded the class.

Furthermore, two professional meetings were held before the teaching sessions and one meeting was held after the teaching session to enable the teachers to discuss the semistructured interviews in detail. The meetings focused on the administrative support system, teacher development, curriculum design, and teaching and evaluation records, enabling the possible constraining factors affecting teaching preparation and teaching as well as the difficulties and restrictions of cooperative learning affecting physical fitness practice to be understood. From week 3 to week 9, the experiment was conducted during two 80 min sessions per week, including 30 min of physical fitness practice; the students took the physical fitness learning effectiveness test at week 10.

2.4. Data Collection and Analysis. The data were analyzed quantitatively and qualitatively to reduce the subjectivity of the researchers. The data analyses were conducted from the viewpoints of various people, including the students, participating teachers, and physical fitness experts, by using triangulation. Teaching practice and cooperative learning were analyzed according to the observation diaries of teachers, which contained information on teaching periods, staff, the participants, groupings, materials and teaching aids, evaluation instruments, management of special events, and thoughts based on observations and discussions (coded "b"). The professional dialogue among teachers was divided into general dialogue and training dialogue. The records were coded "a," the general dialogue was coded "1," and the training dialogue was coded "2." The semistructured interviews were conducted after the learning activities were performed.

2.4.1. Quantitative Data Collection. The items and methods in the Health and Fitness Instructor Manual [25] developed by the Ministry of Education, namely, the body mass index measurement (weight/height^2), flexibility measurement (sit-and-reach), muscular strength measurement (standing long jump), muscular endurance measurement (1 min bent-knee sit-up), and cardiorespiratory endurance measurement (800 m running), were used for the quantitative data collection.

2.4.2. Qualitative Method and Data Collection. Qualitative data were collected from the interviews, dialogue records of the physical fitness teaching team, and the researchers' review. With the analyses, suggestions and feedback were used for evaluating and revising this study.

The quantitative evaluation of the effectiveness of physical fitness teaching was based on the physical fitness test records of the students, and the mean was calculated to compare the pretest and posttest results. SPSS was used in performing the paired-sample mean and t-test analyses.

Regarding the restrictions and difficulties of the qualitative evaluation, triangulation data analysis was applied in this study to analyze the observation diaries, professional dialogue records, and semistructured interview records of the teachers.

3. Results

3.1. Effects of the Cooperative Learning Strategy and Traditional Learning on the Pretest and Posttest Physical Fitness of the Students. Tables 1 and 2 show a comparison between the pretest and posttest fitness of the students in the cooperative learning group and traditional learning group determined using the t-test. The cooperative learning group experienced substantial progress in overall physical fitness, respectively, exhibiting mean pretest and posttest values of 21.80 and 21.05

Table 1: Comparison of pretest and posttest mean and standard deviation between cooperative learning group and traditional learning group after ten-week physical fitness training ($N = 60$).

Physical fitness variable	Pretest		Posttest	
	Mean	SD	Mean	SD
Cooperative learning				
Body mass index	21.80	6.09	21.05	5.81
Sit-and-reach (cm)	17.47	5.34	25.00	8.06
Bent-knee sit-up (times/1 minute)	15.26	10.23	24.73	10.30
Standing long jump (cm)	125.31	28.56	146.52	25.82
800 m running (sec)	343.00	134.24	304.21	116.46
Traditional learning				
Body mass index	21.95	3.99	21.75	4.10
Sit-and-reach (cm)	17.25	7.04	19.10	6.38
Bent-knee sit-up (times/1 minute)	16.70	10.21	20.00	11.78
Sanding long jump (cm)	123.25	5.90	138.65	5.20
800 m running (sec)	341.40	135.99	308.6	110.33

Table 2: Comparison of overall difference in physical fitness pretest and posttest between cooperative learning group and traditional learning group ($N = 60$).

Physical fitness variable	Degree of freedom	t	P
Cooperative learning			
Body mass index	59	−0.32	.749
Sit-and-reach	59	−2.88	.036*
Bent-knee sit-up	59	−4.12	.001**
Standing long jump	59	−1.63	.120
800 m running	59	−2.26	.036*
Traditional learning			
Body mass index	59	−0.86	.605
Sit-and-reach	59	−1.67	0.64
Bent-knee sit-up	59	−4.05	.021*
Standing long jump	59	−1.23	.220
800 m running	59	−3.24	.043*

*$P < .05$; **$P < .001$.

for the body mass, 17.47 and 25.00 for the sit-and-reach, 15.26 and 24.73 for the bent-knee sit-up, 125.31 and 146.52 for the standing long jump, and 343.00 and 304.21 for 800 m running. The pretest and posttest values in sit-and-reach ($t = -2.88$, $P < .05$), bent-knee sit-up ($t = -4.12$, $P < .001$), and 800 m running ($t = -2.26$, $P < .05$) exhibited significant differences. Moreover, the means of the bent-knee sit-up (16.70 versus 20.00; $t = -4.05$, $P < .05$) and 800 m running scores (341.40 versus 308.6; $t = -3.24, P < .05$) of the traditional learning group exhibited considerable differences between the two stages.

Calculating the posttest mean and performing a t-test of the cooperative learning group and traditional learning group (Table 3) revealed substantial differences in the mean bent-knee sit-up (28.00 versus 24.00; $t = -4.87$, $P < .001$) and 800 m running scores (290 versus 303; $t = -4.02$, $P < .001$) of these two groups.

3.2. Constraining Factors of Cooperative Learning and Traditional Learning in Physical Fitness Training. Regarding the constraining factors in physical fitness training, the analysis covered the dimensions of administration, teaching preparation, teaching, and introspection through interviews and the professional dialogue records of the physical fitness teaching team. The results are listed as follows. (1) Effective administrative support is crucial for the comprehensive promotion of physical fitness training; (2) a complete teaching preparation can facilitate the smooth practice of cooperative learning strategies in physical fitness training; (3) the number of people grouped before a cooperative learning session is a factor affecting cooperative learning strategies; (4) student learning can be reinforced through media; (5) constant feedback and introspection of cooperative learning strategies can facilitate the restart of subsequent teaching actions; (6) heterogeneous grouping can be an effective route, because students with favorable outcomes can boost the potential of the group; and (7) providing extrinsic motivation can assist students in learning about the benefits of physical fitness.

4. Discussion

Compared with the pretest results, substantial progress in overall physical fitness was observed in the posttest results of the cooperative learning group, in which the differences

Table 3: Posttest mean and t-test analyses between cooperative learning group and traditional learning group.

Group	Physical fitness variable	Degree of freedom	Mean	SD	t	P
Cooperative	Body mass (kg/m^2)	58	21.05	5.86	−0.74	.640
Traditional			21.75	4.54		
Cooperative	Sit-and-reach (cm)	58	25.30	6.08	−1.87	.082
Traditional			23.75	4.65		
Cooperative	Bent-knee sit-up (times)	58	28	8.76	−4.87	.001*
Traditional			24	6.43		
Cooperative	Standing long jump (cm)	58	146	25.20	−1.97	.067
Traditional			140	24.87		
Cooperative	800 m running (sec)	58	290	115.60	−4.02	.001*
Traditional			303	126.16		

*$P < .001$.

between the two stages for the sit-and-reach and bent-knee sit-up exercises were statistically significant. The performance of students in the cooperative learning group in the bent-knee sit-up and 800 m running exercises substantially exceeded that of students in the traditional learning group. These results support previous research on cooperative learning and traditional learning. However, cooperative learning did not result in a significant improvement in overall physical fitness, improving fitness performance only in sit-and-reach, bent-knee sit-up, and 800 m running exercises, possibly because of the characteristics of these exercises and the cooperative learning model. This result requires further discussion.

According to these results, effective administrative support is crucial for the comprehensive promotion of physical fitness training. Effective administrative support, including meetings and curriculum design, aids teachers and enables physical fitness training to proceed smoothly. Therefore, strong administration is vital for supporting teaching. Complete teaching preparation can facilitate the smooth development of a physical fitness training program using cooperative learning strategies. Physical fitness curricula should be developed in consideration of the experiences and capabilities of students to enable students to master cooperative learning strategies effectively. The number of people grouped before a cooperative learning session is another factor to be considered in cooperative learning strategies. Because slow learners reduce the performance of a group and based on discussions held before the experiment, we decided to group students into teams of four rather than six. The learning of students can be reinforced through media; for example, students can gain knowledge about exercises as well as understand the necessity of cooperative learning by viewing projections and pictures collected by teachers. Constant feedback and introspection regarding cooperative learning strategies can facilitate the restart of subsequent teaching activities; introducing too much teaching content can adversely affect the teaching process, particularly the control of time and class regulation, preventing students from developing as expected. These results can be improved in subsequent activities. Heterogeneous grouping is regarded as an effective route, because incorporating high-achieving students into a group can boost the potential of the group. Providing extrinsic motivation can assist students in learning the benefits of physical fitness. Consequently, whether a group reward or individual reward is used to attain learning effectiveness should be considered by PE teachers.

Our results revealed that using cooperative strategies for physical fitness teaching is feasible but requires that students develop active roles and cooperative attitudes. In turn, cooperative strategies enable students to develop regular exercise habits through teacher-student interaction and mutual encouragement among peers.

4.1. Conclusion. This study examined the physical fitness training of junior high school students by using the curriculum for Grades 1–9 in Taiwan. The overall physical fitness of the students in the cooperative learning and traditional learning groups exhibited substantial progress. Cooperative learning, in which teachers provide extrinsic motivation, was an effective route for improving the physical fitness of the students and should be considered by PE teachers in the future.

4.2. Suggestions

4.2.1. For Teaching Design and Practice

(a) Training Should Be Conducted to Reinforce Peer Cooperative Learning. The software and hardware equipment used in the PE teaching environment in Taiwan are currently insufficient; therefore, teaching is mostly performed in teams. This is one research topic that PE teachers or teaching designers should consider to develop the peer cooperative learning function and, thus, achieve the benefits of physical fitness.

(b) Providing Extrinsic Motivation Can Assist Students in Learning about the Benefits of Physical Fitness. A learner-interest-based design can enhance cooperative learning motivation and deepen the research problems to determine appropriate learning steps and directions. Thus, a teaching design can be enhanced based on the interests of learners in cooperative learning situations to promote efficient interaction among learners. This requires further discussion.

(c) The Designs of Physical Fitness Curricula Should Be Reinforced. A physical fitness curriculum should conform

to a humanized and socialized activity design. In particular, teachers should respect the personality development and motivate the cooperative learning of low-performing students when cultivating these students' expression, communication, and sharing competence.

4.2.2. For Future Research

(a) Future research should consider the effects of motivation on peer learning. For instance, the learning motivation, self-perception, learning style, and self-esteem of a student can influence the effects of peer learning.

(b) Further research is required regarding the division of participants according to their capabilities, because capabilities are currently tested only according to the items and standards suggested by the physical fitness policy of the Ministry of Education.

Conflict of Interests

The author declares that there is no conflict of interests regarding the publication of this paper.

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