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LONGITUDINAL RESEARCH ON THE APPLICATION OF SPORT EDUCATION MODEL TO COLLEGE PHYSICAL EDUCATION

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Longitudinal Research on the Application of Sport Education Model to College Physical Education

Na ZHANG[1], Ronghai SU[2]

Abstract

The application of latent growth model to compare the teaching effect of college physical education between sport education model and traditional physical education model provides reference for the application of sport education model to college physical education. It is considered in this study that sport education model is suitable for the application to college physical education and, in comparison with traditional teaching model, could enhance college students' physical quality, improve sports enjoyment, and fulfill lifelong physical exercise to benefit the realization of sports participation, motor skills, and social adjustment in current college physical education. However, the promotion should take special background and time and space restrictions into account, rather than being suitable for all.

Keywords: sport education model, college students, physical education, latent growth model, longitudinal research, social behavior, social support.

Introduction

Siedentop (1994) regarded sport education model (SEM) as a curriculum and teaching model developed based on play theory. In comparison with traditional physical education, it allowed students acquiring complete sports experience and grasping richer motor skills through sports games. Wallhead & O'Sullivan (2005) mentioned that SEM, since the proposal of Siedentop in 1968, was concerned by researchers in various countries. The empirical research results of SEM conformed to the physical education objectives in the USA, the UK, Australia, and New Zealand to become the primary curriculum practice model in such countries (Line,

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2009). Large curriculum experiments in Australia and New Zealand discovered that SEM could better enhance the development of students' motor skills than traditional physical education (Bevan, 1992) and students still kept high interests in sports after completing the curriculum (Sinelnikov & Hastie, 2010). Moreover, SEM could benefit students' tactical learning and game performance, individual and social behavior development, value formation, and even physical fitness development (Alexander *et al*., 1996). Romar, Sarén, & Hastie (2016) pointed out the great attraction of SEM to obviously enhance students' class participation and assist in the motor technique learning effect. SEM, with teamwork as the major learning method, enhanced interaction times and time among students with distinct skills for positive concept or experience exchange as well as increased opportunities for students practicing skills to enhance the grasp of motor skills (Hastie & Buchanan, 2000). Furthermore, SEM, with sports season as the core concept, guided students, according to the skill performance, to contribute to the teams and cultivated students' responsibility and decision-making through peer interaction to further enhance students' willingness to learn (Wallhead & Ntoumanis, 2004).

Dr. Siedentop was invited to lecture in Beijing Normal University in October, 2004, when domestic sports education trend of thought and experimental research become popular. Gao, Zhang, & Gao (2005) first applied SEM to domestic football teaching experiment and pointed out good effects of sports education on the enhancement of students' motor techniques, tactics, and learning attitudes. After the college basketball teaching experiment, Wang (2006) proposed good effects of SEM on the enhancement of students' physical quality and motor skills as well as the cultivation of students' lifelong physical education idea and habit. SEM could effectively promote students' moderate and stronger exercise time to further enhance teaching effect (Xiong, Ma, & Sun, 2015). Overall speaking, SEM provided a new thinking direction for the practice of school physical education; besides, most domestic and international research supported the teaching effect of SEM. Nevertheless, past research data were repeatedly measured with analysis of variance and merely concerned about differences in mean at different time points, but did not analyze slope variance. The calculation was simple and could be better comprehended, but could not explain the factors in variance among groups (individuals). Moreover, repeated measurement with analysis of variance had to satisfy the hypothesis of covariance matrix sphericity. When the condition was not satisfied, the acquired F test statistics appeared positive bias to enhance the probability of refusing null hypothesis, reduce the statistical test of repeated measurement with analysis of variance, and increase the probability of type I error of F test (Liu & Meng, 2003). To break through the single data statistics in the past, latent growth model (LGM) is applied in this study to precede longitudinal data analysis of college physical education acquired in SEM experiment, aiming to compare the teaching effect of college physical education between SEM and traditional physical education model.

Literature review

Chen *et al*. (2017) pointed out the difference of sport education model from traditional teaching as the teaching method being students' autonomous learning centered (sport education model), rather than teacher centered (traditional teaching). Sport education model, the student centered learning curriculum, could stand for the situational learning theory of physical education, allowing students involving in authentic and meaningful learning activity and cultivating and developing students' specific skills and physical quality through the practice of physical education. Cuevas *et al*. (2016) indicated that sports education model allowed students more positively participate in sports, regardless the skills; and, the arrangement of team roles enhanced students' positive participation and allowed students learning sport knowledge, affection, motor skills, and physical quality in exercises. Micanovic *et al*. (2017) mentioned that sport education model provided students with valuable learning opportunities and applied proper time and methods to learn mutual cooperation and competition; students did not simply participate in a game but would learn the athletic tradition symbolized in games and the structure of games till they became athletes with competence, literacy, and good physical quality. The following hypothesis is therefore proposed in this study.

H1: Sports education shows significant effects on physical quality.

Tao *et al*. (2017) stated that sport education model, originated from play theory, stressed on the participation of everyone; teachers planned the learning content of sports curriculum to have students participate in and plan sports seasons and promotion as well as design team slogans, team flags, team emblems, and mascots and award ceremonies with several awards to have sports games present better enjoyment. Wulf & Lewthwaite (2016) regarded sport education model as a physical education and a teaching model; the important content of sport education model lied in teachers encouraging students' multi-faceted learning and allowing students experiencing real and rich sports experience through the curriculum practice. Moreover, it inspired students to "obey", "respect", and "concern" others' ideas that, regardless of being coaches, players, referees, or staff members, students could enjoy the sense of achievement and physical education enjoyment in games. Pereira *et al*. (2016) indicated that sport education model allowed students seeing and understanding a different side of each other through peer teaching and self-management. Teachers could properly make plans according to other spirits and characteristics of sport education model as well as cultivate students' teamwork, cooperative learning, and leadership and planning ability; multiple learning contents and methods could more easily have students find out physical education enjoyment. As a result, the following hypothesis is proposed in this study.

H2: Sports education reveals remarkable effects on enjoyment.

Chen (2015) mentioned that applying sport education model to school physical education could actually provide sports experience with educational meanings for students; sport education model showed profound meanings on curriculum or teaching and combined direct method, cooperative learning, and peer instruction that teachers had to apply wide teaching skills in the model to change the learning participation model in order to effectively enhance learning satisfaction and learning effect. Leo & Goodwin (2014) stated that all students presented multiple roles in sport education model; they might learn to undertake one or more roles, e.g. coaches, players, referees, and staff members. Such experiences and bases would be enhanced and expanded along with skills, decision-making, responses, and responsibility they learned to undertake in games. From various roles, they had deeper, wider, more positive, and educational sports role participation experiences, which would not be provided in traditional physical education, to clearly promote students' learning satisfaction. Abreu *et al*. (2017) pointed out the difference of positions in sport education model (coaches, team leaders, management, facilities, and referees) from grouping activity in traditional physical education as the "process of role playing". Different sports team mechanisms allowed students with low learning achievement participating in activity to promote the positive reinforcement of learning satisfaction. Accordingly, the following hypothesis is proposed in this study.

*H3: **S**ports education presents notable effects on learning satisfaction*.

Zhang *et al*. (2016) indicated that sport education model enhanced motor skill learning effect and construct students' proper physical fitness development through team games to acquire true and complete sports experience through peer cooperation or team discussion. Students with positive and complete sports experience in physical education would expect to expand the participation and exercise commitment to exceed the physical education program. Porntaweekul, Raksasataya, & Nethanomsak (2016) indicated that learning activity in sport education model gave considerations to social, sports, and cognitive learning outcome, provided students with complete learning, and enhanced students to become good sports participants to promote the learning drive through competition and awards. In addition to the learning and observation of motor skills, exercise commitment of the cultivation of self-confidence and responsibility, teamwork, problem-solving ability, and the cultivation of exercise habits and lifelong learning could hardly be achieved in general physical education. Atzori *et al*. (2016) mentioned that sport education model aimed to teach and realize sports concept and sports behavior in physical education through teachers' curriculum design and practice, to have students learn sports related knowledge through participation to further cultivate the ports interests and habits or appreciation, and to present a unique appearance of physical education through the completion of such objectives and processes in sport education model. Sport education model aimed to encourage individuals developing motor skills and exercise commitment, understanding the

importance of participation in sports, and being a sportsman in the life process. The following hypothesis is further proposed in this study.

H4: Sports education appears significant effects on exercise commitment.

Methodology

Experimental object

60 college students of 2 physical education classes in Beijing Normal University are selected as the experimental objects, including 40 females and 20 males, aged 19~21, with the average age 20.52±0.8. The subjects are physically healthy, without cardiovascular diseases, show the heights and weights within normal range, and do not take any drugs to affect heart rate in the experiment process. All subjects sign the informed consent that they could unconditionally withdraw whenever they feel uncomfortable in the research process.

Teaching method and content

According to the idea of SEM, physical education for the experimental class is designed to have students, with teams, participate in physical game centered season, which is divided into early season, during preseason, during playoff, and final season. The control class applies traditional teaching model with the entire physical education process being divided into perception, comprehension, consolidation, and application. Both the experimental class and the control class have 1 session (90min) per week for 16 sessions. According to students' physical quality, 30 strength and flexibility centered physical actions, 30 sensitivity and coordination centered physical actions, as well as speed and endurance centered short-distance and middle- and long-distance running are arranged.

Experimental objects and rating

The experimental objects are tested every two months, on September 9th and November 9th in 2016 and January 9th in 2017. Before testing physical quality, the experimental class and the control class are controlled the warm-up with the same content and the same time for smooth and consistent test.

Students' physical quality rating. Indicators of sit and reach, 50-meter race, male 1000-meter race (female 800-meter race), extreme plank, Lllinos motion sensitivity test, and cross quadrant jump are used for reflecting students' flexibility, speed, endurance, strength, sensitivity, and coordination quality. According to the equation $y=[(x-xmin)/ (xmax-xmin)]\times6+1$, students' physical quality is rated 1~7.

*Physical activity enjoyment scal*e. Applying physical activity enjoyment scale (PACES) made by Sun (2014), the scale contains 16 projects with negative factors and positive factors; and, the correlation coefficients of factors and the total score of scale appear in 0.311~0.837 and the correlation coefficients of factors and total score appear in 0.663~0.861, with $p<0.01$. The α coefficient of total scale is 0.957 and the α coefficients of sub-scales are 0.923 and 0.918, respectively, and the factor loadings appear in 0.603~0.851. There are significant correlations between dimensions and criterion validity profile of mood state (POMS). It reveals good reliability and validity of PACES to effectively measure students' enjoyment of school physical education. With Likert 7-point scale, the degree reveals from extremely disagree to extremely agree. The lowest and the highest total scores of the scale are 16 and 112, respectively.

Physical education curriculum study satisfaction measurement form. Using college students' physical education curriculum study satisfaction measurement form (PECSS) made by Shi (2010), the scale includes 5 factors of teaching atmosphere and content, teachers' teaching ability, field facilities, and performance rating, with 25 items, to explain 63.898% total variance, the α coefficient of total scale presents 0.933, the α coefficients of sub-scales appear in 0.808~0.890, and the test-retest reliability is 0.835. The correlation between sub-scales and total scale appears in 0.692~0.873, with $p<0.01$, and the correlation among dimensions appears in 0.261~0.483. It explains good reliability and validity of PECSS, which could be used for testing college students' physical education learning satisfaction. According to Likert 7-point scale, the degree reveals from extremely disagree to extremely agree. The lowest and the highest total scores of the scale reveal 25 and 175, respectively.

Physical education exercise commitment scale. Applying college students' physical education exercise commitment scale (ECS) made by Qiu, Cui, & Yang (2012), the scale is composed of 27 projects in commitment characteristics and determining factors, including 2 factors of desired commitment and necessary commitment as well as 6 factors of satisfaction, social restraint, participation in choice, individual involvement, social support, and opportunity for participation. Such two parts could respectively explain 53.26% and 60.99% total variance. The factor loadings appear in 0.430~0.798, the α coefficients of dimensions appear in 0.705~0.815, and the test-retest reliability appears in 0.564~0.781. There are also remarkable correlations between dimensions and exercise behavior. In this case, ECS presents better reliability and validity and is suitable for physical education of college students in China. Based on Likert 7-point scale, the degree reveals from extremely disagree to extremely agree. The lowest and the highest total scores of the scale reveal 27 and 189, respectively.

Mathematical statistics and analysis

The analysis theory of latent growth model is originated from follow-up study in methodology and could discuss mediators, moderators, and multivariable. Researchers therefore suggest the wide application of LGM in physical education (Su & Xu, 2017). The retrieved questionnaire and various physical education data are organized and examined invalid data for recording, and the retrieved data are preceded LGM analysis with SPSS18.0 and Amos22.0.

Results and discussion

Judgment of univariate normal hypothesis

Skew absolute within 2 is the acceptable standard, and kurtosis absolute within 8 is normal. The skew absolute of various data in this study appears in 0.15~1.58, smaller than 2, and the kurtosis absolute appears in 0.01~2.12, smaller than 8 that the research data are regarded as normal. The mean and standard deviation of the tests of physical quality, enjoyment, learning satisfaction, and exercise commitment are shown in *Table 1*.

Table 1. Judgment of normal hypothesis

variable	M	SD	skew	C.R.	kurtosis	C.R.
physical quality a	22.57	3.59	0.18	-1.96	0.78	0.31
physical quality b	25.20	3.83	-0.24	-3.86	0.54	3.80
physical quality c	26.69	3.70	-0.42	-1.99	0.19	0.27
enjoyment a	2.72	0.61	-0.42	0.44	-0.01	-1.55
enjoyment b	3.91	0.72	0.23	0.68	-0.84	-1.39
enjoyment c	5.38	0.97	0.21	-0.91	-1.12	-1.15
learning satisfaction a	5.53	0.94	-0.81	-5.78	0.29	8.27
learning satisfaction b	6.14	0.70	-0.97	-5.40	0.41	5.42
learning satisfaction c	6.54	0.53	-1.58	-3.39	2.12	0.54
exercise commitment a	2.88	0.66	0.15	1.01	-0.57	0.05
exercise commitment b	3.73	0.75	0.24	-0.12	0.18	-1.08
exercise commitment c	4.74	0.65	-0.28	-0.10	0.06	-1.02

Comparison of LGM nested model

The results of 4 models are shown in *Table 2,* where M_1 is a non-growth model, i.e. the 3 tests of physical quality, enjoyment, learning satisfaction, and exercise commitment of the experimental class and the control class college students remaining constant. M_2 is a linear growth model, i.e. 4 dimensions showing linear changes. M_3 is a non-defined growth curve model, i.e. 4 dimensions in the measurement appearing uncertain changes. The nested model comparison in Table 1 reveals that TLI, NFI, and CFI of 4 dimensions in M_2 model are higher than M_1 and 0.90, while the SRMR is smaller than M_1 and 0.05. The nested model comparison further reveals that M_2 notably enhances model fit. In this case, linear growth curve model could better fit the data than non-growth model. The fit of physical quality, enjoyment, and exercise commitment in M_3 is worse than it in M_2, and $\Delta\chi 2$ shows 4.58, 4.45, and 3.05, respectively, and Δdf appears 1, with p>0.01. Such 3 dimensions in M_3 model therefore do not significantly enhance the fit. Apparently, based on the standards of accuracy and conciseness, 3 linear growth models are the optimal fit of changes in college students' physical quality, enjoyment, and exercise commitment; and, learning satisfaction is the optimal fitted model in M_3. That is, the changes in college students' learning satisfaction during the measurement appear non-defined growth curve.

Table 2. Comparison of LGM nested model and fit index

model		χ2	*df*	*model comparison*	Δχ2	*Δdf*	*TLI*	*NFI*	*CFI*	*SRMR*
physical quality	M_1	22.35**	3				0.83	0.80	0.83	0.04
	M_2	6.42	3	M_1vM_2	15.93**	0	0.97	0.94	0.97	0.01
	M_3	1.84	2	M_2vM_3	4.58	1	1.00	0.98	1.00	0.01
enjoyment	M_1	100.50**	3				1.61	1.49	0.00	0.30
	M_2	6.37	3	M_1vM_2	94.13**	0	0.91	0.90	0.91	0.05
	M_3	1.92	2	M_2vM_3	4.45	1	1.01	0.95	1.00	0.03
learning satisfaction	M_1	69.17**	3				0.49	0.48	0.49	0.11
	M_2	14.94**	3	M_1vM_2	54.23**	0	0.91	0.89	0.91	0.04
	M_3	5.10	2	M_2vM_3	9.84**	1	0.96	0.96	0.98	0.02
exercise commitment	M_1	122.25**	3				0.03	0.03	0.03	0.27
	M_2	14.79**	3	M_1vM_2	107.46**	0	0.90	0.90	0.90	0.03
	M_3	11.74**	2	M_2vM_3	3.05	1	0.88	0.91	0.92	0.02

Class predictive model fit test

As shown in *Table 3*, χ^2/df of 4 class predictive growth model of physical quality, enjoyment, learning satisfaction, and exercise commitment reveals 4.81, 4.76, 4.98, and 4.71, respectively; *TLI*, *IFI*, and *CFI* are higher than 0.90; and, *SRMR* appears 0.04, 0.02, 0.03, and 0.04, respectively. It explains good class predictive growth model fit. Regarding standardized coefficients, 4 class predictive model of physical quality, enjoyment, learning satisfaction, and exercise commitment are predicted the R^2 of observation indicators from the beginning and growth rate, which appear in 0.81~0.82, 0.61~0.78, 0.83~0.94, and 0.83~0.87, respectively, higher than the allowable range of 0.50. All estimated parameters achieve the significance, revealing good internal structure of 4 class predictive growth model. Overall speaking, the 4 class predictive growth model constructed in this study is an ideal model.

Table 3. Conditional growth model fit

class predictive model	$\chi 2$	χ^2/df	*TLI*	*IFI*	*CFI*	*SRMR*
	the smaller the better	<5	>0.9	>0.9	>0.9	<0.05
physical quality	24.04	4.81	0.93	0.95	0.93	0.04
enjoyment	23.79	4.76	0.94	0.97	0.95	0.02
learning satisfaction model	19.90	4.98	0.95	0.95	0.94	0.03
exercise commitment model	23.54	4.71	0.90	0.92	0.93	0.04

Comparison of parameter estimate in class predictive model

From the comparison of parameter estimates in *Table 4*, the path coefficient estimates of class covariance to 4 growth model intercept latent variables of physical quality, enjoyment, learning satisfaction, and exercise commitment show 0.75, 0.38, -0.17, and 0.23, respectively, with $p<0.05$, revealing remarkable effects of class predictive variable on students' 4 initial states. In the preliminary, the control class shows notably higher physical quality, enjoyment, and exercise commitment than the experimental class, while the experimental class appears significantly higher learning satisfaction than the control class.

The path coefficient estimates of class covariance to 4 growth model slope latent variables of physical quality, enjoyment, learning satisfaction, and exercise commitment show -0.32 ($p<0.05$), -0.26 ($p<0.05$), 0.05 ($p>0.05$), and -0.09 ($p<0.05$), respectively, revealing notable effects of class predictive variable on the growth rate in the 3 tests of physical quality, enjoyment, and exercise commitment. However, the measurement of learning satisfaction does not appear significant

effects that H3 is not supported. The experimental class remarkably shows higher growth rate in 3 tests of physical quality, enjoyment, and exercise commitment than the control class that H1, H2, and H4 are supported.

Table 4. Comparison of parameter estimate in conditional growth model

physical quality class predictive model		estimate	standard error	*t*	*p*	*Cohen's d*
the control class-the experimental class	intercept	0.75	0.31	2.45	0.014	0.74
	slope	-0.32	0.12	-2.64	0.008	0.76
enjoyment class predictive model						
the control class-the experimental class	intercept	0.38	0.05	7.93	***	0.96
	slope	-0.26	0.04	-6.62	***	0.95
learning satisfaction class predictive model						
the control class-the experimental class	intercept	-0.17	0.08	-2.14	0.03	0.69
	slope	0.05	0.04	1.26	0.21	0.49
exercise commitment class predictive model						
the control class-the experimental class	intercept	0.23	0.06	3.99	***	0.87
	slope	-0.09	0.02	-4.08	***	0.88

Conclusion

The experimental class presents notably higher growth rate in 3 tests of physical quality, enjoyment, and exercise commitment than the control class, revealing better effect of the development of physical quality, the reinforcement of sports enjoyment, and the realization of physical education exercise commitment with sport education model than with traditional physical education model.

Focusing on physical games, SEM is run through the sports season in the term, including learning and practice days, practice and play days, and play days. In comparison with traditional physical education model, students acquire more time for technique learning and accumulate richer game experience. Meanwhile, teaching with sport education model could largely enhance students' practice density and strength. Furthermore, sport education model provides good opportunities for physical education trainees or students not being able to participate in team activity due to weaker physical fitness and largely enhances students' concern about and participation in class learning tasks. A student with worse physical quality in the

experimental class mentioned, "it was difficult for me to insist on the practice in the physical education in the beginning of the term; however, I had to do my best to complete each practice and game for team ranking and pride; in order not to pull back the team, I would practice after class." Moreover, the practice of sport education model could enhance more emotional exchange between teachers and students and create warm interpersonal interaction and teacher-student relationship. Gill, Ashton, & Algina (2004) revealed that students with good relationship with teachers and classmates presented higher learning involvement. Accordingly, sport education model shows great assistance in enhancing the teaching effect on college students' physical quality.

Either in class learning, practice, or class games, the experimental class changes the teacher centered pouring-in-process instruction in traditional physical education model. The teaching idea of sport education model stresses on the learning process of teams. For instance, the control class applies group interval practice for speed-oriented 50m short distance running, while the experimental class practices it with 50m relay. The teaching strengthens students' interaction and sense of belongingness in the experimental class, deepens teamwork comprehension, and particularly enhances classmates who are not willing to participate in or keep far away from class activity participating in sports (Pill, 2008) to further activate class climate and reinforce enjoyment in physical education classes. Woods, Tannehill, & Walsh (2012) regarded positive correlations between physical education enjoyment and physical activity enjoyment that students experiencing higher physical activity enjoyment presented better health conditions. As a result, it is important to create pleasant climate in physical education classes. A student in the experimental class stated, "*we had team practice of strength, speed, endurance, and flexibility in physical education class; the team games, female games, and male games with the facilities of dumbbells, pedals, yoga mat, and elastic band allowed us fully understanding muscle training and learning effective training actions; practice and games were harsh, but the classes were pleasant and active; physical education helped me defeat the fear of physical fitness and even became my weekly expectation*".

Recommendations

Past research revealed that SEM could effectively enhance individual physical fitness, easily acquire pleasant experience, team awareness, and social exchange, enhance students' value agreement with physical education exercise, and further promote autonomous motivation in physical education exercise to induce and maintain persistent physical education exercises. A female in the experimental class mentioned, "I discovered that physical education exercise was so interesting until participating in physical education; teachers designed several interesting exercise items and team games for each classmate attempting to challenge the limit and insist to the end in each practice and game and enjoy the fun of physical

exercise; I would keep good habits of physical education exercise in the future and pay attention to warm-up and physical recovery before and after exercise, as well as apply correct actions taught by teachers for exercise to enhance physical quality." Sport education model presents strong novelty in learning methods, encourages students to change roles in each game, and shows strong situation. Besides, students' enjoyment experience in physical education could cultivate their interests in physical exercise. Ge, Lu, & Lu (2012) proved individual enjoyment experience as the primary factor in inducing situational interest. Through long-term cultivation, situational interest could be developed into individual interest to enhance and realize physical education exercise commitment.

Apparently, sport education model is suitable for being applied to college physical education to enhance college students' physical quality, improve sports enjoyment, and realize lifelong physical exercise to benefit the realization of sports participation, motor skills, and social adjustment in current college physical education. However, the promotion of sport education model in other fields should be cautious. Sport education model is suitable for the application to college physical education, could enhance college students' physical quality, improve sports enjoyment, and realize lifelong physical exercise to benefit the realization of sports participation, motor skills, and social adjustment in current college physical education. Nevertheless, the promotion should depend on special background and time and space restrictions, rather than suitable for all.

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