

The Empowerment of Flipped Classroom in College Basketball Elective Courses: Evaluation of Teaching Reform Effectiveness

Li Tengda, Wen Fang, Liu Binbin

Nanchang Normal University, Nanchang, Jiangxi Province, 330032, China

Abstract: The paper explores the application of the flipped classroom teaching model in college elective basketball courses. The results indicate that this model is more effective than conventional teaching in enhancing students' basketball skills, tactical abilities, and self-directed learning, with a particularly significant improvement observed in male students. However, it is slightly less effective than conventional teaching in improving male students' strength qualities, while there is no significant difference in the improvement of other physical qualities. The enhancement of basic basketball skills is comparable to that of conventional teaching.

Keywords: Flipped Classroom; Public Elective Courses; Basketball Skills; Autonomous Learning Ability

1. Introduction

On October 8, 2018, the Ministry of Education issued the "Opinions on Accelerating the Construction of High-level Undergraduate Education and Comprehensively Improving the Capacity for Talent Cultivation", clearly stating that it should focus on student development, actively promote small-class teaching, blended teaching, flipped classrooms, and build a teaching model that combines online and offline.^[1] On October 17 of the same year, the Ministry of Education, in conjunction with five other departments, once again explicitly required to promote the implementation of inquiry-based cooperative teaching, facilitate students' autonomous learning, and create a learning environment and mechanism that combines online and offline, in-class and out-of-class learning, in order to improve learning outcomes.^[2] School physical education, as an important part of implementing the education policy and quality-oriented education, shoulders the responsibility of enhancing students' physical fitness, cultivating students' correct concepts of physical education, mastering scientific exercise skills and improving students' overall quality.^[3] Flipped classroom is a teaching model that centers on students, takes the classroom as the main line, and is supported by digital educational technology. When applied to public physical education teaching in colleges and universities, it can enhance students' autonomous learning ability and promote the formation of students' motor skills.^[4] This study uses modern digital technology to introduce the flipped classroom teaching model into the basketball elective course of public physical education in colleges and universities. The teaching reform was evaluated by the changes in students' physical fitness, basic basketball skills, basketball technical and tactical abilities, and self-study ability before and after teaching, thereby providing a theoretical basis for improving the teaching quality of public physical education courses.

2. Objects and Methods

2.1 Research Object

The subjects of this study were college students of the 2022 public elective basketball course at Nanchang Normal University, and male and female students from four teaching classes were selected as subjects. The criteria for inclusion were as follows: ① Good physical function and mental state; ② No systematic or professional physical training. Before the experiment began, the subjects' body shape, physical fitness, basic basketball skills, basketball technical and tactical abilities, and self-study ability were tested. In the end, 87 subjects met the criteria and completed the tests, including 32 boys and 13 girls in the experimental group and 31 boys and 11 girls in the control group. After independent sample t-tests, the differences in indicators between the two groups were not statistically significant ($P > 0.05$), so further experiments can be conducted on this basis.

2.2 Experimental Protocol

Both the control group and the experimental group were taught by full-time teachers who taught the same content strictly in accordance with the requirements of the teaching syllabus. The total duration of the course was 14 weeks, with 2 class hours per week, totaling 28 class hours. The control group adopted the conventional teaching mode, which included: ① students previewed independently before class; ② During the class, teachers demonstrate, students practice, and then practice after collective correction; ③ Evaluation and summary at the end of the class. In the experimental group, the flipped classroom model was implemented using modern digital technologies such as Chaoxing Learning, wechat, etc. The specific arrangements were as follows: ① Before class, students watched the designated teaching videos and materials and engaged in online discussions and exchanges; ② During the class, students take the lead in teaching, teachers interact and comment with students, practice after cooperative exploration, and teachers provide itinerant tutoring; ③ A combination of face-to-face and online evaluations and summaries.

2.3 Evaluation metrics

This study adopted a pre - and post-test design for the experimental group and the control group. The evaluation indicators included:

(1) Physical fitness: The test items of the National student Physical health Standard were selected, covering the following five aspects: speed (50-meter dash), strength (one-minute sit-ups for girls, pull-ups for boys), endurance (800 meters for girls, 1000 meters for boys), flexibility (sit and reach), and jumping (standing long jump) physical fitness. ^[6]

(2) Basic basketball skills: Based on the junior basketball skill level standards, assessment items of basic skills such as shooting, dribbling and passing were selected, including tests of one-minute shooting, half-court back-and-forth dribbling layup and full-court passing and receiving layup. ^[5]

(3) Basketball technical and tactical ability: A 10-minute 3×3 basketball game will be used for testing, and the comprehensive score of technical and tactical ability will be used for evaluation. The assessment includes offensive ability, defensive ability and team tactical awareness, with weights of 30%, 30% and 40% respectively for each part. ① Offensive skills: Evaluate the reasonableness, proficiency and practical effect of students' use of offensive techniques. ② Defensive skills: Evaluate students' individual and coordinated defensive skills. ③ Team tactical awareness: Evaluate students' ability to switch between offense and defense, fast break awareness, and individual tactical actions in the game.

(4) Autonomous learning ability: Using Wu Benlian's "Autonomous Learning Scale for College Students' Physical Education", which has 36 items, each item is scored on a 5-point Likert scale from 1 to 5, with some items being scored in reverse. The self-report scale is divided into four dimensions: learning motivation (55 points), learning process (50 points), learning outcome (40 points), and learning environment (30 points). By combining scores, the scale helps analyze students' performance in different dimensions, with higher scores indicating stronger autonomous learning ability in the corresponding sports. ^[7]

3. Research findings

3.1 Changes in physical fitness

The results of the t-tests for physical fitness indicators are shown in Table 1. For boys, the standing long jump ($P=0.010<0.05$) was statistically significant, and for boys, the sit and reach ($P=0.000<0.01$) and for girls, the sit-ups ($P=0.001<0.01$) were highly statistically significant. The results of the standing long jump ($P=0.005<0.01$), sit and reach ($P=0.000<0.01$), and pull-ups ($P=0.002<0.01$) in the control group were highly statistically significant; The 50-meter run ($P=0.014<0.05$) was statistically significant, the sit and reach ($P=0.007<0.01$) and sit-ups ($P=0.008<0.01$) were statistically significant, and the girls' standing long jump ($P=0.038<0.05$) was statistically significant. These indicated that both the experimental group and the control group were able to significantly improve the performance of male students in standing long jump and sit and reach, and female students in sit-ups. In addition, the control group was able to significantly improve the pull-ups and 50-meter dash scores of boys and the sit and reach and standing long jump scores of girls.

Table 1 Comparison of the average physical fitness of students in the experimental group and the control group before and after the experiment

Gender	Metrics	Experimental Group			Control Group		
		Pretest	Posttest	P value	Pretest	Posttest	P value
male	Standing long jump (cm)	222.78 ±13.60	229.50 ±20.35	0.010 *	225.06 ±12.49	234.19 ±20.76	0.005 **
	50-meter run (seconds)	7.83 ±0.58	7.85 ±0.97	0.881	7.87 ±0.82	7.55 ±0.51	0.014 *
	Sit and reach (cm)	14.54 ±5.85	19.12 ±5.67	0.000 **	12.93 ±6.97	17.65 ±5.09	0.000 **
	1000 meters (minutes)	4.37 ±0.41	4.42 ±0.49	0.614	4.30 ±0.27	4.30 ±0.51	0.99
	Pull-ups (pieces)	11.53 ±1.37	11.88 ±3.55	0.641	12.00 ±1.29	13.87 ±3.13	0.002 **
female	Standing long jump (cm)	168.46 ±11.31	167.08 ±18.69	0.707	174.27 ±19.79	181.55 ±15.40	0.038 *
	50-meter run (seconds)	9.31 ±0.56	9.43 ±0.62	0.554	9.22 ±0.51	9.18 ±0.59	0.771
	Sit and reach (cm)	18.21 ±6.80	20.94 ±4.87	0.059	19.50 ±4.21	22.49 ±5.15	0.007 **
	800 meters (minutes)	3.96 ±0.32	4.11 ±0.17	0.063	3.96 ±0.19	4.20 ±0.33	0.108
	Sit-ups (in)	30.15 ±8.84	39.85 ±7.47	0.001 **	34.27 ±6.83	42.27 ±7.42	0.008 **

Note: Significance tests are comparisons within each group before and after the experiment, * indicates $P < 0.05$, ** indicates $P < 0.01$.

Table 2 Tests of effects between Physical Fitness Test groups

Gender	Metrics	Degrees of freedom	Mean square	F value	p value
male	Standing long jump	1	81.756	0.345	0.559
	50-meter run	1	1.534	2.952	0.091
	Sit and reach	1	7.007	0.363	0.549
	1000 meters	1	0.098	0.442	0.509
	Pull-ups	1	63.963	5.613	0.021 *
female	Standing long jump	1	538.575	3.949	0.060
	50-meter run	1	0.245	0.797	0.382
	Sit and reach	1	3.161	0.260	0.615
	800 meters	1	0.051	0.743	0.399
	Sit-ups	1	2.746	0.059	0.810

Note: The significance test is a comparison between the experimental group and the control group, * indicates $P < 0.05$, ** indicates $P < 0.01$.

The results of the effect test of students' physical fitness scores between the experimental group and the control group under the control of pre-test scores are shown in Table 2. There was no statistical significance ($P > 0.05$) between the experimental group and the control group for boys' standing long jump, 50-meter run, sit and reach, 1000-meter scores. The pull-up score was statistically significant ($P = 0.021 < 0.05$); Girls did not achieve statistical significance in all physical fitness scores between the experimental group and the control group ($P > 0.05$). The results showed that the experimental group did not improve boys' pull-ups as well as the control group, but the improvement in other physical fitness items was comparable between the experimental group and the control group.

3.2 Changes in basic basketball skills

Table 3 Comparison of the mean levels of basic basketball skills of students in the experimental group and the control group before and after the experiment

Gender	Indicator	Experimental Group			Control Group		
		Pretest	Posttest	P value	Pretest	Posttest	P value
male	One minute shot (pieces)	2.63 ±0.61	3.81 ±0.56	0.000 **	2.55 ±0.51	3.61 ±0.50	0.000 **
	Half-court round-trip dribbling layup (seconds)	17.68 ±0.75	16.92 ±0.53	0.000 **	17.58 ±0.83	16.93 ±0.57	0.003 **
	Full-court passing, receiving and layup (seconds)	18.75 ±0.64	17.58 ±0.50	0.000 **	18.63 ±0.46	17.72 ±0.52	0.000 **
female	One minute shot (pieces)	1.77 ±0.60	3.23 ±0.83	0.000 **	1.73 ±0.47	3.18 ±0.60	0.000 **
	Half-court round-trip dribbling layup (seconds)	20.86 ±0.93	19.59 ±0.57	0.000 **	21.11 ±0.85	19.54 ±0.62	0.000 **
	Full-court passing and receiving layup (seconds)	20.90 ±1.24	19.70 ±0.80	0.006 **	21.20 ±1.11	19.68 ±0.54	0.001 **

Note: Significance tests are comparisons within each group before and after the experiment, * indicates $P < 0.05$, ** indicates $P < 0.01$.

The t-tests for basic basketball skills are shown in Table 3. Both the experimental group and the control group showed high statistical significance ($P < 0.01$) in one-minute shooting, half-court back-and-forth dribbling and layup, and full-court passing and receiving layup for both boys and girls. This indicates that both the experimental group and the control group were able to significantly improve students' basic basketball skills.

Table 4 Tests of effects between experimental groups on Basic basketball skills

Gender	Metrics	Degrees of freedom	Mean square	F value	p value
male	One minute shot (pieces)	1	0.389	1.988	0.164
	Half-court round-trip dribbling layup (seconds)	1	0.001	0.003	0.954
	Full-court passing, receiving and layup (seconds)	1	0.330	1.249	0.268
female	One minute shot (pieces)	1	0.003	0.006	0.937
	Half-court round-trip dribbling layup (seconds)	1	0.074	0.239	0.630
	Full-court passing and receiving layup (seconds)	1	0.032	0.070	0.794

Note: The significance test is a comparison between the experimental group and the control group, * indicates $P < 0.05$, ** indicates $P < 0.01$.

Under the control of pre-test scores, the effect test of students' basic basketball skills between the experimental group and the control group is shown in Table 4, and the scores of each item did not reach statistical significance between the experimental group and the control group ($P > 0.05$). This result indicates that there is no significant difference in the improvement of basic basketball skills between the experimental group and the control group.

3.3 Changes in basketball technical and tactical skills

Table 5 Comparison of the mean basketball skills of students in the experimental group and the control group before and after the experiment

Gender	Experimental Group			Control Group		
	Pretest	Posttest	P value	Pretest	Post-test	P value
male	81.00±4.78	86.16±2.71	0.000 **	81.61±4.74	81.55±4.29	0.884
female	76.46±5.68	81.77±3.37	0.001 **	76.00±4.41	78.82±3.09	0.002 **

Note: Significance tests are comparisons within each group before and after the experiment, * indicates $P < 0.05$, ** indicates $P < 0.01$.

The results of the t-test for basketball skills and tactics are shown in Table 5. The scores of both boys and girls in the experimental group were highly statistically significant ($P < 0.01$), while only the scores of girls in the control group were highly statistically significant ($P = 0.002 < 0.01$). This indicates that the experimental group can significantly improve the basketball skills of both boys and girls, while the control group can only significantly improve the basketball skills of girls.

Table 6 Tests of effects between groups in the Basketball Skills and Tactics Experiment

Gender	Degrees of freedom	Mean square	F value	p value
male	1	370.316	40.521	0.000 **
female	1	44.853	7.984	0.010 *

Note: Significance tests are comparisons between the experimental group and the control group. * indicates $P < 0.05$, ** indicates $P < 0.01$.

The effect test results of students' basic basketball skills between the experimental group and the control group under the control of pre-test scores are shown in Table 6. The scores of male students were highly statistically significant between the experimental group and the control group ($P = 0.000 < 0.01$), and the scores of female students were statistically significant between the experimental group and the control group ($P = 0.010 < 0.05$). The results suggest that the experimental group is better than the control group in improving students' basketball skills and tactics, especially for boys.

3.4 Changes in self-study ability

The results of the t-test for autonomous learning ability are shown in Table 7. For male students in the experimental group, the scores in the learning outcomes, learning environment dimension and total scale were highly statistically significant ($P < 0.01$), and for female students, the scores in the learning motivation dimension were statistically significant ($P < 0.05$). There was a high statistical significance ($P < 0.01$) in the scores of the learning process, learning outcome and total scale, while there was no statistical significance in the scores of each item in the control group ($P > 0.05$). This indicates that the experimental group can significantly improve the self-study ability of both boys and girls, while the effect of the control group is not obvious.

Table 7 Comparison of the mean values of autonomous learning ability of students in the experimental group and the control group before and after the experiment

Gender	Metrics	Experimental Group			Control Group		
		Pretest	Posttest	P value	Pretest	Posttest	"P value
male	Learning motivation	40.16±2.68	41.06±2.36	0.059	41.00±2.91	41.35±2.89	0.503
	Learning process	37.19±3.96	38.00±4.19	0.345	37.61±3.70	37.55±3.65	0.921
	Learning outcomes	24.88±3.23	26.44±3.05	0.000 **	24.35±4.14	24.52±3.44	0.783
	Learning environment	23.75±3.08	25.69±2.42	0.000 **	24.26±2.37	23.77±2.13	0.243
	Total table	125.97±6.33	131.19±6.30	0.000 **	127.23±6.14	127.19±7.04	0.979
female	Learning motivation	40.69±3.09	42.46±2.15	0.019 *	39.82±3.52	40.82±4.67	0.102
	Learning process	38.38±3.93	41.62±2.33	0.002 **	37.82±3.37	38.27±3.55	0.518
	Learning outcomes	20.62±2.57	23.23±2.05	0.000 **	21.45±2.66	22.08±2.07	0.457
	Learning environment	23.08±3.04	24.38±1.94	0.123	22.55±3.05	23.00±1.95	0.572
	Total Table	122.77±6.80	131.69±3.35	0.000 **	121.64±8.80	124.18±7.25	0.121

Note: Significance tests are comparisons within each group before and after the experiment, * indicates $P<0.05$, ** indicates $P<0.01$.

Table 8 Tests of effects between groups in the Autonomous Learning ability Experiment

Gender	Metrics	Degrees of freedom	Mean square	F value	p value
male	Learning motivation	1	0.124	0.023	0.880
	Learning process	1	6.171	0.468	0.497
	Learning outcome	1	39.63327	7.7911	0.007 **
	Learning environment	1	78.416	38.049	0.000 **
	Total table	1	352.430	11.469	0.001 **
female	Learning motivation	1	4.631	1.015	0.325
	Learning process	1	54.043	11.932	0.002 **
	Learning outcomes	1	13.179	4.297	0.051
	Learning environment	1	8.851	2.885	0.104
	Total Table	1	285.710	18.247	0.000 **

Note: Significance tests are comparisons between the experimental group and the control group, * indicates $P<0.05$, ** indicates $P<0.01$

The results of the effect test of students' autonomous learning ability between the experimental group and the control group under the control of students' pre-test scores are shown in Table 8. There was a high degree of statistical significance among the experimental groups in terms of learning outcomes ($P=0.007<0.01$), learning environment ($P=0.000<0.01$) dimension scores, and total scale ($P=0.000<0.01$) scores. Girls' scores in the learning process ($P=0.002<0.01$) dimension and total scale ($P=0.000<0.01$) were highly statistically significant among the experimental groups. The results suggest that the experimental group outperformed the control group in terms of enhanced self-study ability, mainly in the dimensions of learning outcomes and learning environment for boys, as well as learning process for girls.

4. Analysis and Discussion

4.1 The impact of flipped classroom teaching on college students' physical fitness

Flipped classroom teaching is comparable to conventional teaching in terms of physical fitness, especially in terms of speed, endurance, flexibility and jumping ability, but slightly inferior to conventional teaching in terms of strength for male students. This result may be related to the flipped classroom teaching method of inquiry-based and cooperative learning, where the practice time varies with the inquiry-based learning time^[1], and therefore the practice density and intensity may be lower than that of conventional teaching. In addition, differences in students' interests and hobbies, the arrangement of practice content, and practice habits may also have an impact on the practice effect. Girls usually have a weaker strength foundation, so the improvement in their strength quality is more significant after a period of practice, but the differences between the groups are not obvious after the experiment, which may also be due to the different test indicators for boys and girls. Overall, there was no significant difference in strength improvement for girls compared to regular teaching.^[10]

4.2 The impact of flipped classroom teaching on the basic technical level of college basketball

Both flipped classroom teaching and regular teaching can significantly improve students' basic basketball skills, and there is no difference in the improvement effect. Perhaps the flipped classroom is more used for inquiry, practice and interaction, which promotes students' active learning and thinking, helps students gain a deeper understanding of basketball skills and improves learning efficiency^[2]. However, the flipped classroom may not be as good at optimizing the use of practice time as regular teaching, and thus fails to show differences from regular teaching in terms of improving basic basketball skills.

4.3 The impact of flipped classroom teaching on College Students' basketball skills and tactics

The flipped classroom is superior to traditional teaching in improving students' technical and tactical abilities, and the improvement effect on boys is better than that on girls. Perhaps because the discussions in flipped classrooms are more targeted, students can engage in more cooperation and application, which promotes independent thinking and decision-making and thus better cultivates their sense^[3] of teamwork. Boys' improvement is better than that of girls, possibly because boys usually have a stronger sense of competition in sports and are more willing to improve their performance in competitions, while girls may be more inclined to understand techniques and tactics in detail and gradually.

4.4 The impact of flipped classroom teaching on college students' autonomous learning ability

Flipped classroom teaching is superior to conventional teaching in terms of the improvement of autonomous learning ability, mainly in the dimensions of learning outcomes and learning environment for boys and learning process for girls. This result may be due to the fact that in the flipped classroom model, boys gain more autonomy, can learn at their own pace, show higher enthusiasm, and can actively create and utilize material and social conditions to learn and show themselves^{[11][12]}. Girls, on the other hand, may be more inclined to enhance their learning experience through understanding and thinking, focusing on perception and reflection during the learning process.

5. Conclusions and Suggestions

5.1 Conclusions

(1) The flipped classroom model is inferior to conventional teaching only in terms of strength improvement for boys, while it is comparable to conventional teaching in other aspects of physical improvement.^[8]

(2) The flipped classroom teaching model can effectively improve students' basic basketball skills, and the effect is comparable to that of the conventional teaching model.

(3) The flipped classroom teaching model can effectively enhance students' basketball skills and tactics, and has obvious advantages over the conventional teaching model, especially for boys.

(4) The flipped classroom model outperforms the conventional model in enhancing students' autonomous learning ability, especially in terms of learning outcomes and learning environment for boys, while for girls it is mainly reflected in the learning process dimension.^[9]

5.2 Suggestions

(1) In the flipped classroom teaching of the public option basketball course, while highlighting the students' dominant position, it should also focus on cultivating the methods and strategies of physical exercise, enabling students to adjust the intensity and content of training according to their learning situations, and ensuring that each student can achieve more targeted improvement.

(2) There are differences in physical education learning among students of different genders. In teaching, attention should be paid to providing individualized learning paths for students, setting up reasonable and efficient cooperative learning and discussion sessions to further stimulate their motivation for autonomous learning and lay a solid foundation for their lifelong exercise.

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