PERINATAL JOURNAL

Original Article

Perinatal Journal 2025; 33(1):613-627

https://doi.org/10.57239/prn.25.03310066

Enhancing academic performance of physical education majors through active learning

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Abstract

This study is to investigate the influence of Active Learning on the academic performance of physical education majors by adjusting the curriculum and adopting active learning. Participants were 67 physical education college students. The experimental group consisted of 35 students and the control group contained 32 students. This study is based on a quasi-experimental design with two groups that have different members. After the 10 weeks of lessons the total scores of both groups had significantly improved. The post-test scores were higher than those of the pre-test, the students in the EG had performed better than those in the CG in the post-test. With just a slight change of content in a basketball class, students' attitude toward learning can change and their academic performance be improved by adjusting the teaching method. Active learning has been proved to be effective in improving the academic performance of Chinese college physical education majors.

Keywords: Active learning, Physical education, College students majoring in physical education, Academic performance

Introduction

As a major course of physical education major in colleges and universities, basketball special courses, to a certain extent, undertake the mission of enhancing physical fitness of college students majoring in sports, spreading campus basketball culture, and developing sports special skills [1]. However, in China, most students have been accustomed to passively receiving knowledge, and teachers follow the requirements of the book to explain systematically and in detail, so that students can master a lot of basic knowledge [2], but they fall into a vicious circle of cramming teaching, ignoring students' individual differences and independent thinking ability, and it is difficult to stimulate students' interest. Students do not have the habit and ability to think independently [3]. This Confucian-based approach to education is incompatible with the problem-solving, inquiry-based approach adopted in the West [4]. In the teaching of physical education courses, the traditional teaching mode based on "explanation -- demonstration -- practice" tends to make students in a passive learning state, which will affect their learning motivation and interest, and have a negative impact on learning [5,86]. The modern education concept requires that students should be trained to discover sports knowledge, sports technology and the ability to use sports knowledge and technology through the questions raised by sports teachers, and integrate the factors of discovery and creation into sports classroom [6].

Basketball special results usually include basketball technical level, tactical understanding and application, game performance, physical condition and so on [7]. Therefore, it is necessary to reform the special basketball courses for sports majors and integrate the teaching concept of active learning. Only by correctly grasping the connotation of the curriculum reform can we ensure the steady development of the special courses [8]. In order to change this situation, attract students to take the initiative to join the classroom learning, guide students to learn consciously, improve students' self-learning skills, and obtain a sense of accomplishment and satisfaction in solving special technical problems [9]. Therefore, higher education is faced with a challenge, that is, how to evaluate the traditional teaching practice and adjust it to a more student-centered direction, how to truly return the initiative of students' classroom learning to students, and how

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to effectively implement students' learning ability [10]. Teaching is no longer about instilling knowledge into students; teaching is about getting students actively involved in learning [11]. When students actively participate in learning, they can learn more than passively receiving instructions, such as enhancing students' independent exploration and problem-solving ability [12], cultivate team spirit [13], improve students' ability to use tactics and cope with competition [14], students will retain the material in their minds longer than in a traditional classroom after active learning.

Literature Review

2.1 Pyramid learning theory

Lectures, reading, audio-visual, demonstration, discussion, practice by doing, and teaching others are the seven core elements of the learning pyramid [15]. They can be categorized into passive and active learning. The former four belong to passive learning because students can only retain less than 30% of the knowledge imparted to them, while the latter three elements, which belong to active learning, can help students to retain more than 50% of information they receive [16]. This shows that active learning can help students to understand what they learn more thoroughly [17]. The relationship between a teaching approach and its results can generally be learned from empirical research. Letrud and Hernes (2016) regarded the learning pyramid as an authoritative theory in academia, and according to the learning pyramid, students' learning efficiency grows with their active participation [18]. Masters (2013) believe that, guided by the learning pyramid theory, the right combination of subject, teacher and student helps students to choose active learning and working in groups [19]. Vonderwell and Turner (2005) found that based on the learning pyramid, active learning helps students to retain more of the information they acquire in class. For all these reasons, the learning pyramid is taken as an important theory for this study [20].

Rojas et al. (2023) suggest all educators should adopt new teaching methods for better teaching outcomes [21]. Active learning not only helps learners to actively participate in the learning process to acquire knowledge and skills, but more importantly, it helps them to use their existing thinking abilities, like reflective and critical thinking, to deal with challenges during the course of achieving their personal or collective goals in today's complex social environment [22]. Siburian et al. (2019) define modern education as demanding the integration of knowledge, ability and skills [23]. In active learning, students are the central part of the class, while teachers manage the activities [24]. Wu and Wu (2020) state that active learning has been widely recognized as an effective form of teaching in class. Since the traditional teaching method is generally adopted in sports education, the aim of this study is to introduce active learning into a basketball class with a newly-designed course plan to help students to build new knowledge and improve their performance in a more effective way [25-26].

2.2 Active learning

Active learning has a long history as an educational idea, thought or theory [27]. Some educators have realized the important influence of students' enthusiasm and initiative in their educational practice from different angles [28]. In the process of teaching practice, students should be fully mobilized to effectively carry out the initiative and initiative of learning, let students use their brains, hands, to see, to do, to understand, in order to master the knowledge, technology and skills, and apply these knowledge, technology and skills to solve problems, learn how to learn, how to create, and enrich emotions, sound personality purposes [29]. Active learning is not only a general term for teachers to simply impart teaching knowledge and content to students, but also a general term for teachers to adopt discovery learning, investigation learning, group discussion, debate, group activities, practice teaching, etc., in the teaching process to guide students to actively participate in various teaching activities [30]. Under the teaching mode of active learning, the classroom will become more attractive for students to join, and students' learning is not only passive learning by accepting knowledge, but also the practice and acquisition of various applied skills including cognition, knowledge, ethics, morality and cultivation [31].

Active teaching is both a form of teaching and a style of teaching, in the creation of learning and the acquisition of knowledge in daily life, but also encourages students to be vigilant about learning,

and instills cognitive enthusiasm, is a way of teaching that improves students' academic performance [32]. The traditional teaching mode ignores the initiative and creativity of students in learning, which will inhibit the development of students' various abilities to a certain extent, while the active learning teaching mode has obvious advantages in cultivating students' critical thinking ability, collaborative ability and problem-solving ability [33]. In the process of this specific learning activity, teachers will use various forms of guidance to maximize the subjective initiative of students, students try to use the existing knowledge and skills to participate in and complete the learning activities [34].

2.3 Sports skills

As a popular sport, the study of basketball's special skills has attracted much attention, and many scholars have discussed it from different angles. In terms of physical fitness, the study emphasizes the importance of strength, speed, endurance and agility for basketball players, and good physical fitness is the basis for completing various technical movements and coping with high-intensity games [35]. At the technical level, the training methods for shooting, dribbling, passing and defense skills are constantly optimized [36]. Ji et al. (2023) pointed out that targeted repeated exercises combined with actual combat simulation can effectively improve the technical level [37]. In terms of tactics, the training of teamwork and individual tactical awareness has become the focus of research [38]. How to formulate tactics according to the characteristics of opponents and the decision-making ability of players on the field play a key role in the outcome of the game [39]. In addition, psychological factors such as self-confidence, concentration and ability to withstand pressure are also considered to have a non-negligible impact on the play of basketball-specific skills [40]. Liu and Hodgins (2018) have shown that active learning can stimulate students' interest and enthusiasm for basketball and increase their motivation and participation in learning [41]. Through active exploration and practice, students can better understand and master basketball skills, cultivate innovative thinking and problem-solving ability, and help improve students' comprehensive basketball literacy [42,87].

Methodology

3.1 Participants

The participants in this study were 67 physical education undergraduates in a comprehensive university in Zhejiang Province, China, who were randomly divided into two groups [43]. It is reasonable to assume that all 67 students had the same level of learning ability. The experimental group (EG) consisted of 35 students (26 male and 9 female), and the control group (CG) of 32 students (23 male and 9 female). The course lasted for 10 weeks, or 40 class hours. A double-blind approach was adopted to avoid the Hawthorne effect [44], which meant that the students did not know which group they were in and the control group also studied in the same teaching environment as another group [45].

3.2 Sampling method

A cluster sampling method was adopted to select students who voluntarily chose "Basketball Special" in a university in Zhejiang Province as the course intervention group, and the intervention time was from April 8, 2024 to June 28, 2024. The criteria of the experimental group: (1) same grade and same major; (2) Have not taken similar courses before; (3) Discuss teaching content and teaching methods with teachers and students after each course. The criteria of control group were: (1) same grade and same major; (2) Have not taken similar courses before; (3) After each course, do not discuss teaching content and teaching methods with teachers and students.

3.3 Measuring methods

To better design the course, reference was made to the *Evaluation Standards for Collegial Entrance Examinations of Physical Education Specialty in China*, which contains a set of examination contents, methods and scoring standards for high school students with excellent basketball skills who wish to take the Collegial Entrance Examinations to major in basketball in college [46]. It is important for the tests to be done correctly so that the students' actual basketball level can be truly reflected [47]. The test items include vertical jump (20 points), shot (20 points), layup (20 points) and competitive game (40 points), totalling100 points (see Table 1. A quantitative evaluation is used for simple moves such

as the number of shots and time of dribbling, while a qualitative evaluation is used for complex moves like basketball skills and tactics, and their practical application [48].

Table 1. Score of professional skills in physical education

	Physical Performance	**Skills**		**Performance in Game**	**Total Score**
Item	Vertical Jump	Shot	Layup	Competitive Game	
Score	20	20	20	40	100

Note: Data collected from this study.

At the end of the course, the skill tests were divided into two parts: skill score and standard score [49]. Its Intraclass Correlation Coefficient (ICC) is .782, as shown in Table 2. For the skill score, all students showed the required moves and were scored by five teachers, and the final score was the average after removing the highest and lowest ones [50]. For the standard score, students gained the score that corresponded to their actual performance.

Table 2. Intraclass correlation coefficient result

	Homogenous correlation	**95% confidence interval**		**Use the F test for truth value 0**			
		lower limit	**upper limit**	**value**	***df1***	***df2***	***p***
Individual measurement	.782	.667	.876	18.951	28	112	.000
Average measurement	.947	.909	.972	18.951	28	112	.000

Note: Data collected from this study.

3.4 Research intervention

The EG was subjected to an intervention that was based on active learning in class. This included discussion, practice in doing and teaching others, as well as question-based and cooperative learning. The specific forms of class include classroom lecture, video playback, group discussion, competition analysis, practical demonstration, question-and-answer between teachers and students, etc. While the CG was subjected to the traditional method [51,84]. At the same time, to reduce the variation caused by the teacher to the minimum extent, both groups of students were taught by the same teacher based on the same course design, the same textbook entitled *Ball Game: Basketball (Ed. 3),* and the teaching environment and the course schedule were also the same.

The educational objectives of the control group were typical of those in the traditional teaching method, such as move skills and attitudes. The class emphasis was on the teacher's detailed explanation and the students' repeated practices in a process consisting of explanation, demonstration, practice, tour guiding and error correction [52]. On the other hand, the experimental group followed the curriculum design of this study. Not only did this plan emphasize the improvement of their basketball skills, but also their academic performance. Therefore, along with the main content of the original course plan, the newly-designed plan incorporated the active learning philosophy to help the students to integrate knowledge and skills to a greater extent [53].

The course for the Experimental Group (EG) consisted of 20 lessons, 2 sessions per week and 90 minutes each session. The course content includes: skill training, physical training, breakthrough technology, tactical training, psychological training, sports events.

3.5 Statistical analysis

SPSS26.0 was used to analyze the information collected before and after the experiment, and the data results were expressed by mean ± standard

deviation (X±SD). The influence of group factors, time factors and their interaction on academic performance was analyzed by repeated measurement ANOVA. In the whole analysis process, Greenhouse Geisser is used to correct the degree of freedom for the statistics that do not meet the sphericity test [54]. When the interaction is statistically significant, simple effect analysis is carried out. When the interaction is not statistically significant but the main effect is statistically significant, Bonferroni method is used to compare each time point in the group. The *t* test of independent samples was used to compare the scores of different dimensions of the special scores of the two groups at three time points, and the repeated measurement data was used to compare the scores of different dimensions of the special scores at different time points [55]. The significance level was set as $P < .05$.

Results

4.1 Group pre-test and post-test difference detection

When all the lessons were finished and the tests results before and after all the training were collected, a t-test was undertaken to compare the pre-test and post-test results between the two groups. As can be seen from Table 3, the total scores of both groups had significantly improved that after the 10 weeks of lessons. Clearly, the post-test scores were higher than those of the pre-test. However, the students in the EG had performed better than those in the CG in the post-test.

Table 3. Summary of the paired sample t-test results for academic performance across the different dimensions and overall

Item	Group	Test	n	*M*	*SD*	*t*	*p*
Vertical Jump	EG	PRE	35	11.926	2.555	-9.693	0.000
		POST		13.837	2.669		
	CG	PRE	32	12.003	2.655	-2.451	0.020
		POST		12.378	2.592		
Shot	EG	PRE	35	17.800	1.937	-16.362	0.000
		POST		20.657	2.028		
	CG	PRE	32	17.656	2.026	-4.477	0.000
		POST		18.188	2.039		
Layup	EG	PRE	35	16.960	1.510	-10.501	0.000
		POST		19.154	1.378		
	CG	PRE	32	17.325	1.428	-2.895	0.007
		POST		17.800	1.558		
Comparative Game	EG	PRE	35	34.800	1.023	-22.633	0.000
		POST		39.286	0.710		
	CG	PRE	32	35.031	0.861	-14.131	0.000
		POST		38.250	1.320		
Total Score	EG	PRE	35	81.486	3.971	-70.004	0.000
		POST		92.934	4.381		
	CG	PRE	32	82.016	3.974	-15.988	0.000
		POST		86.616	4.170		

Note: Data collected from this study.

4.2 Analysis of Covariance (ANCOVA)

A One-way Analysis of Covariance (ANCOVA) was used in this study to further analyze the students' problem-solving ability in the post-test. Firstly, there was a need to determine if the pre-test or the grouping had made any difference to students' performance in the post-test. The homogeneity of the regression coefficients was tested before applying the ANCOVA, and the results are shown in Table 4.

Table 4. Test of the homogeneity of the groups' regression coefficients of academic performance

Item	Source	*SS*	*df*	*MS*	*F*	*p*
Vertical Jump	PRE	382.830	1	382.830	357.585	0.000
	Group*PRE	0.034	1	0.034	0.032	0.858
	Error	67.448	63	1.071		
Shot	PRE	219.816	1	219.816	283.615	0.000
	Group*PRE	0.133	1	0.133	0.171	0.680
	Error	48.828	63	0.775		
Layup	PRE	74.719	1	74.719	73.298	0.000
	Group*PRE	3.185	1	3.185	3.124	0.082
	Error	64.221	63	1.019		
Competitive Game	PRE	5.707	1	5.707	5.635	0.021
	Group*PRE	3.095	1	3.095	3.056	0.085
	Error	63.812	63	1.013		
Total	PRE	1070.878	1	1070.878	613.006	0.000
	Group*PRE	3.229	1	3.229	1.848	0.179
	Error	110.057	63	1.747		

Note: Data collected from this study.

As can be seen, there was no significant difference between the EG and CG in Vertical Jump (F=545.25, p= 0.858 > 0.05), Shot (F=283.615, p= 0.680 > 0.05), and other items, as well as the Total Score (F=613.006, p= 0.179 > 0.05). Hence, it can be concluded that the effect of the covariates (or pre-treatment) on the two groups was different, which is consistent with the hypothesis that the regression coefficients of the two tests are homogeneous within the groups. Therefore, the premises of the ANCOVA were all met.

The possibility that the difference between the pre- and post-test was caused by a sampling error can be ruled out based on the one-way ANCOVA. The analytical results of the students' academic performance are shown in Table 5.

Table 5. Summary of the one-way ANCOVA for academic performance

Item	Source	*SS*	*df*	*MS*	*F*	*p*
Vertical Jump	PRE	382.914	1	382.914	363.155	0.000
	Group	39.184	1	39.184	37.162	0.000
	Error	67.482	64	1.054		
	Total	12054.700	67			
Shot	PRE	219.800	1	219.800	287.315	0.000
	Group	91.107	1	91.107	119.092	0.000
	Error	48.961	64	0.765		
	Total	25789.000	67			
Layup	PRE	72.361	1	72.361	68.704	0.000
	Group	42.977	1	42.977	40.805	0.000
	Error	67.406	64	1.053		
	Total	23119.680	67			
Competitive Game	PRE	4.235	1	4.235	4.051	0.048
	Group	19.847	1	19.847	18.984	0.000
	Error	66.907	64	1.045		
	Total	100907.000	67			
Total	PRE	1078.416	1	1078.416	609.247	0.000
	Group	783.549	1	783.549	442.663	0.000
	Error	113.285	64	1.770		
	Total	543551.580	67			

Note: Data collected from this study.

It is obvious that training had a significant influence on the performance of the students in both groups. As shown, the analytical results were as follows: Vertical Jump [$F(1, 64)=37.162$, $p=0.000<0.01$], Shot [$F(1, 64)=119.091$, $p=0.000<0.01$], Layup [$F(1, 64)=40.805$, $p=0.000<0.01$], Competitive Game [$F(1, 64)=18.984$, $p=0.000<0.01$], and Total Score [$F(1, 64)=442.663$, $p=0.000<0.01$], indicating that the scores of the students in the EG were significantly higher than those of the students in the CG for all the test items. Hence, it can be concluded that, with just a slight change of content in a basketball class, students' attitude toward learning can change and their academic performance be improved by adjusting the teaching method.

4.3 Repeated measurement ANOVA

The repeated measurement method was used to measure the students' stage performance at several different times (before, during and after the experiment) as shown in Table 6. Repeated measurement refers to multiple measurements of the same observation index of the same observation object at different times or environments, which is used to analyze the change trend of the observation index. In order to dynamically observe the improvement of active learning and student-centered learning on the specific performance of physical education major, students' performance was measured at different times before and after the experiment (before the experiment, 5 weeks and 10 weeks after the experiment). A Repeated Measures ANOVA revealed a significant variation in physical professional performance over different time intervals ($F(1, 29)=6578.069$, $p=0.000<0.01$). Subsequent post hoc analysis indicated that there was significant difference in the performance between before the experiment ($M=81.486$, $SD=3.971$) and during experiment ($M=86.156$, $SD=3.973$). It was observed that performance significantly improved after the experiment ($M=92.934$, SD =4.381) in comparison to the preceding assessments.

Table 6. The effect of active learning on specific achievement

(I)Time	(J) Time	Mean difference (I-J)	Standard error	*p*	95% Confidence interval b for the difference	
					Lower limit	Upper limit
1	2	-1.363*	0.228	0.000	-1.829	-0.898
	3	-12.337*	0.228	0.000	-12.803	-11.871
2	1	1.363*	0.228	0.000	0.898	1.829
	3	-10.973*	0.225	0.000	-11.434	-10.512
3	1	12.337*	0.228	0.000	11.871	12.803
	2	10.973*	0.225	0.000	10.512	11.434

Note: 1 is before experiment, 2 is during experiment, 3 is after experiment

Discussion

The aim of this study was to determine if active learning and student-centered teaching can improve the academic performance of physical education majors in college. The course was designed based on the *Evaluation Standards for Collegial Entrance Examinations of Physical Education Specialty in China* and the learning pyramid theory in order to nurture students' abilities and skills, stamina, problem solving, psychology, basketball tactics, etc. Active learning and the student-centered teaching method were introduced to the class by applying the active learning elements in the learning pyramid theory (i.e., discussion, practice in doing and teaching others), as well as using question-based and program-based learning methods [51].

The results of the study proved that active learning and the student-centered teaching method can help to improve the academic performance of college physical education students, which is consistent with previous studies and illustrates the value of this approach [56-57]. Researchers believe that teachers who utilize active learning methods will expend more energy on helping students to gain knowledge and

skills, which has a positive impact on students' academic performance and their attitude toward learning [58]. Some researchers have also found that student-centered teaching methods can positively influence students' study habits [59]. Besides, there have been similar studies on the application of active learning and the student-centered method in physical education curricula. For instance, Lonsdale et al. (2013) used these methods to explore the strategies that can arouse youngsters' motivation to participate in sports activities [60]. Ballen et al. (2017) found that active learning had a positive influence on improving students' performance in human anatomy and physiology education [61]. Calderón et al. (2020) tried to incorporate social media and digital technologies into physical education classes to create a student-centered active learning environment and found a positive correlation between this approach and students' academic performance [62].

However, other researchers had different findings. For example, Dyson (2002) proposed that, although active learning has some benefits, it is also likely to be problematic because it requires teachers to shift from the traditional teaching model to innovative ones[63]. This means that teachers need to continuously explore and update their teaching methods to find the most efficient ways to help students to use their initiative to acquire knowledge and solve problems[64].

In addition, it was found in this study that the academic performance of the physical education majors who were assigned to classes that used active learning and the student-centered teaching method significantly improved compared with that of the control group. This is consistent with other researchers, who found that students in active learning classes were more efficient in terms of learning conceptual ideas and performance than those in classes using the traditional teaching model [65]. Prince (2004) also found that students' interest in learning can be developed by active learning and their cognitive ability can be better trained [66]. Students exposed to active learning may display better communication and problem-solving skills [67]. Many researchers have proved that non-traditional teaching models can improve learners' academic performance, as well as their motivation for learning [68].

Freeman et al. (2014) conducted a control study and found that students can have a better grasp of concepts and a better performance in tests by employing some active-learning teaching methods [69]. Then, Oliver et al. (2015) applied active learning and the student-centered teaching method in educational practice to help students to learn better [70]. Prior to that, Armbruster et al. (2002) had used the same teaching model and found that students' academic performance had improved [71].

However, there were also some different findings (72-73) when some researchers discovered that active learning interventions may potentially have a negative impact on students' motivation and attitude toward learning. Silverthorn (2020) identified the factors that hinder the application of active learning as resistance from students, teachers' inaction, etc[74]. However, some limiting factors can be mitigated by the change of role between teachers and students and others by a newly-designed course plan.

Therefore, the use of active learning and a student-centered teaching method in physical education lessons can boost students' enthusiasm and motivation for learning with guidance from teachers and teacher-student interactions, etc., so that students can gain knowledge in ways they prefer and actively exchange information [75]. In these classes, students are able to think, innovate and solve problems, and their sporting skills can become more sophisticated when they are feeling, exploring and thinking [76]. In addition to demonstrating the benefits of the course, this study draws a line between "teacher-centered" and "student-centered" instruction, demonstrating the need to integrate them both to ensure the effectiveness of the curriculum[77]. It was found in this study that the 40 hours of active learning and student-centered classes did improve the academic performance of physical education college students at a university in China, thereby proving that active learning is more effective than the traditional teaching methods [78].

Conclusion

The aim of this quasi-experimental study was to investigate the influence of active learning and the student-centered teaching method on the academic performance of physical education college majors. Active learning and the student-centered teaching

method were applied to the students in the EG (35 students), and the students in the CG (32 students) were taught by traditional teaching methods. The course lasted for 10 weeks (40 class hours).

The results illustrated that active learning and student-centered teaching improved college physical education students' academic performance. Students in the EG and the CG both showed an improved academic performance in the pre- and post-test, but the scores of those in the EG were notably higher than those of the students in the CG[79]. Similar to some other studies, it is suggested that active learning and the student-centered method excel the traditional teaching methods, which have a mediocre influence on students' performance [80]. Therefore, active learning and the student-centered teaching method, which is based on practice by doing, teaching others, program-based and question-based learning, has been proved to be effective in improving the academic performance of Chinese college physical education majors.

Recommendations

According to Shahril et al. (2023), new pedagogical approaches can guide teachers' teaching practice. Hence, the purpose of this empirical research was to examine the effect of active learning and the student-centered teaching method on the academic performance of college PE majors[81,85]. Active learning and the student-centered teaching method were used as an intervention and the results are expected to give researchers and education workers a clear view of their influence. Furthermore, it provides a new and valid framework for incorporating active learning and student-centered teaching into physical education courses. It is recommended that future researchers could examine the influence of teaching tools like the Internet, cloud platforms, and new media technologies, etc. on college students' academic performance [82]. In addition, students' feedback could be collected using semi-structured interviews [83].

Funding

This work was supported by Ningbo University (NO. JYXM2024041). The second batch of undergraduate provincial teaching reform in the 14th Five-Year Plan (NO. JGBA2024125).

References

1. Ji, L., & Ma, D. H. (2019). Reform and development of school physical education in China in the new era. Sports Science, 39(3), 3-12.
2. Huang, Y., Liu, J., Yin, P., & Chen, L. (2014). Some thoughts on the design of Flipped classroom teaching model. Modern Educational Technology, 24(12), 100-106.
3. Van Hooijdonk, M., Mainhard, T., Kroesbergen, E. H., & Van Tartwijk, J. (2024). Can elementary school teachers assess students' creative problem-solving abilities? Teaching and Teacher Education, 146, Article e104644.
4. Hallinger, P., Tang, S. B., & Lu, J. F. (2017). Learning to make change happen in Chinese schools: Adapting a problem-based computer simulation for developing school leaders. School Leadership & Management, 37(1), 162-187.
5. Chow, J. Y., Davids, K., Button, C., Shuttleworth, R., Renshaw, I., & Araújo, D. (2007). The role of nonlinear pedagogy in physical education. Review of Educational Research, 77(3), 251-278.
6. Park, Y. (2024). Integrating career education into physical education: Insights from the Sports DreamCatcher initiative. Journal of Physical Education and Sport, 24(3), 499-512.
7. Ziv, G., & Lidor, R. (2009). Physical attributes, physiological characteristics, on-court performances and nutritional strategies of female and male basketball players. Sports Medicine, 39, 547-568.
8. Alters, B. J., & Nelson, C. E. (2002). Perspective: Teaching evolution in higher education. Evolution, 56(10), 1891–1901.
9. Al-Zarfi, A. J. K., Qalavandi, H., & Hosni, M. (2024). The effect of E-learning on academic progress, critical thinking, higher thinking and student satisfaction with the mediating role of academic self-efficacy, learning motivation and student participation. Kurdish Studies, 12(1), 4935-4951.

10. Murphy, L., Eduljee, N. B., & Croteau, K. (2021). Teacher-centered versus student-centered teaching: Preferences and differences across academic majors. Journal of Effective Teaching in Higher Education, 4(1), 18-39.
11. Deslauriers, L., McCarty, L. S., Miller, K., Callaghan, K., & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. Proceedings of the National Academy of Sciences, 116(39), 19251-19257.
12. Jensen, J. L., Kummer, T. A., & Godoy, P. D. D. M. (2015). Improvements from a flipped classroom may simply be the fruits of active learning. CBE—Life Sciences Education, 14(1), Article e5.
13. Hood Cattaneo, K. (2017). Telling active learning pedagogies apart: From theory to practice. Journal of New Approaches in Educational Research, 6(2), 144-152.
14. Farias, C., Valério, C., & Mesquita, I. (2018). Sport education as a curriculum approach to student learning of invasion games: Effects on game performance and game involvement. Journal of Sports Science & Medicine, 17(1), Article e56.
15. Letrud, K., & Hernes, S. (2018). Excavating the origins of the learning pyramid myths. Cogent Education, 5(1), Article e1518638.
16. Achuthan, K., Francis, S. P., & Diwakar, S. (2017). Augmented reflective learning and knowledge retention perceived among students in classrooms involving virtual laboratories. Education and Information Technologies, 22(6), 2825-2855.
17. McLean, S., Attardi, S. M., Faden, L., & Goldszmidt, M. (2016). Flipped classrooms and student learning: Not just surface gains. Advances in Physiology Education, 40(1), 47-55.
18. Letrud, K., & Hernes, S. (2016). The diffusion of the learning pyramid myths in academia: An exploratory study. Journal of Curriculum Studies, 48(3), 291-302.
19. Masters, K. (2013). Edgar Dale's Pyramid of Learning in medical education: A literature review. Medical Teacher, 35(11), 1584-1593.
20. Vonderwell, S., & Turner, S. (2005). Active learning and preservice teachers' experiences in an online course: A case study. Journal of Technology and Teacher Education, 13(1), 65-84.
21. Rojas, J. C. M., Lira, L. A. N., Fernández, Y. O., Guillén, D. F., Trujillo, L. V. A., & Trujillo, L. A. (2023). Improvements in the academic satisfaction of university students through the effective use of learning management systems and pedagogical innovations. Journal of Higher Education Theory and Practice, 23(7), 202-210.
22. Inzlicht, M., Werner, K. M., Briskin, J. L., & Roberts, B. W. (2021). Integrating models of self-regulation. Annual Review of Psychology, 72, 319-345.
23. Siburian, J., Corebima, A. D., & Saptasari, M. (2019). The correlation between critical and creative thinking skills on cognitive learning results. Eurasian Journal of Educational Research, 19(81), 99-114.
24. Niemi, H. (2002). Active learning—a cultural change needed in teacher education and schools. Teaching and Teacher Education, 18(7), 763-780.
25. Wu, T. T., & Wu, Y. T. (2020). Applying project-based learning and SCAMPER teaching strategies in engineering education to explore the influence of creativity on cognition, personal motivation, and personality traits. Thinking Skills and Creativity, 35, 1-23.
26. Gubacs, K. (2004). Project-based learning: A student-centered approach to integrating technology into physical education teacher education. Journal of Physical Education, Recreation & Dance, 75(7), 33-37.
27. Teslo, S., Thurston, M., Lerum, Ø., Mandelid, M. B., Jenssen, E. S., Resaland, G. K., & Tjomsland, H. E. (2023). Teachers' sensemaking of physically active learning: A qualitative study of primary and secondary school teachers participating in a continuing professional

development program in Norway. Teaching and Teacher Education, 127, Article e104113.
28. Keller, M. M., Hoy, A. W., Goetz, T., & Frenzel, A. C. (2016). Teacher enthusiasm: Reviewing and redefining a complex construct. Educational Psychology Review, 28, 743-769.
29. Thambu, N., Prayitno, H. J., & Zakaria, G. A. N. (2021). Incorporating active learning into moral education to develop multiple intelligences: A qualitative approach. Indonesian Journal on Learning and Advanced Education, 3(1), 17-29.
30. Lombardi, D., Shipley, T. F., & Astronomy Team, Biology Team, Chemistry Team, Engineering Team, Geography Team, Geoscience Team, and Physics Team. (2021). The curious construct of active learning. Psychological Science in the Public Interest, 22(1), 8-43.
31. Hung, H. T. (2015). Flipping the classroom for English language learners to foster active learning. Computer Assisted Language Learning, 28(1), 81-96.
32. Niemi, H., Nevgi, A., & Aksit, F. (2016). Active learning promoting student teachers' professional competences in Finland and Turkey. European Journal of Teacher Education, 39(4), 471-490.
33. Howell, R. A. (2021). Engaging students in education for sustainable development: The benefits of active learning, reflective practices and flipped classroom pedagogies. Journal of Cleaner Production, 325, Article e129318.
34. Xu, Z., & Shi, Y. (2018). Application of constructivist theory in flipped classroom-take college English teaching as a case study. Theory and Practice in Language Studies, 8(7), 880-887.
35. Erculj, F., Blas, M., & Bracic, M. (2010). Physical demands on young elite European female basketball players with special reference to speed, agility, explosive strength, and take-off power. The Journal of Strength & Conditioning Research, 24(11), 2970-2978.
36. Vencúrik, T., Nykodým, J., Bokůvka, D., Rupčić, T., Knjaz, D., Dukarić, V., & Struhár, I. (2021). Determinants of dribbling and passing skills in competitive games of women's basketball. International Journal of Environmental Research and Public Health, 18(3), Article e1165.
37. Ji, X., Samsudin, S. B., Yuan, Y., Nasiruddin, N. J. M., Farizan, N. H., & Soon, C. C. (2023). Effect of short-term coaching program to enhance basketball technical skills of passing, shooting, and dribbling. Revista de Psicología del Deporte (Journal of Sport Psychology), 32(1), 270-282.
38. Rangel, W., Fellingham, G., Santana, F., & Lamas, L. (2023). Integrated evaluation of team strategy, training practices and game performance of a basketball team. International Journal of Sports Science & Coaching, 18(1), 197-206.
39. Wang, Y. (2024). Tactics of training tactical consciousness in basketball teaching and training in colleges and universities. The Educational Review, USA, 8(6), 797-800.
40. Arthur-Cameselle, J. N., & Keeler, L. A. (2024). Effects of brief mindfulness training on basketball free-throw shooting performance under pressure: A randomized controlled trial of dosage response. Journal of Clinical Sport Psychology, 1(aop), 1-18.
41. Liu, L., & Hodgins, J. (2018). Learning basketball dribbling skills using trajectory optimization and deep reinforcement learning. ACM Transactions on Graphics (TOG), 37(4), 1-14.
42. Waffak, M. N., Sukoco, P., Sugiyanto, F. X., Arifianti, E., Setiawan, J., & Daryono, R. W. (2022). Developing a basketball learning model using the teaching game for understanding (TGfU) approach to improve the effectiveness of HOTS in elementary schools. Physical Education Theory and Methodology, 22(3s), S21-S29.
43. Axenfeld, J. B., Blom, A. G., Bruch, C., & Wolf, C. (2022). Split questionnaire designs for online surveys: The impact of module construction on imputation quality. Journal of Survey Statistics and Methodology, 10(5), 1236-1262.

44. Okike, K., Hug, K. T., Kocher, M. S., & Leopold, S. S. (2016). Single-blind VS double-blind peer review in the setting of author prestige. Jama, 316(12), 1315-1316.
45. Chen, P., & Chang, Y. (2021). Enhancing creative problem solving in postgraduate courses of education management using project-based learning. International Journal of Higher Education, 10(6), 11-21.
46. Hao, G. & Li, G. S. (2021). Key problems, development ideas and practical exploration in the integration of sports and education: Taking the development of standards of sport skill levels for schools and Universities as an example. Journal of Beijing Sport University, 44(1), 28-34.
47. Rao, H. F. (1997). A study on the standardization of the evaluating methods of the technical test in basketball as an optional course. Journal of Hubei Sports Science, (2), 85-87+84.
48. Grehaigne, J. F., Godbout, P., & Bouthier, D. (1997). Performance assessment in team sports. Journal of Teaching in Physical Education, 16(4), 500-516.
49. Toan, P. D. (2020). Development of criteria for test and assessment of academic results of high-quality curriculum for students majoring in basketball of sport training discipline under bac NINH sports university. International Journal of Physical Education, Sports and Health. 7(4), 24-28.
50. Xu, F., Zhao, Y. H., Wu, L. S., & Li, H. Q. (2008). Research on the examination methods and scoring criteria of basketball specialty in the institutes or departments of physical education. Journal of Capital Institute of Physical Education, 20(2), 101-103.
51. Anderson, J. R., Greeno, J. G., Reder, L. M., Simon, H. A. (2000). Perspectives on learning, thinking, and activity. Educational Researcher, 29(4), 11-13.
52. Ward, P., Kim, I., Ko, B., & Li, W. (2015). Effects of improving teachers' content knowledge on teaching and student learning in physical education. Research Quarterly for Exercise and Sport, 86(2), 130-139.
53. Broek, G. V., Boen, F., Claessens, M., Feys, J., & Ceux, T. (2011). Comparison of three instructional approaches to enhance tactical knowledge in volleyball among university students. Journal of Teaching in Physical Education, 30(4), 375-392.
54. Armstrong, R. A. (2017). Recommendations for analysis of repeated-measures designs: Testing and correcting for sphericity and use of manova and mixed model analysis. Ophthalmic and Physiological Optics, 37(5), 585-593.
55. Mishra, P., Singh, U., Pandey, C. M., Mishra, P., & Pandey, G. (2019). Application of student's t-test, analysis of variance, and covariance. Annals of Cardiac Anaesthesia, 22(4), 407-411.
56. Rotgans, J. I., & Schmidt, H. G. (2011). Situational interest and academic achievement in the active-learning classroom. Learning and Instruction, 21(1), 58-67.
57. Walker, J. D., Cotner, S. H., Baepler, P. M., & Decker, M. D. (2008). A delicate balance: Integrating active learning into a large lecture course. CBE—Life Sciences Education, 7(4), 361-367.
58. Altun, A., & Cakan, M. (2006). Undergraduate students' academic achievement, field dependent/independent cognitive styles and attitude toward computers. Journal of Educational Technology & Society, 9(1), 289-297.
59. Granger, E. M., Bevis, T. H., Saka, Y., Southerland, S. A., Sampson, V., & Tate, R. L. (2012). The efficacy of student-centered instruction in supporting science learning. Science, 338(6103), 105-108.
60. Lonsdale, C., Rosenkranz, R. R., Sanders, T., Peralta, L. R., Bennie, A., Jackson, B., Taylor, I. M., & Lubans, D. R. (2013). A cluster randomized controlled trial of strategies to increase adolescents' physical activity and motivation in physical education: Results of the motivating active learning in physical education (MALP) trial. Preventive Medicine, 57(5), 696-702.

61. Ballen, C. J., Wieman, C., Salehi, S., Searle, J. B., & Zamudio, K. R. (2017). Enhancing diversity in undergraduate science: Self-efficacy drives performance gains with active learning. CBE—Life Sciences Education, 16(4), 1-6.
62. Calderón, A., Meroño, L., & MacPhail, A. (2020). A student-centered digital technology approach: The relationship between intrinsic motivation, learning climate and academic achievement of physical education pre-service teachers. European Physical Education Review, 26(1), 241-262.
63. Dyson, B. (2002). The implementation of cooperative learning in an elementary physical education program. Journal of Teaching in Physical Education, 22(1), 69-85.
64. Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. Educational Psychologist, 25(1), 3-17.
65. Udovic, D., Morris, D., Dickman, A., Postlethwait, J., & Wetherwax, P. (2002). Workshop biology: Demonstrating the effectiveness of active learning in an introductory biology course. Bioscience, 52(3), 272-281.
66. Prince, M. (2004). Does active learning work? A review of the research. Journal of Engineering Education, 93(3), 223-231.
67. Eison, J. (2010). Using active learning instructional strategies to create excitement and enhance learning. Jurnal Pendidikantentang Strategi Pembelajaran Aktif (Active Learning) Books, 2(1), 1-10.
68. Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. Review of Educational Research, 69(1), 21-51
69. Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences of the United States of America, 111(23), 8410-8415.
70. Oliver, K. L., Oesterreich, H. A., Aranda, R., Archeleta, J., Blazer, C., de la Cruz, K., Daniel, M., Jenn, M., Maggee, O., Lacie, P., & Robinson, R. (2015). 'The sweetness of struggle': Innovation in physical education teacher education through student-centered inquiry as curriculum in a physical education methods course. Physical Education and Sport Pedagogy, 20(1), 97-115.
71. Armbruster, P., Patel, M., Johnson, E., & Weiss, M. (2009). Active learning and student-centered pedagogy improve student attitudes and performance in introductory biology. CBE Life Sciences Education, 8(3), 203-213.
72. Chi, M. T. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. Topics in Cognitive Science, 1(1), 73-105.
73. Knudson, D. (2020). A tale of two instructional experiences: Student engagement in active learning and emergency remote learning of biomechanics. Sports Biomechanics, 1-11.
74. Silverthorn, D. U. (2020). When active learning fails… and what to do about it. Active Learning in College Science, 985-1001.
75. Green, R. D., & Schlairet, M. C. (2017). Moving toward heutagogical learning: Illuminating undergraduate nursing students' experiences in a flipped classroom. Nurse Education Today, 49, 122-128.
76. Middleton, R. (2013). Active learning and leadership in an undergraduate curriculum: How effective is it for student learning and transition to practice? Nurse Education in Practice, 13(2), 83-88.
77. Colbert, V., & Arboleda, J. (2016). Bringing a student-centered participatory pedagogy to scale in Colombia. Journal of Educational Change, 17(4), 385-410.
78. Brooks, D. C. (2011). Space matters: The impact of formal learning environments on student learning. British Journal of Educational Technology, 42(5), 719-726.

79. Van den Bergh, L., Ros, A., & Beijaard, D. (2014). Improving teacher feedback during active learning: Effects of a professional development program. American Educational Research Journal, 51(4), 772-809.
80. Nouri, J. (2016). The flipped classroom: For active, effective and increased learning–especially for low achievers. International Journal of Educational Technology in Higher Education, 13(1), 1-10.
81. Shahril, M. I., Guntur, Yin, T. T., & Mustafa, L. M. (2023). Alternative pedagogy approaches in physical education and health education. Journal of Higher Education Theory and Practice, 23(6), 47-54.
82. Wibowo, J., Krieger, C., Gaum, C., & Dyson, B. (2023). Bildung: A German student-centered approach to health and physical education. European Physical Education Review, 29(2), 233-250.
83. Clavert, M., Löfström, E., Niemi, H., & Nevgi, A. (2018). Change agency as a way of promoting pedagogical development in academic communities: A longitudinal study. Teaching in Higher Education, 23(8), 945-962.
84. Abbas, M., Jam, F. A., & Khan, T. I. (2024). Is it harmful or helpful? Examining the causes and consequences of generative AI usage among university students. International journal of educational technology in higher education, 21(1), 10.
85. Kaewsaeng-On, R., Al-Takhayneh, S. K., Jam, F. A., Chang, B. L., Pradana, M., & Mahmood, S. (2022). A three wave longitudinal study of school innovation climate and entrepreneurship teachers' acceptance to technology: Moderating role of knowledge sharing and knowledge hiding. Frontiers in psychology, 13, 1028219.
86. Gholami, Samineh, Arash Shakuri, and Jasem Raisi. "Evaluation of Bioadsorption Process of Lead Heavy Metal from Aqueous Media Using Two Species of Brown Nizimuddinia zanardini and Ulva rigidaGreen Algae." Environment and Water Engineering 10, no. 1 (2024): 1-17.
87. Ramadhan, N. J. H., . A., & Rizki, A. A. (2024). The impact of volunteer programs in improving literacy and reading engagement among children in rural areas of Indonesia. Journal of Advances in Humanities and Social Sciences, 10(2). https://doi.org/10.20474/jahss-10.2.2