The Effect of Blended Learning and Flipped Classroom Approaches for a Research Method Course on Undergraduate Students in Preschool Education in China

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Abstract

At present, the overall scientific research ability of kindergarten teachers in China is relatively weak. The research method course is usually the most feared course by normal school students. The aim of this study based on objective, preparation, instructional video, review, test, activity, transfer, discussion/summary (O-PIRTATD/S) flipped classroom teaching is to explore the effectiveness of blended learning and improve the teaching of preschool education research method courses and the learning retention of preschool education students to cultivate their scientific research ability in the postpandemic era. This study used a quasi-experimental design, and 240 junior students from a private undergraduate preschool education major in Guangxi, China, were selected. For the research method course of preschool education, the experimental class adopts blended learning in consideration of O-PIRTATD/S flipped classroom teaching, whereas the control class adopts blended learning based on a traditional teaching method. Through the unequal group using pretest and post-test design, the 8-week quasi-experiment was carried out. The test questions were used to collect data. The learning performance was tested on the last week of the teaching experiment (Week 8), and the learning retention of the two groups was tested 8 weeks after the end of the teaching experiment (Week 16). In this way, the difference between the retention rate of the experimental group and control group was explored. The study found the experimental class had blended learning in consideration of O-PIRTATD/S flipped classroom teaching, and the knowledge retention was significantly higher than the control class with blended learning based on traditional teaching. 8 weeks after the course learning, the knowledge retention of the experimental class was still better than the control class. Blended learning contributes to improved learning retention based on the O-PIRTATD/S flipped classroom.

Keywords: preschool education, research method, flipped classroom, blended learning, learning retention

1. Introduction

At present, the overall scientific research ability of kindergarten teachers in China is relatively weak (Huang & Nong, 2023). The general low scientific research ability of kindergarten teachers in China has become an important issue hindering the reform and progress of preschool education (Xiao, 2015). Although most kindergarten teachers have bachelor's degrees, their awareness and ability to conduct scientific research are still relatively weak (Liu & Chi, 2020). As a base for training kindergarten teachers, colleges and universities should cultivate their scientific research ability in the preservice stage (Xiao, 2015). Moreover, a research method course is one of the main components of many undergraduate courses (Earley, 2014). Many undergraduate degree programs require students to have a basic understanding of their research methods (Ball & Pelco, 2006), and students need to select and complete the research methods course to graduate (Slocum-Schaffer & Bohrer, 2021). As a profession to cultivate students' spirit of scientific research and inquiry, preservice teachers should master the basic knowledge and skills of scientific research methods courses when they receive normal education in universities (Tosun, 2014). Research courses positively affect students' understanding of research concepts and their research skills (Unrau & Grinnell Jr, 2005). Therefore, scientific research ability is cultivated from the stage of preschool education majors to solve the problem of weak scientific research ability of kindergarten teachers.

However, students often consider the research methods course as one of the most difficult courses in their academic career (Morris et al., 2020). The research methods course is also one of the most hated and feared courses for preservice teachers (Sointu et al., 2022). Because of the complexity and technical nature of the course materials, the research method course is often unpopular with students (Ball & Pelco, 2006). Undergraduate students usually dislike the content of the course and are reluctant to participate in research methods (Slocum-Schaffer & Bohrer, 2021). Students are often anxious or nervous about the difficulty of the research methods course, are not interested in research methods, and lack motivation to study the course (Earley, 2014). There are even undergraduates who often study research methods with great fear and disgust (Slocum-Schaffer & Bohrer, 2021). Moreover, college students are faced with diversified problems in their research methods. The problems reported by students involve teachers' superficial teaching, the connection between theory and practice, unfamiliarity with concepts and content, and learning difficulties (Murtonen et al., 2008).

In fact, it is not easy to teach research methods to education undergraduates (Papanastasiou & Zembylas, 2008). The content of the research method course is profound, making it difficult for students to understand the complex technical terms and abstract concepts in the research method content (Hsieh et al., 2016). Esoteric and complex and abstract learning content is not conducive to students' memory and knowledge retention. Moreover, traditional teaching-based teaching methods have been unable to help students understand the content of the research methods course (Slocum-Schaffer & Bohrer, 2021). Therefore, the appropriate teaching mode is selected to redesign the research method course and improve the teaching of teachers and the learning of students in the course to improve the learning experience of students, enhance their learning retention, and promote their research ability.

Flipped classroom plays a positive and important role in both short-term and long-term learning retention (Shatto et al., 2017). Flipped classroom refers to students acquiring new knowledge by learning videos recorded by the teacher before class and digesting and consolidating the knowledge in the video by doing exercises and communicating with classmates and teachers in class (Li, 2022). Flipped classroom extends original learning beyond the classroom through the use of online platforms without time constraints (Karabulut-Ilgu et al., 2018). The concept is simple. The part of the classroom given by the teacher is usually provided to learners outside the classroom (usually online), whereas the learning activities usually assigned to students as homework are changed in the classroom (Enfield, 2016). This is a transformation of traditional teacher-centered teaching into student-centered teaching (Jin et al., 2022). As an active learning method, the flipped classroom can not only achieve more learning retention, but also can give students a more positive attitude toward the course (Tutal & Yazar, 2021). Because flipped classroom teaching highlights the role of students in the learning process, this positive environment encourages students to be more learner-centered, influencing students' construction of knowledge and retention of information in long-term memory as long as possible (Al Mulhim, 2021). In being a relatively new teaching model, the flipped classroom has been a concern among researchers (Tutal & Yazar, 2021).

What is more, different theories of learning have proved that flipped teaching would enhance students' performance, interest, and investment in the classroom; promote the flexible use of technology; and satisfy the learning needs of the 21st century (Lo et al., 2021). At the same time, flipped classroom is also a method of active learning, which can improve students' learning investment and enhance the vitality of learning, thus producing a more positive interaction with course content (Olivan-Blazquez et al., in press). Flipped classroom has become popularized in higher education and in many cases is more effective than traditional teaching (Karabulut-Ilgu et al., 2018). At present, some scholars have applied flipped classroom to research methods courses and achieved positive results (Hoffman, 2014).

In addition, COVID-19 is an ongoing phenomenon still affecting education but is also something that has primarily run its course (Butnaru et al., 2021). Because COVID-19 is a changing situation, teaching and learning have been severely disrupted (Finlay et al., 2022). COVID-19 has posed a significant threat to the education sector in adapting to teaching models and school business activities and policies (Blanco et al., 2020). COVID-19 has contributed to changing the status of schools and has further accelerated the revolution of conventional teaching methods (Lo et al., 2021). One of the strategies feasible during COVID-19 has been to integrate different teaching methods including a combination of on-site learning and distance learning (Rapanta et al., 2021). The outbreak of COVID-19 has accelerated the adoption of hybrid learning methods around the world (Adel & Dayan, 2021).

Blended learning is a teaching method that combines the benefits of face-to-face and online learning (Rasheed et al., 2020). In short, blended learning combines web-based learning with a face-to-face course (Joos et al., 2022). Blended learning combines online learning with face-to-face learning and has become popular in educational environments (Ashraf et al., 2021). In the wake of COVID-19, blended learning has become increasingly popular,

with universities adopting blended learning to respond to COVID-19 (Al-Fodeh et al., 2021). At the same time, Randazzo et al. (2021) noted that with the transformation in online learning during COVID-19, new possibilities have emerged in the teaching of research methods. COVID-19 has caused schools to close their campuses and move teaching classes online. However, a sudden shift to online learning can raise unresolved problems (Zheng et al., 2021). Online teaching needs technical support. But technology-mediated learning poses some fundamental challenges, including student retention rates (Hu & Hui, 2012). It is increasingly expected that academia could use a range of strategies to support online learning and understand that these efforts could help to improve student success rate, satisfaction, and retention (Brown et al., 2022). During the COVID-19 pandemic, research that affects retention in student learning has received little attention, so research in this field is necessary to push the flipped curriculum and blended learning curriculum design forward.

In summary, in the postpandemic era, mixed teaching through flipped classroom should be a feasible approach. Therefore, according to the situation of the students and the current epidemic situation, this study improves the preschool education research method of teaching, promotes students' learning, and cultivates preschool education college students' scientific research ability on the basis of the original course design by exploring the course effectiveness of flipped classroom–based blended learning and the difference in the learning retention rate between the experimental group and the control group students in the research method course.

2. Literature Review

2.1 O-PIRTATD/S Flipped Classroom Mode

Through the existing flipped classroom model for integration, Guo (2019) put forward a compatible objective, preparation, instructional video, review, test, activity, summary (O-PIRTAS) model of flipped classroom. This has been confirmed through empirical research to effectively improve college students' learning results.

Taking Chinese undergraduate students as their participants, Jin et al. (2022) adopted a longitudinal quasi-experimental field design to compare the effects of the O-PIRTAS flipped classroom model and the traditional lecture-based teaching method in the career curriculum. The results showed that the O-PIRTAS flipped classroom model was more advantageous than the traditional teaching model based on lectures, produced better learning results, and proved to have long-term effectiveness 2 months after the course (that is, 2 months after the course the students still showed positive learning results).

Many studies have been conducted on the flipped classroom's effectiveness, which are generally inconsistent (Tutal & Yazar, 2021). Lin and Hwang (2019) pointed out that the operation mode of flipped classroom is significantly different from a traditional classroom. The specific effect of flipped classroom can be discussed further, and among the reasons for the different degrees of classroom effectiveness is the teaching design. Enfield (2016) pointed out that the design of a flipped classroom should be student-centered (individual and group practice) rather than teacher-centered (direct guidance) and that each course is different and each flipped classroom can have a unique design. Blau and Shamir-Inbal (2017) demonstrated that the redesign of the flipped learning model in academic curricula makes students more active in learning befofe, during, and after class, so it is necessary to redesign the model of the flipped classroom.

Zheng (2022) fused the small private online course (SPOCS) coaching mode with the O-PIRTAS flipped classroom model, forming a new mode—O-PIRTAS SPOCS—and applied this to international trade practice teaching, which not only stimulates students' knowledge interest and improves the impact and quality of teaching in the classroom, but also improves students' academic performance, independent knowledge, thinking, and exploration ability.

Based on the O-PIRTAS flipped classroom mode, Guo et al. (2023) formed the online flipped classroom mode, and most students took on a positive attitude toward the teaching mode. Nearly 80% of the students said their abilities had been exercised when learning the textbook, and the test scores of the flipped teaching chapter increased significantly, which shows that the further iteration of this design scheme improved the teaching effect of online flipped classroom. In addition, students in a country with a Confucian culture like China are generally considered typically passive and unwilling to ask questions or speak in class, who often based on memory rather than understanding the knowledge of teachers (Tran, 2013).

Therefore, this study is necessary to investigate the O-PIRTAS flipped classroom model based on the characteristics of the research method course and the learning situation of preschool education students to achieve the teaching effect and learning objectives. On the basis of the Guo (2019) O-PIRTAS flipped classroom, Nong et al. (2023) added two links—transfer and discussion—to expand this into the O-PIRTATD/S flipped classroom model. Thus, in this study, the O-PIRTATD/S flipped classroom model is adopted to carry out the teaching design, which is applied to

the research methods of college students majoring in preschool education.

2.2 Learning Retention

Hornby (2004) proposed that people have the ability to remember or recall words, events, memories, and other items after a short or long time, which is known as learning retention. Learning retention usually refers to a conscious process that may involve recitation, practice, associative learning, and learning and retention being considered together, so it is important to understand how the knowledge and skills acquired are retained and should be retained over an extended period of time (Nhan & Yen, 2021). Shieh and Yu (2016) are of the view that learning retention refers to the retention of memory after learning. Learning retention would take knowledge with never having retained it in the memory for a long time so that students would practice their knowledge in the appropriate situation in the future (Daloglu et al., 2009). The most common aspect of learning retention is that knowledge acquisition is part of its organization, which can be retrieved and used in the future (Vijayalakshmi & Reddy, 2020). This kind of knowledge left in the personal mind is an important academic achievement (Al Mulhim, 2021). Skills, abilities, and knowledge have become key factors in the success of learners (Adel & Dayan, 2021).

Flipped classroom can effectively increase students' retention of knowledge and shorten the learning process (Yildirim, 2017). In terms of learning retention, the flipped classroom model is more effective than traditional didactic teaching, providing more learning retention while encouraging students' more positive attitudes toward the curriculum (Tutal & Yazar, 2021). According to previous studies on flipped classroom, the teaching strategies used in flipped classroom can enable students to learn and retain knowledge better than traditional teaching methods (Buil-Fabrega et al., 2019). The learning method of flipped classroom allows students to invest more time in learning and helps to retain knowledge (Tang et al., 2017).

3. Research Design

3.1 Curriculum Design

3.1.1 Curriculum Model

This study adopts the expanded O-PIRTATD/S model of Nong et al. (2023), including two parts before and during class, in which O refers to letting students know the initial learning objectives (knowledge objectives) and advanced learning objectives (competence objectives); P refers to the conduct preparation activities of the class; I refers to watching teaching videos; R refers to reviewing the content of preclass learning; T refers to classroom testing; A refers to conduct classroom activities; T refers to conduct knowledge transfer; and D/S refers to discussion and teacher summary, as shown in Figure 1.

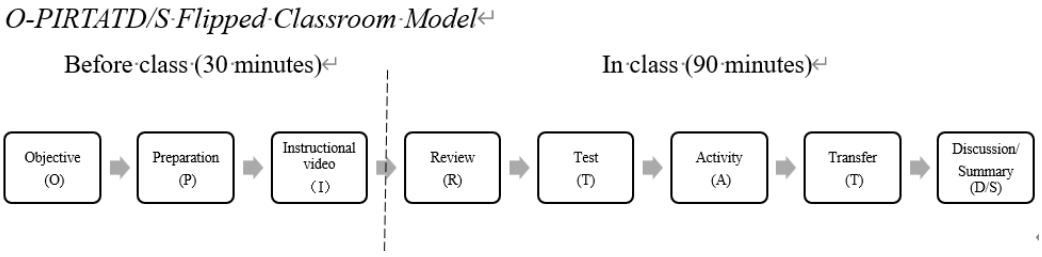

Figure 1.

3.1.2 Participants

This study was conducted in the spring semester of 2022. In the way of conception sampling, junior students majoring in preschool education in the course Research Methods for Preschool Education in Guangxi, China, were the research participants. The experimental class (133 students) and control class (107 students) were allocated by lottery.

3.1.3 Procedure

In this study, the preschool education research method was carried out as a quasi-experiment to verify the design of the hybrid learning curriculum in consideration of the flipped classroom on O-PIRTATD/S. A double-blind strategy was applied to avoid the Hawthorne effect. Both groups did not know their own group differences, applying active control, and the control class conducted normal courses in the same environment (Chen & Chang, 2021; Chen et al., 2017). Table 1 shows that the experimental class is similar to the control class in the students' grade, learning

objectives, teaching content, teaching duration, and class teachers and controls the irrelevant changes, so as to reduce possible interference. Because of the uncontrollable impact of COVID-19, both the experimental class and the control class adopted blended learning, that is, online teaching in the first 4 weeks and offline teaching in the second 4 weeks. However, the difference lies in the fact that the experimental class adopted blended learning in consideration of the flipped classroom on O-PIRTATD/S to carry out teaching. This teaching method is student-centered, and the classroom teaching activities include review, test, transfer, discussion, summary, and other links. The control class adopted blended learning based on traditional teaching. Traditional teaching refers to teacher-centered teaching in the classroom, where students learn by rote memorization (Rao, 1996). In this study, the classroom activities in the control class were mainly taught by the teachers and learned by the students. The results are shown in Table 1.

Table 1. Results on Teaching Design of Experimental Class and Control Class

Items	Experimental class	Control class
Students grade	Junior	Junior
Learning target	Learning retention in the research methods course	Learning retention in the research methods course
Teaching content	Research methods for preschool education	Research methods for preschool education
Teaching method	Blended learning based on the O-PIRTATD/S flipped classroom	Blended learning based on traditional teaching
Teaching idea	Student-centered	Teacher-centered
Teaching activities	Review, test, migrate, discuss, and summarize	Teach
Teaching time	8 weeks (16 periods)	8 weeks (16 periods)
Class teacher	Investigator	Investigator

In the first week of the teaching experiment, the learning effect of the experimental class and the control class was pretested, and then the learning test of the learning effect in the last week is the eighth week of the teaching experiment. Testing the learning retention of the two subjects was carried out at 8 weeks after the end of the teaching experiment, as shown in Figure 2.

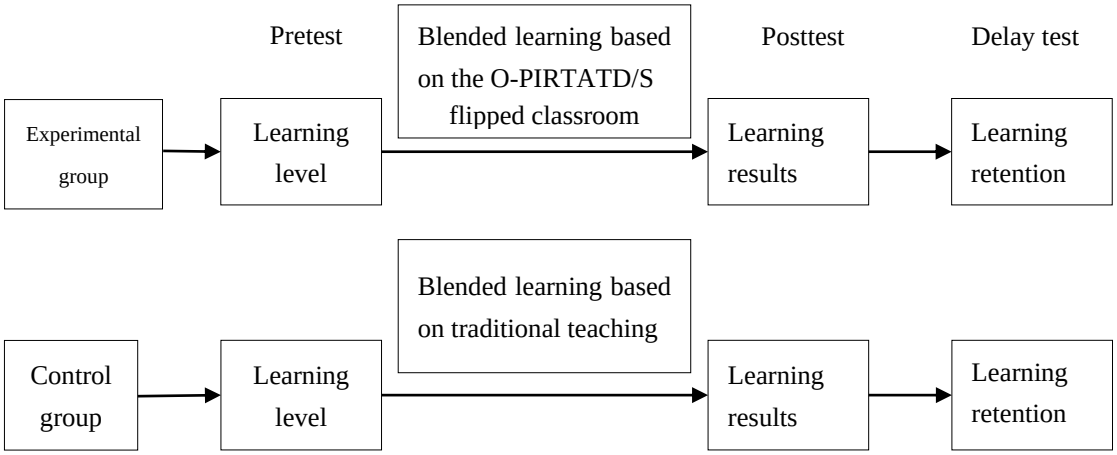

Figure 2.

3.1.4 Research Tool

The learning effect of this study is obtained through the test questions. Taking Scientific Research Methods of Preschool Education as the scope of the test, 50 multiple-choice questions were designed according to the content of the textbook. The questions are used in the pretest, posttest, and learning retention test. Each multiple-choice question scores two points, with a full score of 100 points. The higher the score, the better the learning effect. Also,

before use, the test questions were reviewed by five preschool university teachers to ensure content validity.

When the answer rate of the item is higher than 0.8, the difficulty is extremely easy; when the range is 0.6 to 0.8, the difficulty is easy; when the answer rate is 0.4 to 0.8, the difficulty is moderate; when the answer rate is 0.2 to 0.4, the difficulty is difficult; when the correct answer rate of the question item is lower than 0.2, its difficulty is extremely difficult (Guo, 2010). In this study, among the 50 multiple-choice questions designed by the textbook Scientific Research Methods of Preschool Education for the scope of the test, there are 5 extremely easy questions, 9 easy questions, 19 moderate questions, 10 difficult questions, and 7 extremely difficult questions. Among them, minimalist and simple items are a group, moderate items are a group, and difficult items and extremely difficult items are a group, and the ratio of these three groups of items is roughly 7:2:1. The difficulty ratio usually used in the exam questions is 7:2:1 (Zhao, 2018), which is in line with the usual question difficulty ratio. In addition, for the extremely easy items and extremely difficult items, as well as the easy and difficult items, the number of the two groups is roughly the same, difficult and easy to combine. Therefore, the tests used in this study met the difficulty criteria. The results are shown in Table 2.

Table 2. Results on Test Difficulty Criteria

Items	Yes	No	Difficulty criteria	Index	Items	Yes	No	Difficulty criteria	Index
Q1	40	200	.17	Extremely difficult	Q26	157	83	.65	Easy
Q2	204	36	.85	Extremely easy	Q27	119	121	.50	Moderate
Q3	117	123	.49	Moderate	Q28	129	111	.54	Moderate
Q4	49	191	.20	Difficult	Q29	46	194	.19	Extremely difficult
Q5	224	16	.93	Extremely easy	Q30	59	181	.25	Difficult
Q6	30	210	.13	Extremely difficult	Q31	145	95	.60	Moderate
Q7	74	166	.31	Difficult	Q32	178	62	.74	Easy
Q8	38	202	.16	Extremely difficult	Q33	206	34	.86	Extremely easy
Q9	130	110	.54	Moderate	Q34	38	202	.16	Extremely difficult
Q10	72	168	.30	Difficult	Q35	115	125	.48	Moderate
Q11	109	131	.45	Moderate	Q36	40	200	.17	Extremely difficult
Q12	132	108	.55	Moderate	Q37	54	186	.23	Difficult
Q13	220	20	.92	Extremely easy	Q38	99	141	.41	Moderate
Q14	163	77	.68	Easy	Q39	191	49	.80	Easy
Q15	99	141	.41	Moderate	Q40	13	227	.05	Extremely difficult
Q16	189	51	.79	Easy	Q41	105	135	.44	Moderate
Q17	184	56	.77	Easy	Q42	185	55	.77	Easy
Q18	70	170	.29	Difficult	Q43	191	49	.80	Easy
Q19	108	132	.45	Moderate	Q44	173	67	.72	Easy
Q20	101	139	.42	Moderate	Q45	139	101	.58	Moderate
Q21	51	189	.31	Difficult	Q46	101	139	.42	Moderate
Q22	125	115	.52	Moderate	Q47	129	111	.54	Moderate
Q23	97	143	.40	Difficult	Q48	125	115	.52	Moderate
Q24	56	181	.25	Difficult	Q49	119	121	.50	Moderate
Q25	208	32	.87	Extremely easy	Q50	91	149	.38	Difficult

4. Results and Discussion

In this study, statistical analysis was performed using SPSS, which included descriptive statistical analysis, independent sample *t*-test, paired sample *t*-test, and covariate analysis.

4.1 Descriptive Statistics and t-test Analysis of Learning Results

The full score of the learning effectiveness test is 100 points. In the experimental class the average scores of pretest, post-test, and learning retention were 48.50, 67.25, and 69.13, whereas in the control class they were 47.85, 63.51, and 66.77, respectively. First, an independent sample t-test was carried out in the two classes, and the results showed there was no significant difference between the pretest of the two classes ($t = 0.58$, $p > .05$). The average score of the learning effect in the experimental class was higher than that of the control class in the posttest. After further independent sample t-testing of the experimental and control classes, the results showed a significant difference between the experimental and control classes ($t = 3.11$, $p < .01$). In terms of learning retention, the learning effect of the experimental class was higher than that of the control class. After further independent sample t-testing of learning retention in the two classes, the results reported it was significantly different between the two classes ($t = 2.12$, $p < .05$), as shown in Table 3.

Table 3. Analysis on Descriptive Statistic and t-test of Learning Effectiveness

Category	Group	N	M	SD	t	d
Pretest	Experimental class	133	48.50	8.90	.58	.08
	Control class	107	47.85	8.19		
Posttest	Experimental class	133	67.25	9.00	3.11**	.40
	Control class	107	63.51	9.52		
Learning retention	Experimental class	133	69.13	9.13	2.12*	.28
	Control class	107	66.77	7.84		

Note 1: *p <.05, **p <.01

Note 2: N = Sample size, M = Mean, SD = Standard Deviation, t = t-value, d = Cohen' s d

4.2 In-group Analysis of the Learning Effectiveness Test Before and After Teaching

After the paired sample t-test of the pretest and posttest of the experimental class, the results showed significant differences with pretest and posttest scores in the experimental class ($t = -0.92$, $p < .001$). The average score of the posttest was significantly higher than the average pretest score, with an average improvement of 18.75 points. However, the pretest and posttest scores were significantly different ($t = -15.47$, $p < .001$), and the average score of the posttest was significantly higher than the average pretest score, with an average improvement of 15.66 points, as shown in Table 4.

Table 4. Results on Sample t-test for Learning Effectiveness of Experimental Class and Control Class

Group	Average score of pretest	Average score of posttest	Mean score difference	df	t
Experimental class	48.50	67.25	18.75	132	−20.92*
Control class	47.85	63.51	15.66	106	−15.47*

Note 1: *p <.001

Note 2: df = degrees of freedom, t = t-value

4.3 In-group Analysis of Learning Retentions Before and After Teaching

After the paired sample *t*-test of the pretest and learning retention of the experimental class, the study showed the pretest score and the learning retention of the experimental class was significantly different ($t = -22.91$, $p < .001$). The average score of learning retention was significantly higher than the pretest average score, with an average improvement of 20.63 points. In addition, the pretest scores of the control class participants' learning effectiveness test were significantly different from learning retention ($t = -21.85$, $p < .001$). The average score of learning retention was significantly higher than the average pretest score, with an average improvement of 18.92 points, as shown in Table 5.

Table 5. Results on Sample t-test for Learning Retention of Experimental Class and Control Class

Group	Average score of pretest	Average score of posttest	Mean score difference	df	t
Experimental class	48.50	69.13	20.63	132	−22.91*
Control class	47.85	66.77	18.92	106	−21.85*

Note 1: *p <.001

Note 2: df = degrees of freedom, t = t-value

4.4 Single Covariable Analysis of Learning Retention Before and After Teaching

To further investigate the actual impact of experimental treatment, the effect of pretest scores on learning retention needs to be excluded. In this study, the teaching method (blended learning in consideration of the O-PIRTATD/S flipped classroom and blended learning based on traditional teaching) is used as the independent variable. Pretest scores from the learning effectiveness test were included as covariates. The learning retention of the learning effectiveness test was used as the dependent variable. A single-factor variable analysis was conducted on the learning retention of the two classes to fully grasp the effect source of the dependent variable.

From Table 6, the regression coefficient within the group passes the homogeneity test (F = .03, p > .05). The interaction between the pretest score and the teaching method is not significant, which meets the premise hypothesis of covariate analysis, so the next step of covariate analysis would be conducted.

Table 6. Results on Homogeneity of the Regression Coefficient

Source of variation	SS	df	MS	F	p
Group	36.97	1	36.97	.48	.49
Pretest	2052.52	1	2052.52	26.62	.00
Group*Pretest	2.04	1	2.04	.03	.87
Deviation	18193.95	236	77.09		
Total	1053408.00	240			

Notes: SS = sum of squares, df = degrees of freedom, MS = mean square, F = frequency, p = p-value

Before the formal covariate analysis, the error variation of both learning retention scores was tested for homogeneity. According to the results in Table 7, the two groups have homogeneity and no significant difference. Therefore, one-factor covariate analysis would be conducted on the learning effectiveness test of the students in the two classes.

Table 7. Results on Levene Test of Deviation Variation

F	df 1	df 2	p
.542	1	238	.46

Notes: F = frequency, df = degrees of freedom, p = p-value

Single factor covariate analysis was conducted on the learning retention of the two classes. After excluding the effect of pretest scores from the learning effectiveness test on learning retention, the results showed a significant difference between the two classes (F = 9.51, p < .001), as shown in Table 8.

Table 8. Analysis on Single-factor Covariate of Learning Retention

Category	SS	df	MS	F	p
Pretest	2103.56	1	2103.56	27.40	.00
Group	729.75	1	729.75	9.51	.00
Deviation	18195.99	237	76.78		
Total	1053408.00	240			

Notes: SS = sum of squares, df = degrees of freedom, MS = mean square, F = frequency, p = p-value

Table 9 shows that the average score of the adjusted learning retention of the experimental class is significantly higher than that of the control class, that is, the knowledge retention of blended learning in consideration of

O-PIRTATD/S flipped classroom in the experimental class is significantly higher than that of the control class of blended learning based on traditional teaching. Based on the above analysis, the learning retention of participants has varied significantly because of different methods of teaching.

Table 9. Results on Adjusted Means of Learning Retention Scores

Group	Adj. M	Adj. SD	95% CI
Experimental class	67.15	.76	[65.65, 68.65]
Control class	63.64	.85	[61.97, 65.31]

Note: CI = confidence interval

The results of this study found that the knowledge retention rate of blended learning in consideration of O-PIRTATD/S flipped classroom in the experimental class was significantly higher than the control class of blended learning based on traditional teaching, which echoed the findings of previous studies. For example, Guo (2019) pointed out that the O-PIRTAS flipped classroom model is a flipped classroom model suitable for localization in China, which can effectively promote college students' learning and promote common skills development and test scores. As a kind of student-centered active learning model, Jin et al. (2022) found the O-PIRTAS flipped classroom mode has more advantages than traditional teaching modes based on lectures, can produce better learning results, and proves long-term effectiveness (that is, 2 months after the end of the course, students still present positive learning results). The research results of Zheng (2022) showed flipped classroom teaching based on a micro-curriculum formed after the improvement and development of an O-PIRTAS flipped classroom model has positive and significant effects on students, which contributes to students' interest in knowledge, the classroom teaching impact, the quality of classroom teaching, and the students' academic performance. According to the adjusted O-PIRTAS flipped classroom model, the adjusted teaching model can effectively improve students' learning investment, cultivate students' independent learning ability, and improve students' academic performance (Guo et al., 2023).

In addition, Yildirim (2017) found the practice of flipped classroom has different effects in different stages of the course, which not only improves students' preparation before class, but also promotes students' active participation in the face-to-face teaching stage. More importantly, flipped classroom increases the retention of students' knowledge and shortens the learning process. Tutal and Yazar (2021) also found that, in terms of learning retention, the flipped classroom model is more effective than traditional teaching, providing more learning retention while promoting students' more positive attitude toward the course. Buil-Fabrega et al. (2019) reviewed previous research on flipped classroom and found that the teaching strategies used in flipped classroom can enable students to learn and retain knowledge better than traditional teaching methods. Tang et al. (2017) pointed out that the learning method of flipped classroom allows students to invest more in learning longer, which helps retain knowledge. In this study, the improved O-PIRTAS flipped classroom model was adopted and combined with blended learning to form a hybrid learning method in consideration of O-PIRTATD/S flipped classroom, which had an active impact on students' learning effect and effectively improved the knowledge retention of students. Eight weeks after the end of the course, the experimental class knowledge retention was better than the control class, which echoed the above research results.

Furthermore, after Wang et al. (2020) expanded the traditional flipped classroom, students' learning retention improved, and the degree of learning retention was higher than the traditional flipped classroom. Pal et al. (2020) found students' knowledge was better preserved with a redesigned curriculum using elements of flipped classroom that combined face-to-face teaching with online teaching. It can be seen that the curriculum redesign through flipped classroom has a significantly positive influence on the retention of students' academic knowledge. The O-PIRTATD/S flipped classroom model adopted in this institute is based on the O-PIRTAS model built by Guo (2019), with the addition of transfer and discussion, which expanded the original flipped classroom model, combined it with hybrid learning, and formed a hybrid learning in consideration of the O-PIRTATD/S flipped classroom, thereby confirming the redesign course is effective for improving the learning retention of students. Therefore, it is necessary to expand and innovate the flipped model and redesign the curriculum to promote students to effectively improve their retention of knowledge when learning the preschool education research method curriculum.

5. Conclusion and Suggestions

5.1 Conclusion

Based on the quantitative data, this study found that the learning retention of students in the course of preschool education was significantly improved, and the students of blended learning based on O-PIRTATD/S flipped

classroom improved even more. Compared with hybrid learning based on traditional teaching, hybrid learning in consideration of O-PIRTATD/S flipped classroom can more effectively improve the learning retention of students. Students in blended learning in consideration of O-PIRTATD/S flipped classroom learning need more autonomous and active learning, from passive learning to the main body of learning at the same time in each learning link. When students do not understand certain knowledge, they can rewatch videos to help learning, thereby promoting the understanding of the content and deepening the impression of knowledge. Therefore, students are no longer passively receiving knowledge and are more impressed by what they have learned. In summary, blended learning in consideration of O-PIRTATD/S flipped classroom is effective for improving students' learning retention.

5.2 Suggestions

In the postpandemic era, blended learning in consideration of O-PIRTATD/S flipped classroom was applied to the teaching of a preschool education research methods course, and the effectiveness of this model was confirmed through quasi-experiments. This paper suggests university teachers would take the expanded O-PIRTATD/S flipped classroom model for teaching design when conducting research methods courses for undergraduate college students.

Furthermore, rolling corrections can be performed when conducting experimental studies. Guo et al. (2023) demonstrated the teaching team of the course adjusts the teaching design according to the results of a questionnaire on the course from students, which appropriately increases the key difficult link in the teaching design to prevent students from only relying on the focus and difficulty of self-study courses. This could effectively reduce the difficulty of the flipped classroom, improve students' participation, and improve the class learning effect and teaching quality. Therefore, in the process of carrying out an experiment of teaching models, rolling correction can be carried out according to the actual situation of students, which can be adjusted in time, further improve the curriculum model, and increase students' positive learning experience to better achieve the teaching effect.

5.3 Limitations

Pal et al. (2020) stated that, to determine the effectiveness of a newer teaching model, a study design should span semesters. This study is a quasi-experimental study using blended learning in consideration of O-PIRTATD/S flipped classroom teaching. Although the learning retention of the two groups was delayed at the 16th week, 8 weeks after the end of the teaching experiment, the actual experimental teaching weeks was only for 8 weeks, and the teaching experiment was conducted in the special context of COVID-19. Moreover, the focus of this study is to improve the learning retention rate of Chinese preschool education upgrading college students by improving the teaching methods of research methods and courses, which may limit the universality of the research results to other student groups, regions, or research fields. In addition, this study only explored the effects of teaching methods, but it is not clear how students feel about learning. Therefore, a qualitative section could be added in future research to further understand students' learning feelings after blended learning based on O-PIRTATD/S flipped classroom teaching.

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