

Article

Effects of Project-Based Learning on Teachers' Information Teaching Sustainability and Ability

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Abstract: In the context of the Internet for education, informatized teaching has become the most basic and critical ability of teachers. The application of advanced information technology in education means that the improvement in teaching ability requires instructors to better utilize teaching and learning opportunities. Project-based learning is an inquiry-based learning method that embodies learning by doing. With respect to the training of informatization teaching for pre-service teachers, we choose three aspects: information-based instructional design, information-based teaching resource integration, and information-based teaching evaluation, respectively, from PowerPoint (PPT) skills, multimedia courseware production, and micro lectures. This study explores three experimental projects and undertakes detailed empirical growth research on the cultivation of pre-service teachers. We were able to enhance the informatization teaching design ability of pre-service teachers with the training of PPT skills. In this experiment, we found that integration of information-based teaching resources can be improved by the integration of multimedia courseware production. Information teaching evaluation can be improved through micro lecture production. The mechanism provides a more feasible and practical strategy for the training of pre-service teachers in their informatization teaching ability.

Keywords: educational innovation; project-based learning; information teaching ability

1. Introduction

With the continuous development of the Internet for education, the cultivation concept, teaching mode, and educational media have seen different degrees of innovation and development globally, which moves education into a new stage of 'informatization education' [1]. China has developed an outline of national long-term education reform with a development plan which is aimed at promoting educational reform, encouraging teachers to carry out informatized teaching activities, and to realize the goal of promoting education reform and innovative education. Therefore, it is undoubtedly important to improve teachers' information literacy and cultivate teaching staff in the current teacher education system in China [2].

Project-based learning, or PBL for short, is widely believed to be derived from Dewey's educational concept 'learning by doing'. Markham et al. (2003) [3] believed that project-based learning is an instructional mode where students carry out extended open exploration after carefully designing activities aimed at real-world situations, with the ultimate goal of constructing the meaning of

knowledge and improving their own ability. Wei (2011) [4] believed that project-based learning is a new type of inquiry learning mode that centers on the concept and principle of disciplines, aims at creating works and selling them, carries out inquiry activities with the help of various resources in the real world, and solves a series of interrelated problems within a certain time period.

From its definition, we can see that project-based learning emphasizes student inquiry-based learning in practical situations, encourages the creation of finished products based on student experience, and motivates the cultivation of student abilities in all aspects of the process. Teachers provide the necessary guidance and assistance. Therefore, we believe that project-based learning refers to a learning method in which students complete specific projects in accordance with certain requirements and standards within a certain period under the guidance and assistance of teachers [5].

For training oriented to the information teaching ability, practical application involves the students in the cultivation of key content. When developing this ability, students should be guided to 'learning by doing'. In the process of learning, the learners should take the initiative to explore, experience, and master the content they have learned, and then subtly change their knowledge structure. Rather than passively accepting the knowledge imparted by a teacher, the theory places a high emphasis on learning in practice. Therefore, in the process of project-based learning, the initiative of students should be underscored. The design of project tasks and activities can demonstrate the extent of the initiative of learners. Through doing so, the learners can immerse themselves in the process of information teaching through active inquiry, and enhance their own ability in information teaching [6].

To meet the general trend of education informatization, the Ministry of Education issued a 10-year development plan for education informatization (2011–2020) in April 2012, which clearly proposed that the development of education informatization should start with traditional education and promote the integration of information technology and higher education. However, the conventional training mode for teachers, the teaching mode that effectively supports the training of pre-service teachers, lacks innovation. The system is unitary, which will deter training opportunities that would improve pre-service teachers' informatized teaching ability. In the new era, the actual demand for teachers' information-based teaching ability is far from being satisfied. The lag in the personal training system of education informatization has become a problem. Therefore, the development of new training paths and strategies has been placed on the agenda.

Using the precise search criteria 'pre-service teachers', 'informatization technology teaching ability', and 'project-based learning', there are a few related studies to be found but no systematic research on capacity development. However, there is still much exploration of the use of project-based learning in information technology courses in basic education and higher education designed to improve the information technology level of students. The mechanism provides the basis and possibility for pre-service teachers to use project-based learning in the training of the informatization teaching ability. The current exploration of project-based learning in this area is limited to allowing learners to learn to use information technology tools and has not risen to the capacity development stage [7]. In China, there are fewer related studies and applications to improve the teaching context of the information technology, compared to other countries. For example, Ardi Marwan indicates the results of action research of implementing project-based learning (PBL) and information and communication technology (ICT) in an English classroom [8]. In the same training mode, the informatization teaching ability of pre-service teachers is limited to exploring the TPACK (Technological Pedagogical Content Knowledge) framework as the standard through the investigation of the current situation of pre-service teachers, analyzing the gap and trying to find the cause and then proposing countermeasures. However, the specific teaching mode has not been designed through practice, verification, and exploration to improve the path and strategy of the informatization teaching ability. It also does not take into account the difference between the pre-service teacher's ability training and post-employment training. It is designed to cultivate pre-service teachers with a unified standard of competence [9].

The difference between project-based learning and traditional teaching is reflected in the emphasis on practicality, student autonomy, and subject knowledge integration into the tasks and activities. These

characteristics are in perfect harmony with the training needs of pre-service teachers' informatization teaching ability.

Project-based learning applies students' practical experience to real-life situations. It enables students to apply their knowledge to practical situations. Pre-service teachers can also apply the information-based teaching ability acquired in this process to future work to form a strong information technology application ability.

- Project-based learning gives full play to students' autonomy and initiative. The training in the informatization teaching ability for pre-service teachers is the key content of the practical application ability. The process of project-based learning emphasizes active inquiry. The design of project tasks and activities allows learners to experience the process of information-based teaching through active inquiry, and strengthens the self-information teaching ability.
- Project-based learning emphasizes the fusion of diverse subject knowledge. Through the process of exploration, it enhances the ability of learners to integrate knowledge from other subjects. Therefore, project-based learning can grasp the integration of information technology and teaching content while learners master the informatization teaching ability.
- Project-based learning is conducive to the development of a collaborative spirit: due to the reliance on independent learning, students form groups to undertake activities, cultivating collaboration and achieving better learning results for the informatization teaching ability. Thus, they can learn or internalize the knowledge from their own perspectives.

2. Research Hypotheses

In this study, we take the Information Age as the background and combine it with the trend to explore the basic teaching abilities that pre-service teachers need to be armed with as 'teachers'. Here, we draw on the "Standards for Information Technology Application Ability of Primary and Secondary School Teachers" and relevant expert and scholars' opinions on the training strategy for pre-service teachers in the pre-service stage are able to accept the informatization teaching ability. The following should be achieved in the training strategy of the informatization teaching ability: pre-service teachers can understand the basic theories and models of information-based instructional design and can determine the teaching objectives of the teaching content under the guidance of these theories, rationally organize and utilize information technology resources, and implement teaching according to the process and strategy of informatization teaching design. Pre-service teachers can collect and select digital teaching resources according to specific teaching objectives and teaching needs. For resources that cannot be found on the Internet, they can process existing resources or develop new learning resources independently. Pre-service teachers can smoothly implement teaching in a multimedia teaching environment based on the informatization teaching design scheme and use a variety of information technology equipment to assist in optimizing teaching. Pre-service teachers can evaluate informatization instructional design, resources, and processes based on specific evaluation criteria.

Through the analysis of the pre-service teacher's ability goals, to better implement project-based learning, the following research hypotheses are proposed:

Hypothesis 1. *Pre-service teachers can improve the ability of informatization teaching design and improve teaching ability through project-based learning;*

Hypothesis 2. *Pre-service teachers can improve the integration of informatization instructional resources and enhance resource development capabilities through project-based learning;*

Hypothesis 3. *Pre-service teachers can improve the evaluation ability of informatization teaching through project-based learning, and can correctly evaluate instruction, active inquiry, and enhance their own ability in information instruction.*

3. Methodology

3.1. Participants and Learning Materials

This study targeted 30 sophomores in a university education major. The class of the project is 2016 primary education major, with 30 pre-service teachers. Based on the teaching of modern education technology skills in public courses, the teaching experiment is carried out by task-driven learning. The students are divided into 6 groups of 5 by cross-grouping, according to the difference of students' ability. After graduation, students are assigned to their hometowns to teach basic education. For these prospective teachers, informatization teaching is an indispensable ability to cultivate. The students ranged in age from 18 to 20. According to Piaget's theory of cognitive development, students around this age have gone beyond the concrete operational stage, which means they already have fully developed abstract thinking, reasoning, and other thinking. The physical and psychological development of college students has matured, and their control and willpower are at a relatively high level. Therefore, project-based learning based on self-inquiry learning is in line with the basic situation of college students. The learning material was "Information Technology and Curriculum Resources Integration".

3.2. Experimental Procedure

The experiment began in September 2017 and lasted for 1 semester, 2 lessons per week, for a total of 28 hours. The experimental class was a 2016 primary education major with a total of 30 students. According to Table 1, the experimental procedure is divided into two stages: a theoretical study and the practical stage. The theoretical study was to enable learners to develop the corresponding basic information literacy. The practical stage was the group report, discussion, and evaluation, and each group reported their own group instructional design, script design, material production, etc. Following the report, teachers and non-members gave comments to help the group to correct the program, and from the procedure, improve their own abilities.

Table 1. Experimental procedure of this study.

Item	Activities	Time
Theoretical study	Instructional design, strategies, evaluation, etc.	2 hours
Selected item	Demonstration example, according to the interest group, determine the subject type of microlecture	4 hours
Make a plan	Analyze examples, group discussions, assign tasks, and develop preliminary plans	4 hours
Activities exploration	The machine operation is included PowerPoint + Wancai animation master + Camtasia Studio9	8 hours
Work to make	Group cooperation + final report: instructional design + script design + production material	8 hours
Results exchange and evaluation	The final report result in the class + results mutual evaluation	2 hours

3.3. Instrument

In the implementation process of this procedure, in addition to the displaying of works, a questionnaire survey was used to understand the learner's informatization instructional design ability, the informatization instructional resource integration ability, and the informatization instructional evaluation ability. Before the procedure, the contents of the questionnaire, the reliability, and validity of the questionnaire were tested, as shown in Table 2.

Table 2. Reliability analysis of the informatization teaching design capability questionnaire.

Title	Calibration Item Total Correlation (CITC)	Item Has Been Deleted for Alpha Coefficient	Cronbach's Coefficients	KMO
6-1 I can choose the knowledge points that are suitable for teaching with micro lectures	0.787	0.73	0.828	0.631
6-2 I can choose the media type that fits the level of students' ability according to the different learning objects	0.619	0.805		
6-3 I can design appropriate teaching resources according to different teaching objectives	0.736	0.761		
6-4 I can effectively design each stage of the teaching process according to the existing technical resources	0.621	0.82		
7-1 According to the script design to find the required materials (such as pictures, audio, animation, video, etc.) from the network	0.557	0.752	0.788	0.662
7-2 The collected materials can be processed as needed (such as cropping, stenciling, etc.)	0.439	0.788		
7-3 Make some of the material you need.	0.569	0.747		
7-4 Integrate all the materials according to instructional design and script design, complete micro video	0.561	0.751		
7-5 In the process of making micro video, the teaching design and script design scheme can be modified according to the actual situation	0.734	0.698		
17-1 Evaluate yourself according to the evaluation criteria	0.587	0.683	0.728	0.662
17-2 Evaluate PPT works according to evaluation criteria	0.613	0.562		
17-3 According to the evaluation criteria, the micro lecture works are evaluated	0.567	0.659		

Project-based learning is an instructional method for the training of the informatization teaching ability of pre-service teachers. According to the "Information Technology Application Capability Standards for Primary and Secondary School Teachers" [10] combined with the opinions of relevant experts at home and abroad, teachers' "information-based teaching ability" is mainly divided into four aspects: (1) teaching design ability based on information technology, (2) resource integration ability, (3) teaching implementation ability, and (4) teaching evaluation ability. To confirm whether the learning process of this project could improve learners' abilities, the following four aspects of the pre-service teachers' informatization instructional ability reflect the changes in learners' ability through the analysis of questionnaire results and the screenshots of students' work.

Table 2 shows the Cronbach's coefficient of 'informatization teaching design ability', 'informatization teaching resource integration ability', and 'informatization teaching evaluation ability' in the questionnaires. The results indicate that the Cronbach's coefficients of the three questionnaires are 0.828, 0.788, and 0.728, respectively. Two of which were greater than 0.7, pointing out that the reliability of the study data was higher.

For the 'alpha coefficient of item deleted', the reliability coefficient value of the deleted analysis item has not been significantly improved. Therefore, the description items should all be retained, further indicating that the research data reliability level is high, and that the high internal consistency reliability of the questionnaires is high. At the same time, through the analysis of the dimension reduction factor in the SPSS tool and KMO and Bartlett's Test (Bartlett spherical test results are all significant, $p < 0.001$), the KMO values are shown as follows: 0.631, 0.662, and 0.662. All of the values are greater than 0.6, in line with the requirements of factor analysis.

Principal component analysis was used to analyze the scales of the questionnaires. It was found that the extracted factors were consistent with the dimensional design of the questionnaires, indicating that the structural validity of the questionnaires is high.

4. Project-Based Learning Process

4.1. Early Stage of The Project: Student Activities under the Guidance of Teachers

The main purpose of the project implementation was to introduce learning programs and enable students to understand the learning objectives. Based on the gap between the learning objectives and the initial level of learners, teachers built reasonable learning supports and provided resource support [11]. In this stage, the learning topic examples take 10 hours in total, and mainly adopt sample learning support to enable students to quickly understand the project results. Through the guidance of teachers, students were encouraged to establish study groups, formulate group study plans, assign team members' tasks, and ensure the smooth implementation of the project [12].

4.1.1. Selected Projects: Identify Project Tasks, Build Study Groups

This session was the first part of the implementation process for the project-based learning. As the initial stage, it was responsible for attracting students and allowing students to develop their desire for further study [13]. This session took 4 hours in total, and the specific instructional steps are shown in Table 3.

Table 3. Select project to link teacher and student learning activity.

Teachers' Activities	Students' Activities	Design Intent
Play a micro lecture example to explain the learning objectives of this project	Watch examples to learn about the learning objectives of this project-based learning activity	Identify project themes and objectives
Publish questionnaires online (understand the subject types of micro lecture)	Use your mobile phone to fill out questionnaires	Understand student interests, Feel the way of informational classroom survey
Display the results of the questionnaire and group them reasonably	Freely form a group based on the results of the questionnaire analysis	Display of informatization means timely feedback classroom teaching situation
Classify the differences between different subject content and informatization use	Student brainstorming and understanding subject knowledge and information technology relevance	Clarify the significance of informatization teaching, find the subject content and information technology

At the beginning of the project, the teacher clarified with the students that they were about to start a project study. The main purpose of the project-based learning was made clear: to enhance their informatization teaching ability by first, mastering the teaching design of informationization; second, by applying the existing technical resources to complete the instructional implementation process according to the teaching design; third, by experiencing a variety of informational evaluation methods throughout the project-based learning process; and finally, by implementing informatization teaching evaluation according to the needs of each stage of teaching. The teacher showed the students the excellent micro lecture works prepared before the class, and informed the students that the final project goal was a 5 to 8-minute micro-course work. The students developed a connection between their existing level of ability and the final result required in the project during the viewing process. Students demonstrated their willingness to learn and expressed their desire to produce high-quality work. Subsequently, appropriate subject selection and grouping were conducted according to the wishes of the students, as shown in Table 4.

Table 4. Group division table.

Group	Number	Subject
1	4	Chinese
2	5	Chemical
3	4	Chinese
4	4	Chinese
5	5	Chinese
6	4	History
7	4	Sports

4.1.2. Clear Goals: Decompose Project Tasks and Develop Learning Plans

This session was the second part of the instructional implementation for the project-based learning process. The objective was to enable students to better understand the learning objectives of the project, and to clarify what was needed to successfully complete the final product using the project-based learning process; that is, to develop their own learning tasks and help the group to create a plan. In the planning process, the team's common tasks were refined to each individual, which prevented the group from inaction. There were 2 hours in this session. The specific teaching steps are shown in Table 5.

Table 5. Planning and learning activities for teachers and students

Teachers' Activities	Students' Activities	Design Intention
Online questionnaire (what abilities do you think you lack in order to complete the micro lecture?)	Use your mobile phone to fill out questionnaires	Understand the gap between the student's foundation and the goal, and provide accurate help conveniently
Interpret project tasks and propose project-based learning outcomes	Refine project tasks and actively explore their recent development zones	Let students feel that the learning content of the project has an appropriate gradient
Provide planning templates to assist the team in completing the plan	Group discussion and preliminary preparation of micro lectures completion plan	Through planning, students will become more familiar with the learning process of the whole project
Assist the team in assigning tasks	Group members assign tasks	Help the team to carry out individual tasks and ensure the smooth implementation of the project

First, we demonstrated the example of micro lectures, and guided students to consider what abilities a teacher needed for micro lecture production. It was emphasized that the production of micro lectures must rely on information-based instructional design and specific script design. The subsequent production links can only be justified in the design process. The combination of instructional ability and information technology not only focuses on the use of simple information technology but also on the integration of information technology with learning materials and instructional methods. The learning materials and instructional methods must be integrated into all instruction processes, and therefore, must be in the instructional design, thus being reflected in the script design [14].

Second, we designed project tasks and clarified learning objectives. To help students to understand how to complete the final micro lecture, the first step was to teach micro lecture design, then to follow the script design, complete the production of each section according to the design, and finally, integrate the material into a complete micro-video. The specific content is shown below. In each task, there was a group report, and everyone discussed specific points to enable the group to improve the work [15].

Finally, we carried out practical teaching and completed task learning. The teacher explained that the next classes would be 8-hour experimental classes in the computer room. The aim was to use learning techniques and to explore the combination of teaching and teaching content.

4.2. Midterm Project: Skill Training and Works Creation

The main purpose of this phase was to enable learners to master the basic skills of micro lecture production. Micro lectures are the product of knowledge, pedagogy, and information technology. Learners can only know what they can accomplish with information technology when they are teaching design after mastering basic information technology capabilities [16]. However, due to the student's independent learning, if there is a significant gap between the learning objectives and the student's fundamental skills, it will be difficult for the student to achieve the learning objectives. Therefore, during the project preparation stage, the learners assessed their skill level through examples. Students learned to master basic information technology skills at their own level. There were eight lessons in the preparation stage, including PowerPoint courseware production, animation production, and micro lecture video editing [17].

According to the feedback, basic material processing, PowerPoint production, animation production, video editing, provided a sound basis for the teaching material.

4.2.1. PowerPoint Skills Learning

The PowerPoint (PPT) courseware production process was divided into two stages. First, students learned the basic PPT production technology, used PPT for creating learning materials, and then chose a theme to complete the PPT courseware through instructional design and script design. In this stage, the students completed the basic skills based on the experimental instructions provided by the teacher, and completed the corresponding classroom tasks. Second, they exerted their own subjective initiative to endeavor to make PPT courseware, referring to the teacher's prior information on the social media. Referring to the "PPT Courseware Production Evaluation Form" that teachers had published in advance, the groups improved their PPT production. The arrangement of the 2 hours is shown in Figure 1.

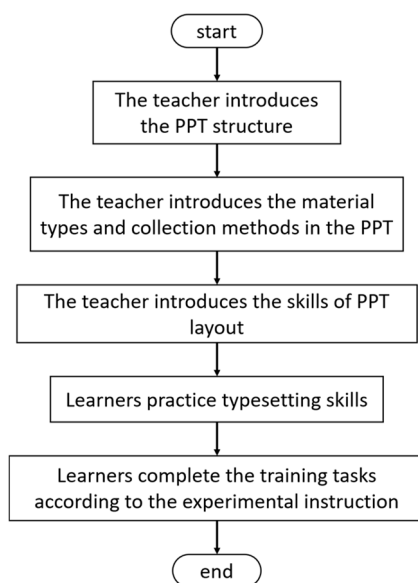


Figure 1. PowerPoint (PPT) production class schedule.

4.2.2. Courseware Production

The courseware phase lasted 2 hours, requiring learners to follow the elements and steps of the instructional design. It built on the simple PPT production method learned in the last course, and taught students how to think about how to use PPT to display the instructional process, and how to better assist teaching with the intervention of pictures, audio, and video. The purpose of the courseware production process was to let students initially experience how to integrate information technology into instructional design and implementation, stimulate the thinking of the students, and prepare for the follow-up project-based learning. The arrangement of the 2 hours is shown in Figure 2.

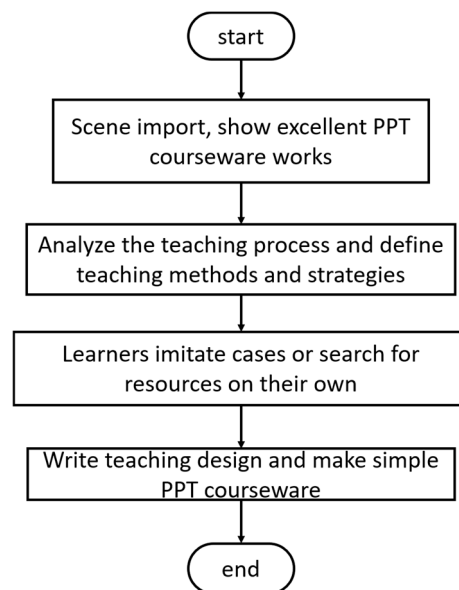


Figure 2. Flow chart of courseware production class arrangement.

After completing the above operations, the students had mastered the basic methods of simple processing of pictures, audio, and video. The next step was to select a topic based on their own interests and create a simple PPT courseware containing a teaching design.

4.2.3. Micro Lecture Video Production

This session is the final part of the students' basic skills instruction. The aim was to explore the use of the Camtasia Studio 9 software to integrate all the resources made previously to synthesize a complete micro-video. The Camtasia Studio 9 is relatively simple to operate and there are fewer functions involved in making micro lectures. Experimental tutorials were designed to help students in active exploration. The tutorials were completed in groups with the team members assisting each other to achieve the outcome. The teacher was available in the instances when the group could not solve the problem.

In this session, the learners not only learned the program but also enhanced each other's experience in the learning process. Furthermore, students developed the skill to create a positive learning atmosphere where mutual communication and mutual exploration [18] could occur.

Class time is insufficient to fulfill the active inquiry process. To master the software, constant contact outside class time is required. Knowledge of the various functions of the software enables the students to use them more effectively in the classroom [19]. Therefore, during the 8 hours, extra circular time was required. Furthermore, to facilitate the process of project-based learning, relevant tutorials and examples were circulated through social media. This enabled students to have convenient and quick access to materials conducive to learning and to sharing knowledge with their team members in a timely manner [20].

4.3. Late Project: Work Exchange and Interactive Evaluation

In the process of project-based learning, through group cooperation and report communication, the subjective construction of the learner can be objectively presented, and then the evaluation of others will re-construct the knowledge, re-form subjective knowledge, and complete the cycle of knowledge construction. In the process of circulation, subjective knowledge and objective knowledge promote the generation, renewal, and reproduction of each other [21].

4.3.1. Reporting of Works: Individual Cognitive Sharing and Promoting Complementarity

Through the exploration and experimentation of integrating information technology with subject content and instructional methods in the inquiry activity, learners completed the micro lectures in cooperation with the group according to the knowledge and skills acquired in the exploration stage. In Figure 3, this stage was to complete the task class report, share, exchange, and draw opinions from which the students could perfect the work, and experience a meaningful construction [22].

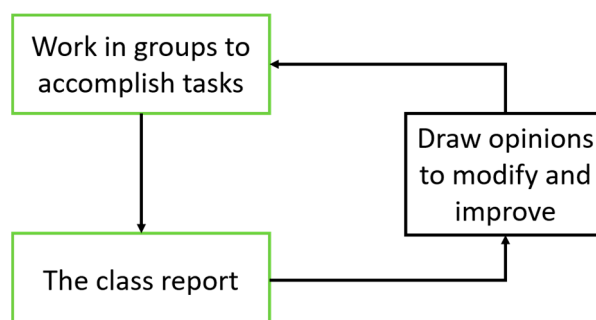


Figure 3. Flow chart of the work report.

The report focused on problems, and the exchange of ideas enabled students to find solutions. Through the reports, we saw the integration of technology, learning materials, and instructional methods. With a further understanding and knowledge of what types of technology should be used to better assist the teaching, the informatization teaching method of micro-teaching can have better teaching effects.

4.3.2. Mutual Evaluation: Strengthen Self-Awareness and Make an Objective Evaluation

In this session, the groups required a representative to present the final micro lecture product, and report the gains and shortcomings of the process. When the final micro-videos were played, there was a feeling of excitement among the students and they were pleased to share their achievements [23]. The feedback indicated that ‘micro lecture noobs’ who did not know what a micro lecture was had transformed into people with the skills to complete a micro lecture. They recognized their own growth. Meanwhile, they also noted shortcomings due to time constraints and felt that some details could have been better handled. However, they believed that they had developed the skills to achieve better results in the future.

As part of the process, teachers evaluated the micro lectures and provided feedback. Subsequently, after the presentations, the students evaluated each other’s micro lectures online by scanning the QR code. Each student was required to complete six questionnaires to evaluate the other groups’ work. There were 180 questionnaires collected. The evaluation results are shown in Table 6.

Table 6. Students' micro lecture evaluation form.

Title	Group	First Group	Second Group	Third Group	Fourth Group	Fifth Group	Sixth Group	Seventh Group
Selected topic design	Topic selection	8	8.36	8.5	8.42	8.44	8.65	8.38
	concise design	8.23	8.2	8.35	8.5	8.2	8.5	8.15
The teaching content	Reasonable design							
	Scientific and correct	8.19	8.24	8.27	8.5	8.48	8.42	8.35
	Clear logic	8	8.16	8.12	8.46	8.36	8.31	8.12
Work specification	Structural integrity	8.19	8.12	8.27	8.65	8.36	8.35	8.27
	The technical specification	7.58	7.72	7.65	8.35	8.12	8.42	8
	Language specification	8.08	7.8	8.12	8.19	8.08	8.23	7.65
Teaching effect	Novel form	8.12	7.92	8.31	8.65	8.12	8.35	8.42
	Interesting	7.65	7.72	7.77	8.42	8.4	8.65	8.42
	Reach the goal	8.38	8.84	8.35	8.65	8.52	8.5	8.23
Total		80.42	80.84	81.69	84.81	83.08	84.38	82

5. Results

The questionnaires were based on the Crete five-level scale, which increase in order from 1 to 5. A total of 30 questionnaires were sent, and 30 questionnaires were collected. All 30 questionnaires were valid.

5.1. Analysis of Informatization Instructional Design Ability

The analysis of the learner's learning feedback on the informatization teaching design ability consisted of two aspects. On the one hand, the self-evaluation in the form of the questionnaire completed by the learner. On the other hand, the mastery of the informational instructional design reflected in the informational instructional design lesson plan submitted by the learners.

First, the questionnaire part included four questions. The learners answered according to their own actual situation. The specific data results of the statistical questionnaire are shown in Table 7.

Table 7. Questionnaire of information-based teaching design ability.

Items	Options	Frequency	Average
I can choose the knowledge points that are suitable for teaching with micro lectures	Not very consistent	2	3.83
	Don't know	3	
	More consistent	23	
	Very much in line	2	
I can choose the media type that fits the level of students' ability according to the different learning objects	Not very consistent	1	4.13
	More consistent	23	
	Very much in line	6	
I can design appropriate teaching resources according to different teaching objectives	Not very consistent	1	3.93
	Don't know	3	
	More consistent	23	
	Very much in line	3	
I can effectively design each stage of the teaching process according to the existing technical resources	Very inconsistent	1	3.57
	Not very consistent	4	
	Don't know	5	
	More consistent	17	
	Very much in line	3	

Through the result of the questionnaire, in terms of informational teaching design ability, more than 80% of learners can organize and utilize information technology resources based on specific learning materials, instructional objects, and an instructional process according to the process and strategy of informational instructional design.

5.2. Analysis of the Integration Ability of Informatization Instructional Resources

First, the questionnaire part included five questions. The learners responded according to their actual situation. The specific data results of the statistical questionnaire are shown in Table 8.

Table 8. Informatization teaching resource integration ability questionnaire details.

Items	Options	Frequency	Average
Follow the script design to find the required materials (such as pictures, audio, animation, video, etc.) from the network	Not very consistent	1	3.7
	General	4	
	More consistent	20	
	Very much in line	5	
The collected materials can be processed as needed (such as cropping, stenciling, etc.)	Not very consistent	1	3.97
	General	3	
	More consistent	16	
	Very much in line	10	
Make some of the material you need	Not very consistent	2	3.43
	General	6	
	More consistent	17	
	Very much in line	5	
Integrate all the materials according to instructional design and script design, complete micro video	Not very consistent	3	3.43
	General	5	
	More consistent	18	
	Very much in line	4	
In the process of making a micro video, the teaching design and script design scheme can be modified according to the actual situation	General	6	3.93
	More consistent	17	
	Very much in line	7	

In addition to the questionnaires, the majority of learners were able to develop simple teaching resources by themselves with guides and observation of the learner's production process. Similar to the more complex teaching resources of micro-courses, for the pre-service teachers who have never been exposed to developing a micro lecture, the cooperation of the group and the guidance of the teachers proved beneficial. Therefore, we believe that through this project-based learning approach, learners can collect and select digital teaching resources according to specific teaching objectives and for resources that cannot be found on the Internet, they can process existing resources as needed or develop new learning resources on their own.

5.3. Analysis of the Evaluation Ability of Informatization Teaching

First, the questionnaire part included three questions. The learners responded according to their actual situation. The specific data results of the statistical questionnaire are shown in Table 9.

The learners' evaluation of the other groups' micro lecture works can indicate the learners' attitude towards the evaluation of digital teaching resources. In this study, we used the Kendall consistency coefficient to determine whether the learners' attitude toward the same teaching resource was consistent. The 180 questionnaires in the evaluation section of the micro lecture were sorted into seven categories based on the evaluation group, and the Kendall consistency test was performed, respectively. The test results are shown in Table 10.

Table 9. Result of the informatization teaching evaluation ability questionnaire.

Items	Options	Frequency	Average
Evaluate yourself according to the evaluation criteria	Don't know Did it	1 29	2.97
Evaluate PPT works according to evaluation criteria	Don't know Did it	3 27	2.9
According to the evaluation criteria, the microlecture works are evaluated	Don't know Did it	4 26	2.87

Table 10. Learners' evaluation of the Kendall consistency checklist for micro-classes.

Group	Number	Kendall W	Chi-Square	Degrees of Freedom	Asymptotic Significance
First group	26	0.136	31.914	9	0.000 **
Second group	25	0.101	22.641	9	0.007 **
Third group	26	0.193	45.117	9	0.000 **
Fourth group	26	0.086	20.194	9	0.017 *
Fifth group	25	0.092	20.601	9	0.009 **
Sixth group	26	0.074	17.231	9	0.045 *
Seventh group	26	0.131	30.733	9	0.000 **

* $p < 0.05$, ** $p < 0.01$.

As can be seen from the above table, the results of three of the seven groups are 0.000, less than 0.01, and the progressive significance of the other four groups of data is also less than 0.05. It proved that learners have significant differences in the evaluation attitudes of different evaluation modules of the same digital learning resources; that is, learners can objectively evaluate digital learning resources according to standards, reflecting that learners can evaluate learning resources objectively and fairly according to standards through project learning.

6. Conclusions

In this paper, learners reached the predetermined learning goal. They could complete the information-based instructional design, develop instructional resources according to the instructional design, and implement the class application. They could also make reasonable and stable evaluations of informatized instructional design, teaching resources, and teaching processes based on standards. The entire implementation process revolved around the project-based learning process. For example, at the beginning of the teaching, we must follow the previous design, and learners rely on teachers and learning supports to carry out independent inquiry learning. At the same time, after the basic knowledge reserve period, project-based learning will be officially started. After the selected projects, the establishment of the team, the formulation of the plan, the decomposition of the task, the activity exploration, the production of the work, the sharing of results, and the evaluation of the project, the product of a 'micro lecture' was generated as an explicit manifestation of the informatization teaching ability. In this process, teachers should always provide relevant learning resources in a digital way for learners, and use the information evaluation tool reasonably to evaluate the learners in a timely manner. Multi-party collaboration and a multi-pronged approach have improved the informatization teaching ability of pre-service teachers.

Due to there being only one class in the teaching object, whether the project-based informatization teaching ability works can only be judged by considering the different states of the same class through project learning. The sample is relatively small and it is an operational experiment. There may be certain contingency whether it can improve the informationization ability of normal students. There may be some contingency in the improvement of students' informationization ability. Targeted training of informatization teaching ability will enhance the educational and teaching competency of pre-service teachers.

6.1. Findings

From the result of Hypothesis 1, we assumed that pre-service teachers can improve the informatization teaching design ability through project-based learning, and improve the teaching ability, assuming verification is established. We proved that pre-service teachers can organize and utilize information technology resources based on the specific teaching content, teaching objectives, and teaching process according to the specific teaching content, teaching process, and arrange the teaching according to the process and strategy of informationized teaching design.

In the result of Hypothesis 2, pre-service teachers can improve the integration of information-based teaching resources through project-based learning, and enhance the ability of resource development. It is assumed that verification is established. We proved that pre-service teachers can collect and select digital teaching resources according to specific teaching objectives and needs. Moreover, they can process existing resources or independently develop new learning resources according to specific needs.

In the result of Hypothesis 3, pre-service teachers can improve the evaluation ability of information-based instruction through project-based learning, and they can correctly carry out teaching evaluation. Then, the hypothesis verification is established. We proved that pre-service teachers can evaluate the informatization instructional design, resources, and processes according to the specific evaluation criteria through project-based learning. The pre-service teachers' ability in the informatization teaching evaluation has been improved through project-based learning.

6.2. Discussion and Suggestions

Educational practice is crucial to the training of pre-service teachers' informatization teaching ability, and it has a very important impact on the pre-service teachers' informatization implementation ability and information evaluation ability. In the process of pre-service teacher education, school authorities should strengthen the training and assign more pre-service teachers to the corresponding primary and secondary schools for educational practice. For example, using a combination of decentralized apprenticeships and teaching practice, the school can establish a cooperative relationship with the corresponding schools. Regularly going to school as an internship during the sophomore year and junior year, and striving for practical opportunities, creates an environment where pre-service teachers can apply their own learning to the real teaching situation. Thus, the learners can enter the migration-integration period after the learning imitation period as soon as possible [24]. The informatization teaching knowledge and the informatization teaching practice complement each other and promote the formation of learners' informatization teaching wisdom. It is internalized in the teacher's information-based teaching concept, which infiltrates into different teaching situations and runs through various teaching links. It is the fusion of explicit knowledge and tacit knowledge, and is the integration of information-based teaching practice and ideas, and is the foothold of teacher professional development in the informatization society. It is also the value pursuit of teachers' informatization instructional behavior [25].

For the cultivation of learners' ability, national policies and school regulations are the upper-level construction, and teachers are instructors. Teachers should make efforts from the perspective of improving teaching, to promote the informatization teaching ability of pre-service teachers in a 'bottom-up' manner. Through the analysis of the learning effect of pre-service teachers who studied through the project, we believe that the diversified and informatized evaluation mechanism can not only play an incentive role in the teaching process but also evaluate the teacher evaluation, group evaluation, mutual evaluation of learners, and self-evaluation [26]. Through the multiple evaluation methods of informatization to cultivate the pre-service teachers' informatization teaching evaluation ability, the informatization teaching evaluation ability, which is difficult to cultivate in the classroom teaching process, of the project learning is improved.

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