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DEVELOPMENT OF SCAFFOLDING TEACHING MODEL FOR ENHANCING INDEPENDENT LEARNING ABILITY ON UNDERGRADUATE STUDENTS IN CHINA

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Abstract: In this study, constructivism theory and the theory of "Zone of Proximal Development" are used to develop woodcut prints curriculum and construct scaffolding teaching model to improve students' independent learning ability. A total of 62 students from two groups were selected from 861,000 undergraduate students in Hubei Province through simple random sampling and cluster sampling. Secondly, through the results of student questionnaire survey and in-depth interview Expert, this paper analyzes the reasons for the low self-learning ability of students. Thirdly, the scaffolding teaching method is used to design the curriculum of Woodcut and carry out quasi-experiments in the experimental group, while the control group uses the traditional teaching model to carry out ordinary experiments. Finally, SPSS software was used to calculate the pre-test and post-test values of students' independent learning ability in the two groups. The results of paired sample T-test and independent sample T-test showed that the scaffolding teaching model could improve students' independent learning ability better than the traditional teaching model.

Key words: Constructivism; Zone of Proximal Development; scaffolding teaching model；independent learning ability；Woodcut Prints

Research background

In the past class teaching on undergraduate students in china, teachers believed that it was only necessary to pay attention to the teaching of knowledge and skills, while students' ability growth and future development in learning were often ignored. In order to adapt to the rapid development of culture and education, higher education has put forward higher requirements on the quality of personnel training. The cultivated talents should not only have strong professional knowledge and skills, but also enhance their learning ability and personal development to a certain extent. In particular, the ability of independent learning plays a pivotal role in quality of personnel training.

In 2010, the CPC Central Committee and The State Council issued the Outline of the National Medium-and Long-Term Plan for Educational Reform and Development (2010-2020), proposing to implement the Project of Undergraduate Teaching Quality and Teaching Reform in institutions

of Higher Learning. Strict teaching management. We will improve the teaching quality assurance system and improve teaching evaluation in universities. Fully mobilize the enthusiasm and initiative of students to study, encourage students to study hard, enhance the awareness of integrity, and develop a good style of study(Ministry of Education,PRC.2010).

At present, there is a lack of students' independent learning ability in undergraduate teaching in China.The reasons as the following aspects:(1)The single and traditional teaching model leads to the insufficiency of students' independent learning ability.(2)Traditional teaching methods lead to the insufficiency of students' independent learning ability.(3)Teacher-led and passive learning leads to insufficient independent learning ability of students.(4)Teachers' lack of guidance and development of teaching resources lead to the insufficiency of students' independent learning ability.

Scaffolding teaching helps students to effectively carry out independent learning, so as to improve their independent learning ability, which has the following benefits:First of all,The use of scaffolding in classroom teaching can effectively promote students' cognitive development and improve students' independent learning ability.(Yuan,2023) Secondly, Scaffolding teaching optimizes student learning by providing a supportive environment while promoting student independence(Larkin,2002). Third, Using scaffolding as a teaching technique can help students build ideal learning strategies or tasks in their spare time.(Vacca,2008) Finally, Scaffolding teaching can make students change from passive learning to active learning, from passive receiving to active construction of knowledge, and from result evaluation to process evaluation.

In a word,Scaffolding teaching is the use of scaffolding teaching method to carry out curriculum teaching reform. In view of the shortcomings of traditional classroom teaching in universities,The scaffold is used to guide students to conduct independent learning and help them master knowledge and skills flexibly, Monitor the learning process, so as to effectively improve students' independent learning ability.

Therefore, the research aiming at the deficiency of students' independent learning ability in traditional teaching, this study constructs Scaffolding teaching model to help students improve their independent learning ability.

Literature review

Scaffolding teaching theory was based on constructivism and Zone of Proximal Development theory(Li,2022).

1. Constructivism theory

Constructivism was proposed by Swiss psychologist Jean Piaget (1966). In his view, knowledge is constructed in the interaction of subject and object.

In The Principles of Genetic Epistemology,Piaget(1970)discussed how knowledge is formed and developed. Through the study of children's psychology, he pointed out that cognition is a view that is actively constructed on the basis of the subject's existing knowledge and experience.

Widdowson also pointed out that “Constructivism is a theory of learning and holds that learning is an active process of knowledge construction in which learners build on prior knowledge and experience to shape meaning and construct new knowledge”(1979).

Therefore, knowledge construction emphasizes the interaction between learner subjects and external material environment. It is a construction behavior in which learners constantly interact with the external environment on the basis of existing knowledge and experience.It should be an active behavior of learners,not passively imposed.

2. "Zone of Proximal Development" theory

The theory of "Zone of Proximal Development" was put forward by Vygotsky (1929), a famous psychologist in the former Soviet Union. Vygotsky believed that there were two levels of students' intelligence: the first level of development, which is the current level of development reached through independent learning without any guidance based on past learning experience and knowledge accumulation; and the second level of development, which refers to the higher level of development that students may reach under the guidance of teachers based on their own potential and existing educational resources. The distance between the two is what he called the "Zone of Proximal Development." It can be seen that the first level of development is the level that students can reach through independent learning, while the second level of development refers to the level of development that students cannot reach by virtue of individual ability and need the help of teachers or peers in cooperative learning.

3. Scaffolding teaching theory

Scaffolding theory was first introduced in the late 1950's by a cognitive psychologist,Bruner. He used the word to describe oral language acquisition in young children. With the help of parents, children acquire the instinctive structure to learn language as soon as they begin to learn to speak. It is a conceptual framework for learners to understand knowledge, and it is a teaching model based on the current level of developmentof learners, systematically guides learners to use various methods, actively construct knowledge and skills, and moving towards a higher development level(Bruner,1975).

Wood, Bruner & Ross(1976a)are the first to use the term "scaffolding" in Problem Solving. It was explained as a "process that enables a learner to solve a problem,carry out a task, or reach a goal that would be beyond his unassisted efforts."

Rosenshine(1992) defined scaffolding teaching as: in the process of learning activities, the teacher or more talented students provide a ladder for them to use new skills and solve problems by themselves through the ladder.

Therefore, A researcher believes that the "scaffolding teaching method is a learner-centered teaching method based on the constructivism learning theory and aimed at cultivating students' problem-solving ability and Independent Learning Ability."(Li, 2019)

Most foreign scholars also agree with this view and believe that scaffolding plays an important role in the construction industry. After that, Bruner applied Vygotsky's theory of "zone of proximal development" and Piaget's constructivism to the field of education and teaching, and put forward the concept of "scaffolding teaching".

The early scholars divided the scaffolding teaching process slightly differently. For example, in 1984, Brow et al. divided scaffolding teaching into three stages: preheating, exploration and independent exploration(Chen & Liu,2010).Other researchers divided it into four stages: putting

up scaffolding, entering the situation, inspiring guidance and removing scaffolding(Zheng & Zu,2010). But later researchers generally agree that Scaffolding teaching consists of five stages: building scaffolding; entering the situation; independent exploration; cooperative learning; effect evaluation (He,1997).

Building scaffolding is to set up scaffolds according to students' "zone of current development".Entering the situation is to provide teaching situation for scaffolds' learning.Independent exploration is to carry out independent learning and exploration under the guidance of scaffolds.Cooperative learning is to learn and solve problems together with the help of teachers or peers.Effect evaluation is to evaluate the acquired results.

However, some researchers also believed that the relationship of these five stages was not linear, but could be arranged flexibly according to teaching needs (Chen & Chen, 2009).

4. Research on teaching model

Joyce et al. (1972) put forward in the book Teaching Model that Teaching model is a plan or model that can be used to structure curriculum and homework, select textbooks, and encourage teachers to teach in class or other occasions.

The definition of teaching can be roughly divided into two categories: one definition thinks that teaching model belongs to the category of teaching process, they either propose that teaching model is the model of teaching process, or think that teaching model is a "strategy system" or "teaching style" related to teaching procedures. Another kind of definition holds that teaching model belongs to the category of teaching structure(Yan,2001).

The research structure of teaching model generally includes the following elements(Ran,2006):

(1)Teaching ideology or teaching theory: This is the theoretical basis on which the teaching model is based, and it helps people to understand the theoretical origin of the teaching model.

(2) Teaching objective: It is the core element determined by the teaching model, which determines the standard based on the operating procedure of the teaching model, the proportion of teacher-student activities and the evaluation standard.

(3) Operation procedures: Handle the implementation of time procedures for teaching content by teachers and students.

(4)Teaching strategy: The synthesis of teaching methods, methods and measures adopted by teachers and students in the teaching process.

(5)Evaluation: Evaluation methods and standards should be used in the applicable teaching environment. Different teaching models have different evaluation methods and standards.

5.Research on independent learning ability

The concept of independent learning ability originates from the West. It comes from the constructivism learning theory. French linguist Holec(1981) first proposed the concept of Independent Learning Ability in the 1980s, defining it as "the ability to self-manage learning", and specifically explaining it as "Decide on learning goals, determine the learning content and progress, choose leaning methods and techniques, monitor learning process and Evaluate the results of acquisition".

Some researchers have specifically explained these five aspects as: (1)Students can determine their own learning objectives.(2)Determine their own learning content spontaneously during the learning process.(3)In order to achieve better learning results, they can choose different learning methods for different content.(4)At any time Monitor your learning progress and learning status, correct problems when they are found.(5)Evaluate learning outcomes.(An & Jiao,2020)

If a student can set clear learning objectives, spontaneously determine their own learning content, flexibly choose learning methods according to the learning content, monitor their learning progress and status at any time, discover and solve problems in time, and evaluate their own learning effect, then the student will have a strong independent learning ability.

Population and Sample Groups

1. Population

The total number of undergraduates in Hubei Province is 861,000 in the study.

2.sample Groups

This study adopts simple random sampling method, to select Sample multi-stage.

The first stage: First extract Huang gang City from 13 prefecture-level cities in Hubei Province.

The second stage: The School of Fine Arts is selected from 20 departments of the only undergraduate university in Huang gang City.

The third stage: the fine arts major is selected from the five undergraduate majors in the Academy of Fine Arts.

The fourth stage: From the four grades of fine arts major to the second grade.

The fifth stage: Two groups were selected from the four classes in grade 2, and one experimental group and the other control group (31 students per group) were randomly assigned.

Variables of the study

1.The independent variable is the scaffolding teaching model developed by the research team.

2.The dependent variable is Students' independent learning ability.It has 5 sub-dimensions: (1)Decide on learning objectives; (2)Decide the learning content and progress; (3) Choose learning methods and techniques; (4) Monitor the learning process; (5) Evaluate the results of acquisition.

Design of teaching

1. Design of teaching content

This study will take the undergraduate woodcut teaching as an example to elaborate the scaffolding teaching process and construct the scaffolding teaching model to help students improve their independent learning ability.

Scaffolding teaching of Woodcut Prints will design three teaching cases: problem scaffolding, student-centered scaffolding and online and offline mixed learning scaffolding, which includes all the contents of scaffolding teaching.

(1) Problem scaffolding mainly studies the basic knowledge of woodcut prints. Using this kind of teaching case to carry out scaffolding teaching, can guide students to better preview the new lesson, look up the information, take the initiative to think and answer questions, and prepare tools and materials.

(2) Student-centered scaffolding learning woodcut drawing and transfer printing techniques. It is helpful to enhance students' learning desire, confidence and active sharing of learning results.

(3) Online and offline mixed learning scaffolding is used to learn the production, rubbing and lesson design of woodcut prints.Help students actively participate in group cooperation, take the initiative to participate in class, and be good at planning and evaluation.

2. Design of teaching assessment

The Assessment Scale of students' independent learning ability designed in this study refers to Holec' theory and Ma X.'s "Expression with Decorative Colors" lesson Assessment Scale of independent learning. (Ma,2017)

The scale of Self-Assessment, Mutual-Assessment and Teacher-Assessment adopts the 10-point system.1 represents the lowest score, 10 represents the highest score, and the larger the value, the stronger the ability of the evaluation index.Five evaluation indexes are set respectively, and two questions are set for each evaluation index.

3.Design of implementation steps and Procedures

This phase mainly carries out the quasi-experiment of scaffolding teaching woodcut prints and the ordinary experiment of traditional teaching woodcut prints, and verifies the research hypothesis through comparison.

1.Procedures of quasi-experimental implementation of experimental group

This is a study that uses experimental procedures, takes advantage of teaching scenarios, and controls subjects flexibly. As scaffolding teaching is more flexible, this study does not have to directly practice lesson design completely in classroom teaching like traditional teaching. Teachers are required to build scaffolding in class according to the actual situation to help students solve specific problems in specific situations. Scaffolding teaching is used in the experimental group to test the feasibility and effectiveness of this study, verify whether the hypothesis is valid, and test the effect of this teaching design on improving students' independent learning ability.

The quasi-experimental procedures is as follows:

Step 1: Preparation before the quasi-experiment

Before implementing the scaffolding teaching model in the experimental group, Researchers work in the following steps:

(1) Select experimental group population and sample according to the teaching design.

(2) Prepare and train professional teachers to learn the "Woodcut" teaching documents. The teacher spent hours familiarizing themselves with teaching plan,lesson plans, teaching materials, and assessment tools.

(3) Prepare the learning environment. Including preparing the laboratory, arranging tables and chairs, arranging teaching and learning tools, checking the quality of machine operation and health environment.

Step 2: Quasi-experimental implementation

The quasi-experimental implements the following procedures:

(1) Pre-test the independent learning ability of students in the experimental group before the implementation of the quasi-experimental, and collect the average values of students' self-

assessment, mutual-assessment and Teacher-Assessment tests.

(2) In the classroom prepared before class, according to the scaffolding teaching design, the students of the experimental group are carried out quasi-experiments. The three teaching cases in the teaching design are mainly implemented according to the five steps of scaffolding teaching. The purpose is to improve students' independent learning ability through quasi-experiment of scaffolding teaching.

(3) After the quasi-experiment, qualitative analysis was carried out on the three teaching cases respectively to summarize the improvement of students' independent learning ability through scaffolding teaching.

Step 3: Evaluation effect of quasi-experiment

(1) Conduct post-test on students immediately after the implementation of the quasi-experiment, summarize the average values of students' self-assessment, mutual-assessment and Teacher-Assessment.

(2) Use SPSS software to conduct paired T-Test on the experimental data, and compare whether there is a significant difference between the P-values of the pre-test and post-test of students' independent learning ability in the quasi-experiment.

2.Procedures of teaching implementation of control group

Traditional teaching methods are used in the control group to implement the woodcut prints teaching. The purpose is to provide comparative data for the experimental group, and further verify that the scaffolding teaching method is more conducive to improving students' independent learning ability than traditional teaching methods.

Step 1: Prepare for class

(1) Select the population and sample of the control group according to the traditional teaching design.

(2) Prepare the Woodcut prints teaching documents that are familiar with traditional teaching methods. Have professional teachers spend hours familiarizing themselves with teaching plan, lesson plans, and assessment tools.

(3) Prepare the learning environment. Including arranging laboratory tables and chairs, arranging teaching and Learning Assistance Aids, checking the operation of the machine, etc.

Step 2: Teaching implementation

(1) Before the implementation of the teaching in the control group, the research group should collect the average values of students' self-evaluation, mutual evaluation and teacher evaluation tests.

(2) Using traditional teaching methods and teaching contents to carry out woodcut prints teaching in the control group.

(3) At the end of the teaching implementation, summarize and reflect on the effect of traditional teaching methods.

Step 3: Evaluation of teaching implementation effect

(1) The evaluation shall be carried out immediately after the end of teaching, and the data of self-assessment, mutual-assessment and Teacher-Assessment of students' independent learning ability shall be collected and the average value shall be calculated.

(2) Using SPSS software to conduct independent sample T-Test, compare the post-measured values of the experimental group and the control group, and observe whether there is a significant difference in P-value.

Research Instruments

The following research instruments were used in this study to effectively implement the teaching model.

(1) The documents of the scaffolding teaching of Woodcut prints

The documents of the scaffolding teaching of Woodcut prints: revised syllabus, teaching design, teaching plan, lesson plan, PPT,etc.

(2) The documents of the traditional teaching of Woodcut prints

The documents of the traditional version of Woodcut prints: syllabus, teaching design, teaching plan, lesson plan, PPT, etc.

(3) Assessment Scale of students' independent learning ability

After the formal implementation of the teaching, the research team needs to collect pre-test and post-test data of students' independent learning ability in the experimental group and control group respectively. The pre-test is to understand students' independent learning and original knowledge construction at the stage of the "zone of current development". Post-test is to test the level of potential development of students under two different teaching methods and the status of self-construction of knowledge.

(4) pilot study

Refer to the relevant literature, develop the pilot study procedures and specific operating steps.

(5) Quasi-experiment

All the students in the experimental group by using the scaffolding teaching, which is carried out in strict accordance with the syllabus, teaching cases, teaching steps, evaluation methods, etc., And the teaching by a teacher who has learned all the contents of the teaching.

(6) General experiment

The general experiment are carried out in the control group. Using the traditional teaching syllabus, teaching plan and lesson plan of woodcut prints, which was taught by a teacher who didn't know the content of scaffolding teaching design of woodcut prints, the traditional teaching methods were used from beginning to end.

Data Analysis

1.Analysis of reliability and validity of the assessment scale

Before the implementation of the teaching model, the research team asked 58 students to fill in the self-learning ability scale. According to the test data, we analyzed the reliability and validity test results of the evaluation scale.

(1) Reliability test

Statistical data of 58 valid sample tables were obtained through reliability analysis of SPSS software. Cronbach's Alpha in the table is 0.947(Table 1), and a result greater than 0.9 indicates high reliability of the scale.

Table 1 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.947	.948	5

(2)Validity test

This scale refers to the five aspects of Holec's independent learning ability and Ma Xiao's independent learning assessment scale. Combined with the research in the early stage of this study, the scale is designed after several modifications, which is in line with the characteristics of students' learning conditions. Therefore, the evaluation indicators of the scale come from reliable sources and the design process is reasonable.

After completing the scale design, 5 experts (3 experts in the field of fine arts and 2 expert in the field of education) were consulted by letter. Item-level content validity index, I-CVI range is 0.80 to 1.00, The scale-level content validity index, S-CVI/AVE = 0.98, indicated that the scale had high content validity.

SPSS was used for Factor Analysis of scale data, which showed that KMO value was 0.843, greater than 0.8, Bartlett's Test of Sphericity, P value less than 0.05(Table 2), indicating that the data was very reliable and the scale validity was high.

Table 2 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.843
Bartlett's Test of Sphericity	Approx. Chi-Square	282.547
	df	10
	Sig.	.000

2.Analysis of Results of pilot study

After pilot studies, students using scaffolding teaching methods have significantly improved their independent learning ability, and scaffolding teaching methods are more effective than traditional teaching methods. During the pilot study, it was found that the scaffolding steps of the original teaching design needed to be clearer, the teachers should give proper guidance in the process of students' cooperative learning, and the details of the teaching design of the online and offline hybrid learning scaffolding needed to be further optimized. Therefore, the research team made corresponding improvements to the original teaching design to make the original teaching design more scientific, reasonable and effective.

The results of the pilot study revealed problems in the teaching and learning process. Data collected from conducting pilot studies are used to revise instructional designs, lesson plans, and instructional materials for:

(1) Adjust the appropriateness of teaching activities.

(2) Modify the expression of teaching plans and teaching plans to avoid ambiguity.

(3) Revise the teaching plan by adding teaching design details and giving teaching situations.

3.Data Analysis of implementation steps and Procedures

This teaching model implemented in the 2023 academic year for second-year undergraduates. The subjects of the experimental group as a whole underwent scaffolding teaching practice in the printmaking laboratory, and the control group was taught by traditional methods in another laboratory. A random pre-test and post-test design study was used to test the improvement of students' independent learning ability. The results of the implementation of the teaching model are as follows.

1.The results of woodcut print scaffolding teaching documents

Check and collect the syllabus, teaching design, teaching plan, lesson plan, PPT, etc. of the woodcut scaffolding teaching curriculum, upload the electronic version to the Super Star Learning online curriculum system, and print the paper version for the reference of the experimental group.

2. Results of traditional woodcut teaching documents

Collect woodcut traditional teaching curriculum syllabus, teaching design, teaching plan, teaching plan, PPT and other documents, and print out the paper version for the control group.

3. The data results of the assessment scale of students' independent learning ability

Through the data statistics of the pre-test and post-test of the experimental group and the control group, the measured values of the five dimensions of students' independent learning ability were obtained (Table 3). SPSS software was used to calculate the mean and standard deviation of students' independent learning ability.

Table 3 Comparison of pre-test between experimental group and control group

Test	group	Decide on learning goals	Decide the learning content and progress	Choose learning methods and techniques	Monitor the learning process	Evaluate the results of acquisition
pre-test	E-group	6.4140	6.6720	6.6129	6.7366	6.5645
	C-group	6.0323	6.4839	6.4946	6.6398	6.4679
pro-test	E-group	8.3602	8.5	8.3710	8.457	8.2366
	C-group	6.4462	6.7903	6.6774	6.8763	6.8548

Note:

E-group means experimental group
C-group means control group

(1) Comparative results of pre-test between experimental group and control group

Table 4 Data of Pre-test of experimental group and control group

Test	N	$\overline{X}$	S.D.
C1	31	6.60	0.83
E1	31	6.42	0.91

Note:
N=number of students
C1=Pre-test of control group
E1=Pre-test of experimental group

Table 4 shows the average score and standard deviation of the pre-test of students' independent learning ability in the experimental group and the control group. The results show that the data measured before the experimental group is distributed near the mean value 6.60, with an average deviation from the mean value 0.83; the data measured before the control group is distributed near the mean value 6.42, with an average deviation from the mean value 0.91.

Through the independent sample T-test, the comparison between the two groups of data shows that the P value is 0.168, which is greater than 0.05, and there is no significant difference between the two. The independent learning ability of students in the experimental group and the control group is basically the same, so covariance analysis is not necessary.

(2) Compare the results of the pre-test and post-test of the control group

Table 5 Data of Pre-test and Post-test of control group

Test	N	$\overline{X}$	S.D.	R
C1	31	6.42	0.83	0.05
C2	31	6.73	0.56	

Note:
N=number of students
C1=Pre-test of control group
C2=Post-test of control group
R=growth rate

Table 5 shows that the pre-test data of the control group are distributed near the mean value 6.42, with an average deviation from the mean value 0.83; the post-test data are distributed near the mean value 6.73, with an average deviation from the mean value 0.56. The independent learning ability of the students in the control group using the traditional teaching mode is only increased by 5%.

Normality test was carried out on the five pairs of paired items. According to the normal Q-Q chart, the measured values of the independent learning ability of the students in the control group accord with the normal distribution. Through the spss paired sample T-test, the P-values of the five dimensions were all greater than 0.05, indicating that there was no significant change in the measured values of the independent learning ability of the students in the control group before and after.

(3) comparison of pre-test and post-test of experimental group

Table 6 Data of Pre-test and Post-test of experimental group

Test	N	$\overline{X}$	S.D.	R
E1	31	6.60	0.92	0.27
E2	31	8.38	0.87	

Note:
N=number of students
E1=Pre-test of experimental group
E2=Post-test of experimental group
R=growth rate

Table 6 shows that the pre-test data of the experimental group is distributed near the mean value 6.60, with an average deviation from the mean value 0.92; the post-test data is distributed near the mean value 8.38, with an average deviation from the mean value 0.87. The independent learning ability of the students in the control group increased by 27% by using the scaffolding teaching model.

According to the spss independent sample T-test, the p values of the five dimensions are all 0.000, less than 0.05, and the measured values of the experimental group students' independent learning ability have significantly changed before and after, which confirms the validity of the second hypothesis of this study.

(4) Comparison between Post-test of experimental group and control group

Table 7 Data of Post-test of experimental group and control group

Test	N	$\overline{X}$	S.D.	R
C2	31	6.73	0.56	0.25
E2	31	8.39	0.87	

Note:
N=number of students
C1=Post-test of control group
E2=Post-test of experimental group

R=growth rate

Table 7 shows that the post-test data of the experimental group is distributed near the mean value 8.39, with an average offset of 0.87 from the mean value; the post-test data of the control group is distributed near the mean value 6.73, with an average offset of 0.56 from the mean value. Compared with the control group, the independent learning ability of the experimental group is increased by 25%. It can be seen that the scaffolding teaching mode is easier to improve the independent learning ability of the students than the traditional teaching mode.

According to the spss independent sample T-test, the p values of the five dimensions are all 0.000, which is less than 0.05. The post-test values of students' independent learning ability in the experimental group and the control group have significantly changed, which confirms the validity of the third hypothesis of this study.

Conclusion and discussion

The scaffolding teaching model of woodcut prints has significantly improved the independent learning ability of students in the quasi-experimental group. However, this teaching model is still in the process of exploration. While summarizing successful experiences, we also need to discuss some shortcomings and put forward practical suggestions.

1. Qualitative data collected during the teaching implementation phase

(1) The teachers of the experimental group and the control group inspected the learning environment respectively. Including arranging laboratory tables and chairs, arranging teaching and learning Aids, checking the operation of the machine, etc.The main difference between the two groups is that the experimental group needs to prepare an online learning environment, so that students can better carry out online independent learning.

(2) The teachers of the experimental group and the control group have been prepared separately the curriculum syllabus, teaching plan, lesson plan and PPT used.The teaching materials used in the experimental group mainly focus on scaffolding teaching, while the control group still adopts the traditional teaching methods.

(3) quasi-experiment were carried out in the experimental group,general experiments were carried out in the control group. And have been separately to carry out pre-test and post-test of independent learning ability, and collected student self-assessment, mutual evaluation and teacher evaluation forms.The two groups use the same evaluation form and evaluation method in order to fairly compare the independent learning ability of students in the two groups.

(4) The teachers of the experimental group implemented the three teaching cases in the teaching design according to the five steps of scaffold teaching, analyzed the teaching effects of the three teaching cases, and summarized the improvement of students' independent learning ability.This approach can well apply the theory to the concrete scaffolding teaching model.

(5) After the study, the teacher timely collected the students' classroom experiment report and skill activity report (the middle school printmaking lesson plan written by the students).These materials can be used as the archives of the implementation results of the scaffolding teaching model.

2. Analysis of experimental data of two groups

The quasi-experimental study participants in the experimental group performed well and completed the expected tasks on time. The method of sample and population selection is reasonable and conforms to the law of this study. The teaching content and teaching cases are complete and consistent with the teaching design. The teaching implementation process and implementation steps are orderly and in line with standards. The assessment data of students' independent learning ability were collected using SPSS. The data usage and statistics were in line with statistical principles and norms. The qualitative evaluation of quasi-experimental results was consistent with quantitative statistical results.

In the general experiment of the control group, the teacher's information is clearly described, and the sample and population selection methods are scientific and normative. The arrangement of teaching content and teaching activities is reasonable and suitable for traditional teaching methods. Teaching implementation process and implementation steps are concise and standardized. The assessment data of students' independent learning ability are evaluated using SPSS statistical method, and the description of the general experiment results is clear, which truly reflects the status of students' independent learning ability.

3.Revision results after the implementation of scaffolding teaching model

The data collected from the implementation and evaluation of the scaffolding teaching model were used to revise the construction scheme of the model. The revisions are as follows:

(1) Modify the question scaffolding in the teaching plan by asking more detailed questions.To guide students to learn new teaching content by themselves with more abundant question scaffolding.To ensure the rigor of scaffolding teaching, the problem scaffolding is more accurately applied to the teaching plan design.

(2) Write down the details of the organized activities, so that students can understand the details of the activities and know the activities procedures. This allows students to better manage their learning content and monitor their learning results.

(3) Increase the teaching content and specific time of teaching activities, so that students can clearly choose what content to learn and where to participate in activities at a specific time node.It can help students optimize their learning plan and determine their learning goals more accurately.

(4) Arrange details of how students will present their work and lesson plans in class.In this way, students can better share the learning results and the ideas if they get those results.

(5) Further refine and modify the handout to make it look more practical, simple and interesting.In order to teach in fun, improve students' interest in learning.

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