A Practical Study on Promoting the Development of Student's Independent Learning Ability Through Information Technology Courses in Senior High School

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Abstract: The cultivation of innovative talents is the strategic goal of education in China. The creative consciousness, creative spirit, creative thinking, and creative ability necessary for innovative talents are built based on independent learning by cultivating students' extensive thinking and collaborative inquiry in primary education. Information technology in senior high school is the best entry point for cultivating students' independent learning ability because of its attractive, project-based, and practical. Therefore, in the context of the information technology discipline, it is feasible and necessary to build a new teaching model consistent with independent learning to promote the development of their independent learning ability, taking into full consideration the types, characteristics, and needs of learners. This study explored the impact of an independent teaching model based on information technology discipline in senior high school on students' independent learning ability with the help of empirical research and conducted an empirical study on seven dimensions: learning motivation, learning time, learning methods, learning results, learning environment, learning process, and learning content. The semester-long teaching practice showed that the independent learning skills training based on the information technology discipline background in senior high school had stimulated students' learning motivation, promoted them to master effective independent learning methods, and improved teaching quality. Finally, based on the teaching practice and effectiveness, the cases and activities of applying this strategy to organize effective teaching were summarized, providing a reference for similar teaching practices.

Keywords: Information Technology, Independent Learning Ability, Teaching Model

1. Introduction

1.1. Research Background

1.1.1. The Cultivation of Independent Learning Ability Is an Essential Part of the Cultivation of Innovative Talents

To comprehensively improve the quality of the nation and promote the scientific development of education, the "Outline of the National Medium- and Long-term Education Reform and Development Plan" has made ability training one of the strategic themes of China's education reform and development: adhere to ability first, optimize the knowledge structure, enrich social practice, strengthen ability training, and strive to improve student's learning ability, practical ability, and innovation ability.

Innovation is the soul of a nation's survival and development. The cultivation of innovative talents is the strategic goal of education in China. Cultivating students' ability to think independently and study independently is not only the goal of independent learning but also the basis of innovative thinking. Therefore, independent learning is the way and guarantee to cultivate innovative talents, and independent learning ability is an essential embodiment of students ' innovative literacy [1].

1.1.2. The Advantages of Relying on Information Technology Courses for Independent Learning

The advantages of independent learning in information technology courses in high school are as follows: (1) The highly operational learning content improves students' initiative; (2) The support of modern information technology has laid a solid foundation for students' independent learning. Therefore, the interactive, friendly, and open practical environment of information technology creates a learning situation conducive to independent and collaborative learning for students. Organize and guide students to actively explore and think in computer practice activities, give full play to students' subjective initiative, stimulate their imagination, creativity, and interest in learning, and help them take the initiative to construct a knowledge structure [2].

1.2. Research Objectives

Through literature review, determine the current situation, theoretical basis, and evaluation methods of independent learning. Construct the independent learning model of information technology curriculum in senior high school at the theoretical level. On the practical level, the teaching design of the information technology curriculum in senior high school is carried out, and the independent learning mode teaching experiment is conducted based on the "Multimedia Technology" module. Analyze students' ability changes in seven aspects: learning motivation, learning time, learning methods, learning results, learning environment, learning process, and learning content, as well as students' classroom performance and final work scores to verify the effectiveness of the teaching model.

2. Literature Review

2.1. Concept Definition

Regarding the meaning of independent learning, different scholars have different priorities. Yu Wensen believes that independent learning refers to students who dominate their learning and is a learning method that is opposed to other main learning [3]. Dong Qi believes that independent learning is characterized by initiative, feedback, regulation, Mobility, and effectiveness [4]. Xu J. F proposes that independent learning ability should include five aspects: one is to understand the teacher's teaching goals and requirements; the second is to formulate learning goals and formulate learning plans; the third is to use learning strategies effectively; the fourth is to monitor the use of learning strategies, and the fifth is to evaluate the entire learning process [5]. Mubashra believes that independent learning refers to the ability of individuals to actively regulate their learning without seeking the help of others [6].

This study is based on the definition of scholar Pang Weiguo: Independent learning is the ability of individuals to consciously determine learning goals, formulate learning plans, choose learning methods, monitor the learning process, and evaluate learning results [7].

2.2. Research Status

2.2.1. Development Status of Independent Learning

(i). Foreign research

Foreign educators have done much research on independent learning. Before the 20th century, the thought of independent learning was at the level of theoretical speculation. Experimentalism emerged at the beginning of the 20th century, such as Dewey's "learning by doing" and Skinner's teaching procedures. In the 1960s, different schools appeared abroad, among which humanistic theory advocated a "student-centered" organization of teaching to cultivate students' independence, autonomy, and creativity. From the perspective of interaction among individuals, behavior, and environment, the social cognitive theory holds that independent learning is determined by instincts, needs, drives, and characteristics within the individual. Will theory believes that independent learning is a process of will control, and the will component controls people's learning behavior. Cognitive constructivism theory considers independent learning as metacognitively monitored learning, a process in which learners actively adjust their learning strategies according to their learning abilities [8].

Various theoretical schools of independent learning have conducted systematic and in-depth research on independent learning. The corresponding teaching models have been developed, such as interactive teaching and cooperative learning oriented towards social interpersonal interaction [9], scaffolding teaching and anchoring teaching oriented by meaning construction, and an independent learning cycle model oriented to self-regulation [10].

(ii). Domestic research

The research on independent learning in China first began in the pre-Qin Dynasty. In the early 20th century, China's independent learning entered the preliminary experimental stage. Mr. Cai Yuanpei proposed the educational method of "focusing on inspiring students so that they can study automatically." Furthermore, Systematic teaching methods such as the Dalton plan, Winnetka Plan, and design pedagogy have been introduced one after another; In the mid-20th century, the "Kirov Five-stage pedagogy" and "Procedural pedagogy" were introduced. In the late 1970s, teaching experiments to guide students' independent learning emerged: as summarized by Duan Lipei and others, "Reading, discussing, practicing, and speaking" Eight-character pedagogy [11]. Qiu Xuehua's "Experimental pedagogy" [12]. Lu Zhongheng's "Self-study tutoring Teaching" [13]. Wei Shusheng's "Six-step pedagogy" [14]. Independent learning has entered a systematic research stage with both theory and experiment; After the 1990s, the concept of independent learning was put forward based on inheriting the ancient thought of independent learning and drawing on foreign theories of independent learning.

With the development of modern information technology, several scholars have conducted corresponding research on the classroom teaching model of information technology: Wu Aiping tried the application of the dominant—subject

teaching model in the classroom teaching of information technology [15], Song Tianming divided the scaffolding teaching model into six steps: build a "scaffold," ask scientific questions, the direction of student inquiry, experimental measurement data, discussion and exchange, conclusions and evaluation [16]. Based on constructivist learning theory, Huang Yebin divided the task-driven model into five links: Creating Situations, independent learning, collaborative learning, effect evaluation, and meaning construction [17].

2.2.2. Independent Learning Evaluation Techniques

Traditional methods of assessing students' abilities include exams and quizzes, but this method is considered an external assessment of students. With further emphasis on student independence and autonomy, student-centered forms of internal assessment have emerged, namely self-assessment and peer assessment. Moreover, Lou Ho-Ying's study further confirmed the relationship between self-assessment, peer assessment, and the development of independent learning ability [18]. Later, Pang Weiguo divided the evaluation of independent learning into two categories based on the orientation of foreign evaluation: one is to regard independent learning as an ability, and the measurement methods include questionnaires, interviews, and teacher ratings; the other is to regard independent learning as a learning activity, and the measurement methods include think-aloud assessment, error detection, trace analysis and behavior observation. Based on this, the researchers have also developed assessment tools for independent learning accordingly: the "Independent Learning Questionnaire for Secondary School Students" by Shan Zhiyan [19], the "Independent Learning Interview Form" by Zimmerman, and the "Learning Autonomy Scale" by Pang Weiguo [7].

This study is based on the measurement of independent learning as an ability and chooses Pang Wei-Guo's "Learning Autonomy Scale " as the measurement tool.

3. Research Design

3.1. Research Preparation

3.1.1. Selection of Research Objects

In this study, two parallel classes in the senior class of Beijing A High School were selected as the research objects, including 39 students in Class 7 as the control class and 38 students in Class 8 as the experimental class. The experimental class received training in the independent learning teaching mode, while the control class remained traditional teaching mode. The independent variable was the independent teaching mode, and the dependent variables were the student's autonomy scale scores and the final work grades.

3.1.2. Control of the Research Process

To ensure that the entire research process was based on strict design and control, the following conditions were met in the selection of experimental and control classes:

First, to ensure that the knowledge base of the two classes was similar, this study conducted an independent sample t-test based on the student's final examination scores of the previous

semester during the pre-test. As shown in Table 1, the probability value of the mean test between the experimental class and the control class scores on the student's final examination scores was 0.998, which was greater than 0.05, confirming that there was no statistically significant difference in the level of prior knowledge between the two classes.

Table 1. *Independent sample T-test results of the final examination scores in the previous semester between the experimental class and control class.*

Dimension	Levene Test of Variance Equation		T-test of the mean equation
	F	Sig.	Sig. (2-tailed)
Final examination scores	3.390	.069	.988

Second, to ensure that the two classes were close in their independent learning ability, an independent sample t-test was carried out on the pre-test data of the experimental class and control class on the seven dimensions of learning autonomy, as shown in Table 2.

The probability values tested on the seven dimensions of learning motivation, learning content, learning time, learning process, learning environment, learning method, and learning results were all greater than 0.05, indicating that there was no statistical significance in the level of autonomy between the control class and the experimental class, and comparative experiments can be carried out.

Table 2. *Independent sample T-test of pre-test scores between experimental class and control class.*

Dimension	Levene Test of Variance Equation		T-test of the mean equation
	F	Sig.	Sig. (2-tailed)
Learning motivation	.113	.737	.745
Learning content	.018	.892	.901
Learning time	.000	.991	.994
Learning process	.056	.814	.817
Learning results	.041	.840	.849
Learning environment	.033	.857	.865
Learning methods	.058	.810	.819

Finally, this study ensured that the instructor, lecture content, and lecture length were the same for both classes. This comparison experiment was concealed from the students in both classes to ensure that irrelevant factors did not influence the experimental process and effects.

3.2. Research Process

Concerning how to apply the independent teaching model and how to conduct teaching evaluation in information technology courses, this study developed the following operational procedures:

First, combining the course content and the characteristics of students' cognitive structure, learning motivation, and learning style, design a teaching model to promote students' independent development, the corresponding teaching plan, teaching content, group cooperation activities, and evaluation methods.

Second, a comparison experiment was carried out in which the experimental class received the independent teaching model, five students were selected as cases based on their pre-test

scores, and the teacher entered the information technology classroom teaching site to collect the classroom performance of

the cases and conducted interviews after the class. The control class maintained the traditional teaching model.
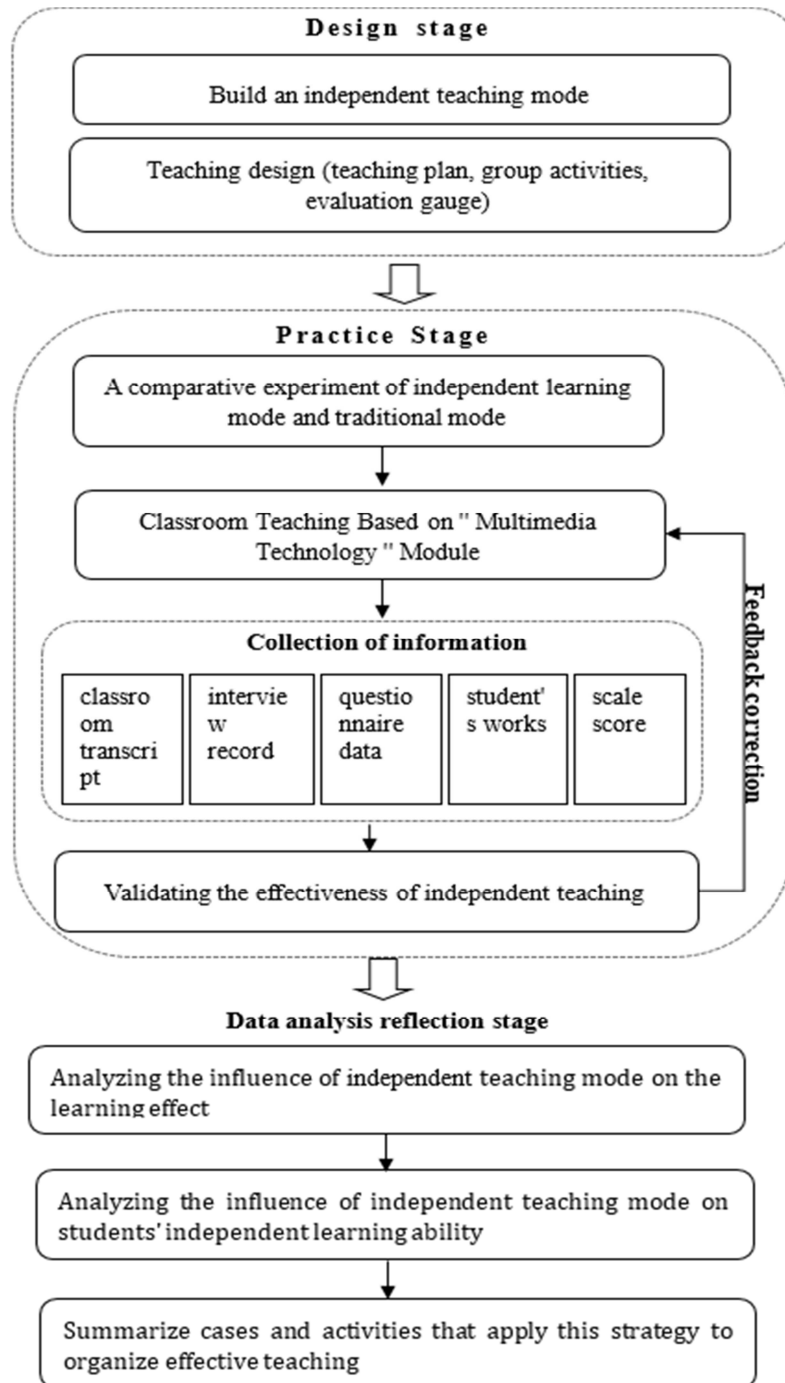

Figure 1. *Research process.*

Finally, the scale was used to obtain objective data on the level of student's independent learning, and the subjective experience of learners on the independent teaching model was obtained utilizing questionnaires, interviews, and classroom observations. Students' works in the independent teaching model and traditional mode were collected and rated as objective data for evaluating the learning effect to verify the effectiveness of the independent teaching mode. If the practical effect of the mode does not meet the expectation, the

reasons need to be found and improved. As shown in Figure 1 is the operation process.

3.3. Design of Research Tools

The independent learning scale was used to obtain objective data on high school students' independent learning levels. A classroom observation scale was designed to record students' activities in natural classroom situations. An interview outline

was designed to understand students' subjective experience of the independent teaching model. a self-designed questionnaire was used to obtain students' views on the independent teaching model for subsequent improvement of teaching.

3.3.1. Learning Autonomy Scale

The study used Pang Wei-Guo's "Learning Autonomy Scale," which measured students' levels of independent learning around seven dimensions: learning motivation, learning content, learning time, learning process, learning methods, learning results, and learning environment. Several scholars have verified the scale's reliability and validity, as shown in Table 3 for the specific content design.

Table 3. Scale design.

Dimension	Content Design	Total
Learning motivation	Initiative consciousness: the aspiration to actively require learning Values: the value assigned to learning activities and outcomes Self-efficacy: the degree of confidence in completing learning tasks Interest in learning.	22
Learning methods	Preview Strategy: knowledge and psychological preparation before learning Assistive Learning Strategy: Consciously use assistive technology to help oneself learn Organizational Strategy: build internal connections between new knowledge to make information easy to receive Finishing Strategy: Establishing connections between old and new knowledge to enhance understanding of new knowledge Review and Examination Strategy: review, test preparation, and test-taking strategies Extracurricular learning strategy: learning content outside the curriculum	12
Learning time	Time Plan: Reasonable Arrangement of Time Time management: monitoring learning time according to learning plans	11
Learning results	Self-checking: Check your work for accuracy Self-summary: A phased overview of learning progress Self-evaluation: judging whether learning has achieved its goals Self-reinforcement: self-reward and punishment for learning results	29
Learning environment	Create a material environment: creating material conditions conducive to learning Create a social environment: taking advantage of social conditions conducive to learning	17
Learning content	Learning content selection: Choose learning content Goal setting: determine learning goals and standards	9
Learning process	Overcoming physical and mental disorders: Using personal will to overcome distractions in the learning Self-monitoring of the learning process: monitoring the learning process	13

3.3.2. Classroom Observation Scale

The classroom performance of five cases was observed, and the classroom behaviors of the cases were described with commentary, as shown in Table 4.

Table 4. Classroom Observation Scale.

Time	Location		Topics		
Behavior Category	Teacher explanation☐ Student explanation☐ Teacher-student interaction☐ Group discussion☐ Student self-study☐				
Case	**Process Description**		**Performance Status**	**Effectiveness evaluation**	
S1					
S2					
S3					
S4					
S5					

3.3.3. Interview Outline

The semi-structured interviews were used to focus on the subjective experiences of the five cases with the independent teaching model, as shown in Table 5.

Table 5. Interview outline.

Question item
1. Do you think learning is a happy thing?
2. What troubles have you encountered in the learning process, and how did you solve them?
3. Can your homework be completed on time?
4. What is your motivation for learning?
5. How do you arrange the time and order of each subject?
6. Do you preview before class, and what is the reason?
7. Don't you do anything irrelevant to the teaching content in the information technology classroom?
8. Please make some suggestions to the teacher in class.

3.3.4. Self-designed Questionnaire

The questionnaire was used to investigate the students' views in the experimental class on the independent teaching model. The

questions focused on students' gains, difficulties, and feelings in the process of teaching practice, as shown in Table 6.

Table 6. Questionnaire questions.

Question item
Do you think the information technology course is helpful for the development of your independent learning ability?
What is your confusion in the process of independent learning?
Are you satisfied with your current learning state? What are the reasons?
What do you think are the effective learning method?
Whether you adapt to group collaborative learning, what are the reasons?
Please put forward some suggestions for the teacher's teaching method.

4. Teaching Practice

In order to explore the cultivation of independent learning ability based on information technology courses, this study chose the "Multimedia Technology" module, which is more interesting, rich in internal logic, and convenient to collaborate in groups as the teaching practice base. Moreover, it explored a new teaching model for cultivating independent learning ability based on the teaching practice activities of the "Multimedia Technology" curriculum.

4.1. Instructional Design

4.1.1. Course Objectives

The information technology course applying the independent teaching model has the following goals for the development of students' core literacy: to cultivate students' computational thinking and innovative consciousness; to help students acquire independent learning ability by promoting independent learning through teacher-student interaction, conducting self-regulated learning in the learning process, and completing independent learning through group cooperation; and to develop students' awareness of sensitively perceiving information and complying with the norms of the digital environment.

4.1.2. Teaching Plan

The schedule of this course is shown in Table 7.

Table 7. Teaching plan.

Weekly	Remarks
Week 1 Understanding Multimedia Technology	
Week 2 Multimedia work design	Gathering
Week 3 Mind Map Planning Multimedia Works	Materials
Week 4-6 Picture material processing (front cover, back cover, background design, and picture material processing)	Improving the program
Week 7 Catalogue and navigation creation	
Week 8 Video Acquisition	
Weeks 9-11 Video Processing	Doing works
Week 12 PPT technology	Composite works
Week 13-18 Flash animation Production	Complete the short film

4.1.3. Teaching Model Design

(i). Basic process

This study constructed an independent teaching model based on the "attempt teaching method" in the context of an information technology curriculum, as shown in Figure 2.
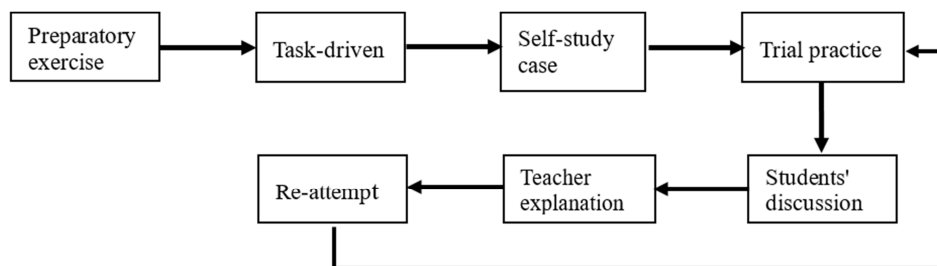

Figure 2. A new teaching model for the cultivation of independent learning ability.

Preparatory exercises: Students perform preparatory exercises on the knowledge needed to solve problems, facilitating the migration of old knowledge and the assimilation of new knowledge.

Task-driven: The teacher creates a learning environment related to the learning topic and implicitly includes new knowledge in the task, and students need to analyze and discuss the task.

Self-study case: The teacher provides information about the task to be solved by students and guides them to explore the solution by self-study the case. After students have a general solution for the task to be solved, students enter the next step.

Trial practice: Students try to solve the problem independently and continue to read the study plan when they encounter difficulties. Teachers patrol to get feedback on students' practice and provide individual counseling for students with difficulties.

Student discussion: The teacher guides students in discussing the different results of the exercise.

Teacher explanation: The teacher explains the difficult teaching points and the knowledge that the students are confused about.

Re-attempt: Students get feedback to correct errors after discussion and explanation and try again for testing.

(ii). Group collaboration

Using appropriate monitoring methods to prompt students to carry out group collaboration enables the sharing and exchanging of knowledge resources, makes learning more autonomous and equal, and stimulates students' consciousness and initiative in learning. It enables students to dialectically view the answers to problems from different perspectives, which are complementary to advantages. Promote the internalization and development of students' independent learning abilities [20].

In the organization of group activities guided by collaborative learning theory, students are divided into groups based on course content, students' ability level, and the number of people required for the task. Members of each group have a clear division of labor, share resources, and work collaboratively. Completing the tasks they undertake through independent learning ensures the completion of the whole group task; the collaboration results are presented, and the group collaboration is evaluated in all aspects [21].

4.2. Teaching Plan and Implementation

This study involved a total of 12 cases and 17 weeks of lessons, and due to the length of the thesis, only one of them will be briefly described to present the study's overview fully. In this section, we will take "My Template I Make - Try to Make a PowerPoint Personality Template" as an example and briefly explain the specific process of the teaching process.

4.2.1. Teaching Content and Critical Steps

The teaching content and critical steps of the course "My Template I Make - Try to Make a PowerPoint Personality Template " are shown in Table 8.

Table 8. Teaching Process of "Try to Make PowerPoint Personality Template".

Stage of teaching	Teacher activities	Student Activities	Intention	Time: min
Create situations, Introduce new lessons	Comparing the PPT works of different students, it was found that the styles of the works with their templates are the same, and the works with self-made templates highlight the theme and lead to the advantages of making personalized templates.	Watch, think	Stimulate interest in production	2
Preparation exercise	Ask students' understanding of PPT templates, Enable students to experience PPT with its template	Answer, experience	Prepare for students ' practice	5
Self-study Program	Provide a thematic learning website	Self-study on the website	Exercise independent learning ability	5
Task-driven Try the exercise	Task: Complete the personalized template design Task one: Enter the slide master view Insert the title slide master Task two: Title master slide plus background base map Content master slides plus background base map Task three: Set the title format Insert the icon in the material folder into the ' Title Slide Master.' Optional: Set dynamic effects for templates Task four: Save and apply the template 1. Save: File saved as. pot format, the default path 2. Apply: After closing and reopening PowerPoint, find it in Format—Slide design and click Apply	Conceived around the theme. Master the steps Complete task One Complete task Two Complete task Three Complete task Four Check, modify and improve.	Guide students to complete the personalized template design. Task hierarchy	15
Student discussion, Teacher explanation	Show students common questions and focus on answering questions and explaining.	Raise confusion	Express opinions Deepen understanding	5
Exhibition works, Communication evaluation	Please encourage students to display their work and guide students to evaluate each other.	Display works, Mutual evaluation, Modified and improved	Inter-group interaction	10
Expand and improve	Recommend websites to encourage students to apply what they have learned	Extracurricular application	Expand knowledge	3

4.2.2. Organization of Group Collaboration Activities

(i). Process arrangement of group activities

The study took the teaching process of the Flash animation short film as an example to show the independent learning model based on group cooperation in the information technology classroom. The schedule is shown in Table 9.

Table 9. Schedule.

Stage	Task
Week 1	Member assignments based on different learning abilities, the 4-person group selected group leader. Each group determines the theme and assigns tasks within the group.
Week 2-5	Collect and organize materials, make scripts, and discuss the production.
Week 6	Perfect, display, and evaluate works. Put forward suggestions for improvement and optimization.

(ii). Teaching process of group activities

The design of the group teaching process is shown in Table 10.

Table 10. *Teaching Process.*

stage of teaching	Teacher activities	Student Activities	Intention	Class Time
Create situations, Introduce new lessons	The teacher showed the commercial FAMILY, informed the students that Flash made it, and asked what other Flash clips were available.	Observe and brainstorm	Stimulate students' interest	
Preparation exercise	The teacher guides students through a review of motion interpolation, masking, frame-by-frame animation, and analysis of Flash techniques in short films.	Reviewing what they have learned	Reviewing old knowledge and brainstorming	1
Task-driven	Assign tasks and customize the theme (public welfare short story), Clear requirements, division of labor, and cooperation	Discuss topics and divide labor rationally	Guide students to operate	
Independent learning	Guide students to use online resources to learn	Learn how to make animations	Exercise independent learning skills	
Try the exercise	Organizing groups of students to produce works	Conceive the work, determine the script, assign tasks, collect materials, and produce content	Collaborate in groups to complete tasks	4
Student discussion, Teacher explanation	Observe and inspect the production process of students, guide students to think and discuss, explain Important and difficult knowledge and typical errors	Thinking, Operation	Practice before lecture Lecture at the critical point	
Exhibition works, Communication evaluation	Encourage students to show and guide students to evaluate each other	Showing work and exchanging methodological skills	Feedback on completion	1
Improve and perfect	Guiding students to improve their work	Refining work based on evaluation	Developing self-adjustment skills	

4.3. Evaluation of Teaching Effectiveness

4.3.1. Evaluation of Student-Oriented Works

Based on the evaluation form for electronic newspapers in the textbook "Fundamentals of Information Technology," the evaluation forms were created for students' newspaper and multimedia works, as shown in Table 11.

Table 11. *Evaluation Form of Newspaper Works.*

Evaluation Criteria	Evaluation Indicators	Weight	Sub-total	Total Score	Grade: Excell.>=90, Good>=80, Pass>=60, Poor<59	Comments
Thoughtfulness Scientific (28 points)	Clear theme and positive content	7				
	Can express the theme idea completely	7				
	The content is realistic	7				
	Smooth content	7				
	Material acquisition and processing are original	10				
Creativity (27 points)	Imagination and individual expression	7				
	The original design of content and structure	5				
	Novel expressions and clever ideas	5				
	The layout design is lively, and the style of each page is harmonious,	7				
Artistry (25 points)	Reasonable layout design and proper color application	7				
	Illustrated and legible	7				
	Have a specific aesthetic ability	4				
Technicality (20 points)	Appropriate production tools and production techniques	7				
	Accurate, appropriate and concise use of technology	7				
	Include all elements of the newspaper	6				

The evaluation indicators of multimedia and newspaper works differ only in "artistry" and "technicality." The "artistry" of multimedia works was expressed in: the application of materials to express the theme (7), balanced overall layout (7), consistent page design and theme style (7), and specific aesthetic ability (4); the "technicality" was expressed in: the skillful production tools and techniques (7), smooth graphics and sound audio-visual effects (7),

reasonable interaction and accurate navigation links (6).

4.3.2. Evaluation of Group Activities

In the group communication and evaluation session, appropriate evaluation gauges, group self-assessment forms, and group mutual evaluation forms were designed to manage group activities, as shown in Table 12 - Table 14 below.

Table 12. Evaluation Gauges.

Assessment Project	Assessment Rules			Rating Standards	Sum mary	Total Score 40%
	excellent	commonly	fail			
Learning Performance	Active study, discipline (7-10)	Active learning, occasional indiscipline (3-6)	Not serious about learning Undisciplined (0-3)	10		
Material collection and utilization	Rich in materials, organized and processed for use (10-15)	More materials, less processed for direct use (5-10)	Few materials, temporary collection, and patchwork (0-5)	15		
Topics Content	The clear theme, rich content, and unique idea (10-15)	Clear theme, not rich enough content, some creativity (5-10)	The theme is not clear, content is empty (0-5)	15		
Animation background, Animation effect	Beautiful background, reasonable layout, smooth animation (10-15)	Ordinary background, average layout, not too smooth animation (5-10)	Messy background layout, not smooth animation (0-5)	15		
Animation performance, Music coordination, The Lens use	Various forms of expression, coordinated with music, smooth use of sub-cameras (13-20),	Monotonous form, less coordinated with music, slightly jerky use of sub-cameras (7-12)	Confusing music (0-6)	20		
Color Effect	Color harmony, in line with the theme (10-15)	Color more harmonious (5-10)	Color clutter (0-5)	15		
Work Efficiency	Better completion of the task within the specified time (7-10)	Completed within the specified time (3-6),	Not completed (0-3)	10		

Table 13. Group self-evaluation Form.

Assessment Items	Marking Criterion	Group Self-Evaluation (30%)							Subtotal	Total Score
		1	2	3	4	5	6	7		
Learning Performance	10									
Material collection and utilization	15									
Topics, Content	15									
Animation background, Animation effect	15									
Animation performance, Music coordination, The Lens use	20									
Color Effect	15									
Work Efficiency	10									

Table 14. Group Mutual Evaluation Form.

Group	1	2	3	4	5	6	7	Mean (30%)
1								
2								
3								
4								
5								
6								
7								

4.3.3. Evaluation of Student-Oriented Independent Learning Ability

This study will make use of the research tools predetermined in 3.3, interspersed with various tools in the research process, and collect data from different dimensions in the process of actual teaching practice to measure the development of student-oriented independent learning ability. Try to obtain research data with guaranteed reliability and high validity.

5. Research Results and Discussion

The success or failure of pedagogical research aimed at fostering the development of students' independent learning ability is mainly reflected in two aspects. First, whether the new pedagogical model has achieved the expected research goal of promoting the development of student's independent learning ability; second, whether the research has promoted the improvement of teaching quality and enabled students to improve their knowledge and skills. Therefore, this study will analyze the quality of the research from the two dimensions of knowledge and skills objectives and the development of independent learning ability.

5.1. The Influence of Independent Teaching Mode on the Learning Effect

The results of students' works under the independent and traditional teaching modes were calculated based on the evaluation indicators of newspaper and multimedia works as objective data to evaluate the learning effectiveness, as shown in Table 15 below.

Table 15. Results of Students' Work in Two Groups of Pre-test and Post-test.

Group	At the end of last semester		At the end of this semester	
	Mean value	Total score	Mean value	Total score
Experimental group	79	3064	85	3390
Control group	78	3139	77	3066

The paired sample t-test was conducted on the pre-test and post-test work scores of the experimental and control groups, as shown in Table 16: the probability values of the work score tests of the experimental and control groups were 0.182 and

0.597, respectively, which were greater than 0.05, indicating that there was no significant difference between the work scores of the experimental and control groups before and after the experiment.

Further, the change trend chart of the experimental and control group's pre-test and post-test mean values were made, as shown in Figure 3. After the experiment, the scores of the experimental group showed an upward trend, while those of the control group showed a downward trend.

Table 16. *Two Groups of Pre-test and Post-test Works: Paired Sample T-test.*

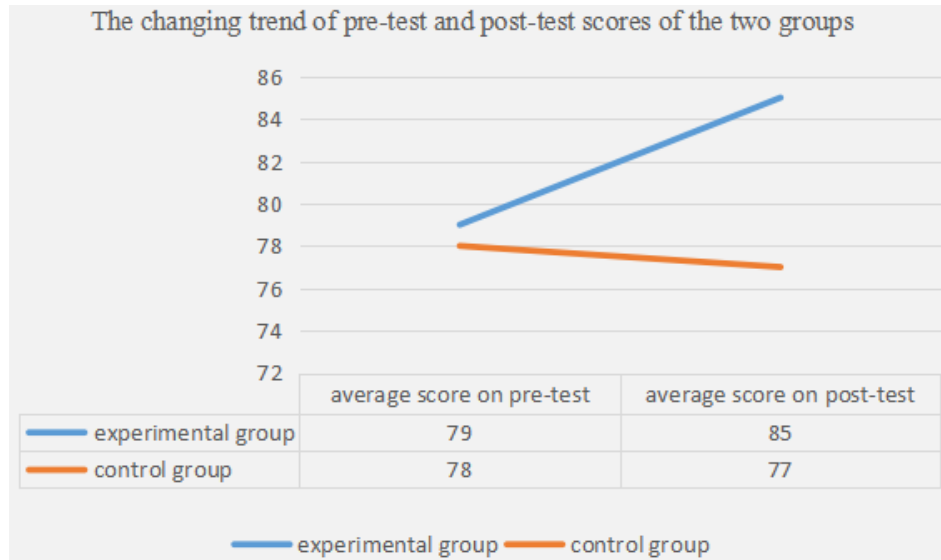| Group	Dimension	Mean value	Standard deviation	df	Sig. (2-tailed)
Pair 1	achievement	-5.92500	27.54706	39	.182
Pair 2	achievement	1.84615	21.61936	38	.597

Figure 3. *The changing trend of pre-test and post-test scores of the two groups.*

5.2. The Influence of Independent Teaching Mode on Students' Independent Learning Ability

To verify whether the independent teaching mode can promote the development of students' independent ability in a statistically significant way and to conduct a comparative analysis and T-test on the pre-test and post-test scores of the students' independent scale in the experimental class and the control class.

5.2.1. Pre-test and Post-test Comparison of Two Groups in Seven Dimensions

The mean values of pre-test and post-test scores of the experimental and control groups in the seven dimensions of learning motivation, learning time, learning methods, learning results, learning environment, learning process, and learning content were respectively made into trend analysis graphs shown in Figure 4-Figure 10.
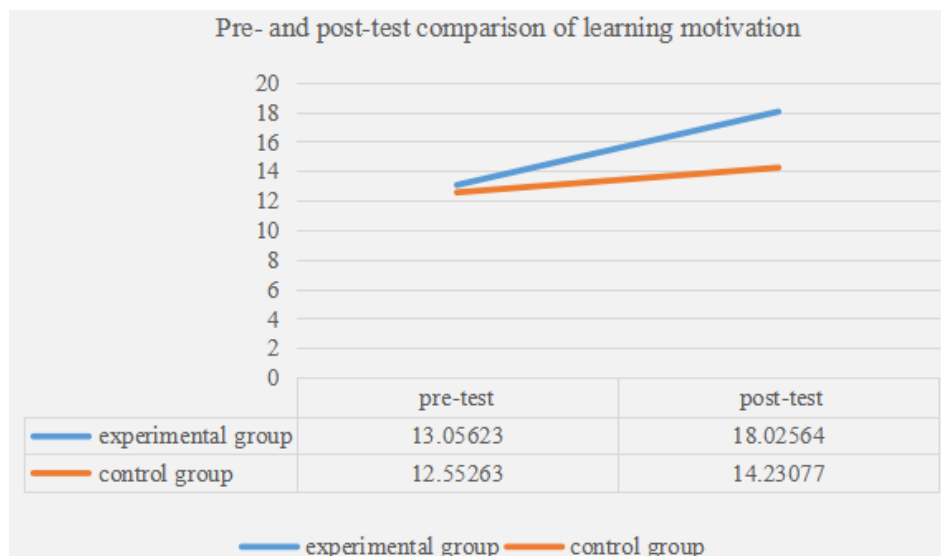

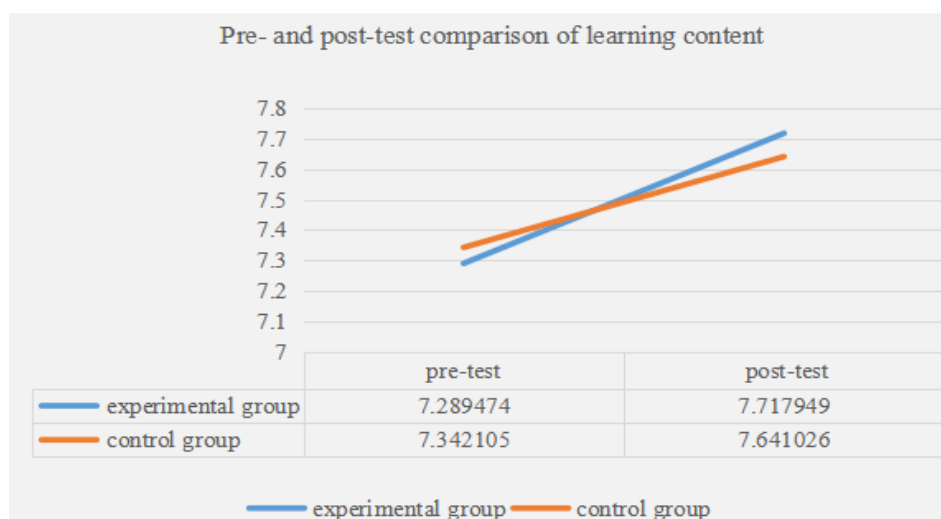Figure 4. *Comparison of learning motivation.*
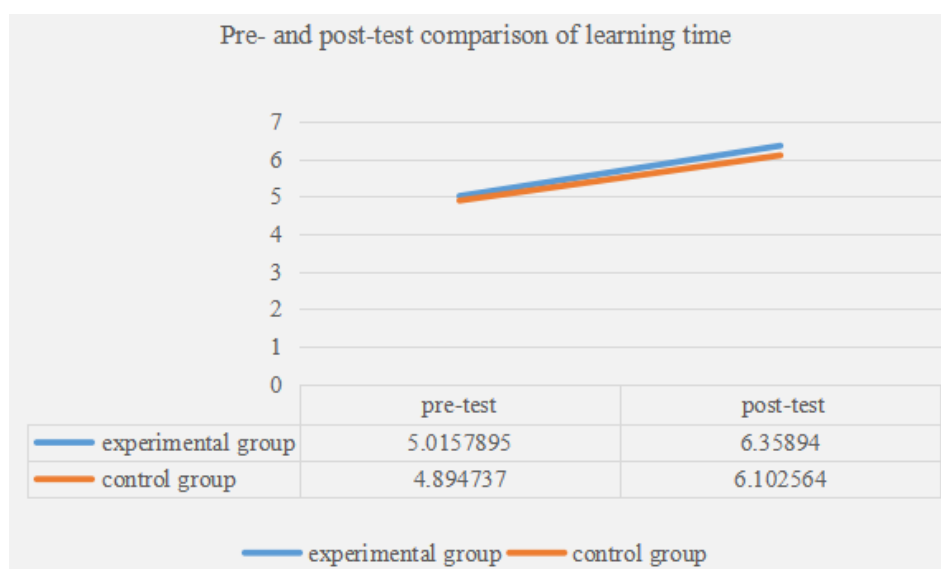
Figure 5. *Comparison of learning content.*
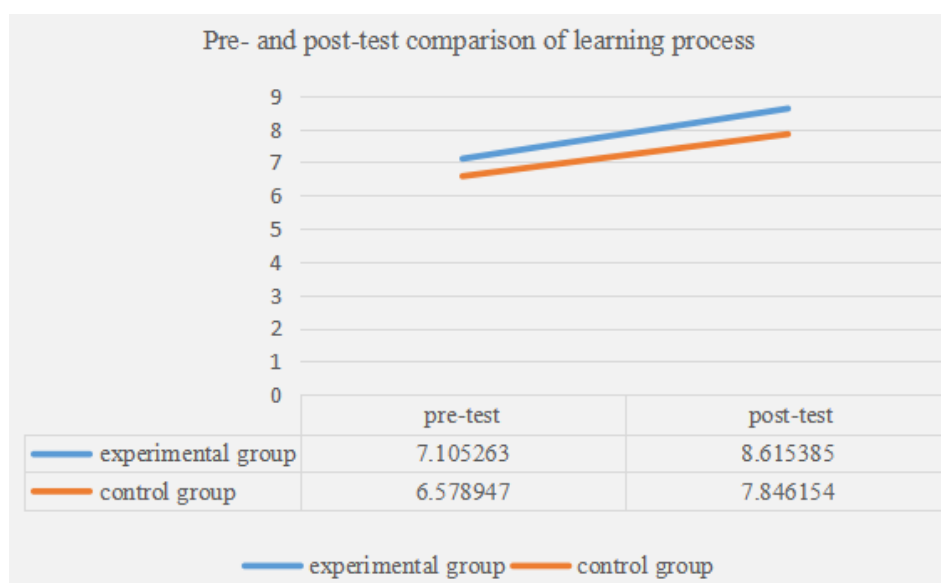

Figure 6. *Comparison of learning time.*
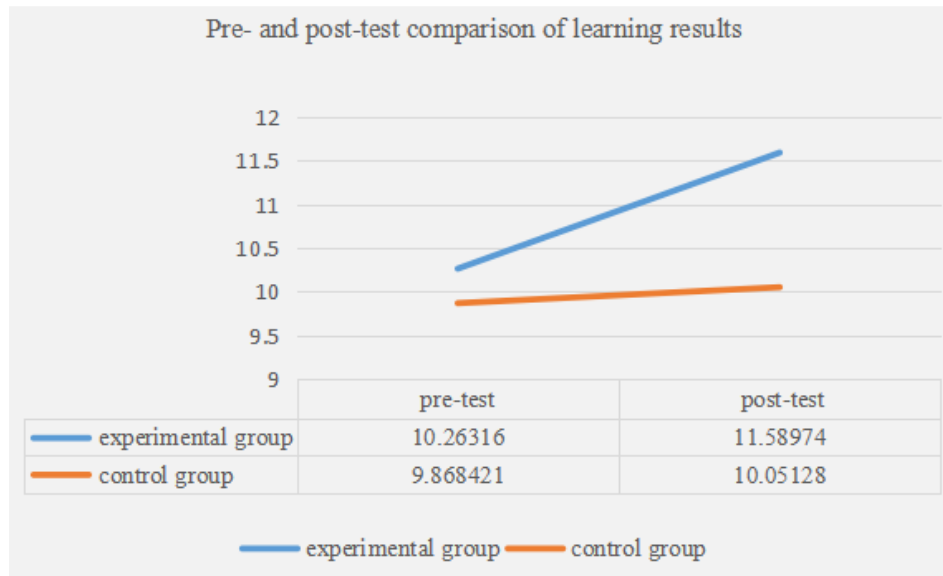

Figure 7. *Comparison of the learning process.*

Pre- and post-test comparison of learning results

	pre-test	post-test
experimental group	10.26316	11.58974
control group	9.868421	10.05128

Figure 8. *Comparison of learning results.*

Pre- and post-test comparison of learning process

	pre-test	post-test
experimental group	6.447368	7.051282
control group	6.289474	6.666667

Figure 9. *Comparison of the learning process.*

Pre- and post-test comparison of learning methods

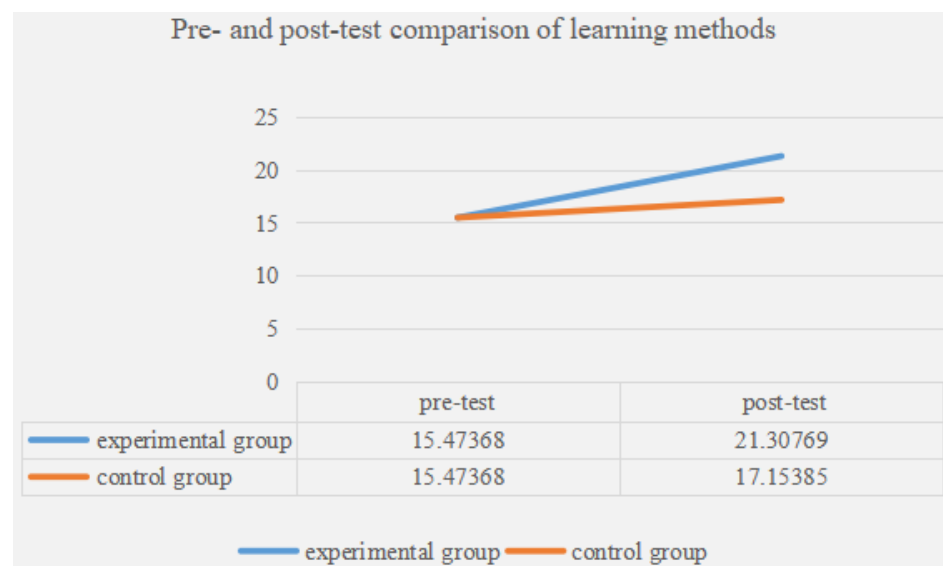|	pre-test	post-test
experimental group	15.47368	21.30769
control group	15.47368	17.15385

Figure 10. *Comparison of learning methods.*

As shown in the figure: the mean values of the seven dimensions of learning motivation, learning content, learning time, learning process, learning results, learning environment, and learning methods in the experimental group showed an increasing trend, but the magnitude changes were different, and the increase was significant in three dimensions of learning motivation, learning result and learning method. The control group showed an increasing trend in seven dimensions, but none of the changes in magnitude reached the significance level, nor were they as significant as the experimental group.

5.2.2. Paired Sample T-test of Pre-test and Post-test Scores of Two Groups

First, the pre-test and post-test scores of the experimental group were made into a paired sample T-test, as shown in Table 17. The probability values of the experimental class in the dimensions of learning motivation, learning results, and learning methods were 0.002, 0.001, and 0.002, which were less than 0.05, indicating that there were significant differences between the learning motivation, results, and methods of the experimental class before and after teaching practice. However, the probability values of the four dimensions of learning content, learning time, learning process, and learning environment were more than 0.05, indicating no significant differences in learning content, time, process, and environment before and after teaching practice.

Table 17. Paired sample T-test before and after the experimental class.

Group	Dimension	Mean value	Standard deviation	df	Sig. (2-tailed)
Pair 1	learning motivation	-6.92308	13.05532	38	.002**
Pair 2	Learning content	-.92308	3.51227	38	.109
Pair 3	Learning time	-2.48718	8.22663	38	.067
Pair 4	learning process	-2.84615	9.39075	38	.066
Pair 5	Learning results	-1.74359	3.00629	38	.001***
Pair 6	learning environment	-1.10256	3.77523	38	.076
Pair 7	learning method	-7.61538	14.66219	38	.002**

Secondly, the pre-test and post-test scores of the control class were made into a pair sample T-test. The test probability values of the students in the seven dimensions were more than 0.05, indicating no significant difference in the independent learning ability of the control class before and after teaching practice.

5.2.3. Independent Sample T-test Between Two Groups of Post-test Data

Considering that the improvement of students' autonomy may be due to the natural growth during learning, the experimental and control classes' post-test data on the seven dimensions of learning autonomy were tested using to independent sample T-test. The results are shown in Table 18: the probability values of the two teaching classes in the dimensions of learning motivation, learning results, and learning methods were 0.000, 0.005, and 0.000, respectively, which were less than 0.05, indicating that the learning motivation, learning results, learning method of the experimental and control classes had produced the significant difference before and after the teaching practice; However, the probability values of the test in the dimensions of learning content, time, process and environment were all greater than 0.05, indicating that there were no significant differences between the two classes in learning content, time, process and environment before and after the experiment.

Table 18. Independent sample T-test of two groups of post-test data.

Dimension	Levene Test of Variance Equation		T-test of the mean value equation
	F	Sig.	Sig. (2-tailed)
Learning motivation	11.149	.001	.000***
Learning content	5.975	.017	.814
Learning time	8.512	.005	.441
Learning process	11.000	.001	.105
Learning results	.027	.870	.005**
Learning environment	.850	.360	.416
Learning methods	2.622	.110	.000***

It can be concluded that applying an independent teaching mode can increase students' sense of self-efficacy, learning interest, and initiative in the experimental class. Applying the developed learning strategies in the actual learning situation deepened students' learning and achieved good learning results.

5.3. The Influence of Independent Teaching Mode on Case Students

In order to explore the influence of independent teaching

mode on case students, the pre-test and post-test scores, interview transcripts, and classroom observation scales were analyzed for the five case students in the experimental group.

According to the comparison between the pre-test and post-test scores of the case students, as shown in Table 19. the scores of the seven dimensions and the total scores of the case S1, S2, S4, and S5 in the independent learning ability had improved, indicating that the independent learning ability of

the case students had been improved to varying degrees through the teaching activities of the information technology independent learning model. Among them, S1 had the fastest growth in the dimension of learning methods, and the corresponding total score had also increased rapidly, which showed that S1 had mastered effective independent learning methods, and its learning effect was good.

Table 19. Comparison of pre-test and post-test scores of case students.

Student	Learning motivation		Learning content		Learning time		Learning process		Learning result		Learning environment		Learning method		Total score	
	before	after	before	after	before	after	before	after	before	after	before	after	before	after	before	after
S1	14	15	9	9	7	9	7	8	10	11	6	7	13	20	66	79
S2	20	21	9	9	9	9	12	13	8	14	6	8	24	25	88	89
S3	21	21	11	11	10	10	13	13	15	15	8	8	29	29	107	107
S4	12	15	8	7	7	8	10	11	11	13	8	8	17	20	73	82
S5	17	19	10	11	8	10	11	12	15	15	8	8	23	23	92	98

Based on the classroom observations of the case students, it was found that S3 was a good independent learner and good at allocating time. S5 was better at learning but lacked creativity. S2 was good at self-learning using learning plans and had a strong independent learning ability. S4 was poor at self-monitoring and lacked inquiry ability. S1 had poor study habits and self-control, which further illustrated that the student's classroom performance was consistent with their scores on the independent learning scale.

According to the interviews with the students, most of the students were interested in taking information technology courses. When they encounter difficulties in learning, they will first figure it out by themselves and then ask their classmates and teachers. Learning motivation came from the yearning for future career development and pursuing life values. The order of completing assignments tends to be accessible first and then challenging, and they will do the subjects they like first and then the ones they do not like. Most students think they will preview as long as they have time. Many students can control themselves and not do anything irrelevant to the teaching content when taking information technology courses.

5.4. Students' Perceptions of Teaching Information Technology in an Independent Learning Mode

A questionnaire was used to survey the students' opinions in the experimental group at the end of the course. The student responses were summarized and distilled as follows.

The gains in the learning process were manifested in: (1) mastering the learning methods; (2) realizing the internalization and transfer of knowledge; (3) increasing the ability to solve problems.

The confusion in the learning process was shown in (1) Unclear learning goals; (2) Strong dependence on learning; (3) Poor self-control; (4) Low learning quality and efficiency.

The views on teachers' teaching methods were as follows. Most students were satisfied with the teachers' teaching style, and the classroom learning atmosphere was good; Some

students suggested that teachers should appropriately increase the discussion time and give timely feedback and guidance to the problems.

In general, students in the experimental group believed that the information technology independent learning model could help students master independent learning methods and improve their problem-solving skills. However, there were still difficulties in time management and knowledge understanding.

5.5. Discussion

5.5.1. The Independent Teaching Mode Could Indeed Improve Students' Independent Learning Ability

The effect of independent teaching mode on students' independent learning ability showed that the implementation of independent teaching mode was more effective than the traditional teaching mode in the information technology courses of senior high school, and the independent learning ability of different students had been improved to varying degrees. In the teaching practice of independent teaching mode, the teaching effect was significantly improved through the design of key steps of teaching contents and the organization of group cooperation activities.

Firstly, the task-driven link in the independent teaching model greatly stimulated students' interest and initiative in learning; Secondly, the teacher encouraged and fed back the results of the students' trial practice, which fully improved the students' self-efficacy. Finally, re-attempt made students apply the formed learning strategies in actual learning situations, deepened students' knowledge learning, and achieved better learning effects.

In addition, in the independent teaching mode, the subjective role of students was the center. Teachers guide students. The subjective role of students was to achieve success through the transfer of old knowledge, the complementary role among students, and the auxiliary role of teaching methods. The multi-directional emotional role of teachers and students provided a good teaching context for the realization of the above factors. The following similar studies

also proved that the implementation of an independent teaching mode in information technology courses could improve the learning effect and promote the development of students' independent learning ability and collaboration abilities, which was consistent with the conclusions of this study [22].

5.5.2. Students' Group Collaboration Ability Was Improved Under the Independent Teaching Model

Guided by collaborative learning theory, this study showed the independent learning mode in the information technology classroom with group collaboration as the carrier. The members of each group had a clear division of labor and work collaboratively to complete their tasks through independent learning, which stimulated the students' learning consciousness and initiative, and promoted the internalization and development of students' independent learning ability.

In the group communication evaluation part of this study, we designed corresponding group self-evaluation forms and group mutual evaluation forms to manage group activities, which reflects the concept of diversification of evaluation methods under the new curriculum standards. Through these evaluation forms, students got better feedback on their knowledge and task completion. Students reflected on their strengths and weaknesses by comparing their evaluations and others' evaluation, which was conducive to adjusting their behavior and achieving teaching goals.

In the process of group collaboration, students not only realized the sharing and exchange of knowledge resources but also learned to dialectically view the answers to problems from different perspectives. In addition the impact of the independent teaching model on the learning effect, and again this showed that the model was conducive to promoting the development of students' knowledge and skills and improving the teaching effect.

6. Conclusions and Suggestions

6.1. Research Conclusion

This study constructed an independent learning model based on the information technology curriculum to cultivate students' independent learning ability development. The study confirmed that based on the new model oriented to independent learning, experimental class students had significant differences in learning motivation, learning results, and learning methods after the experiment, which indicated that the attempt to develop independent learning ability based on information technology courses was successful and effective.

In addition, the teaching practice proved that although there was no difference between the experimental and control classes' final scores before and after the experiment, there was a significant upward trend in the experimental group's grades. There was also a significant difference between the post-test data of the two, which fully proved that the integration of independent learning ability cultivation in information technology courses would not affect the teaching quality of information technology courses and could even promote the

teaching level of information technology courses. From the perspective of the learner cases, the independent learning ability of the case students had been improved to varying degrees through the implementation of teaching activities that emphasized the independent learning model.

In conclusion, the independent teaching model constructed based on this study was consistent with students' cognitive characteristics and learning needs, helped to improve students' independent learning ability, and had certain popularization and application values.

6.2. Suggestions

The development of students' independent learning abilities was a long-term process. Based on personal experience in this study, the author believed that developing independent learning abilities for high school students needs to be done in two ways.

First, cooperate with other discipline teachers to make long-term cooperation. The cultivation of students' independent learning abilities was a process of long-term practice in multiple disciplines. Thus the author suggested that it can be done from the perspectives of liberal arts and sciences, with science subjects being more practical, designing inquiry tasks for students, attaching importance to questioning teaching, and guiding students to verify independently [23]; and liberal arts subjects being highly theoretical, which creates contexts for students related to learning topics, attaches importance to experiential teaching, and creates a harmonious atmosphere of independent learning [24].

Second, we build a student-centered teaching model with integrated pre- and in-class sessions. The pre-class session can significantly exercise students' self-learning ability and push preview resources for students in layers. The students can independently verify, investigate, question, and discuss during class. After class, the teachers can assign personalized after-class consolidation programs for students and use diversified assessment methods [25].

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