Research on the Investigation and Cultivation Strategy of Freshmen's Autonomous Learning Ability

Xiulin Ma, Xue Jiang, Shumin Tian, Yujuan Jia

Faculty of Education, Beijing Normal University, Beijing, China
Email: maxl@bnu.edu.cn, jx19981115@163.com, t18139869165@163.com, jyujuan8807@163.com

Abstract

With the continuous development of lifelong learning trend of thought, in order to enable students to have the quality that matches the future education pattern, higher requirements are put forward for students' autonomous learning ability. Under the background of "Internet education", there are many learning resources with different quality. The level of students' autonomous learning ability affects their learning effect. This research adopts a qualitative and quantitative method to investigate freshmen's autonomous learning ability, deeply analyzes the influencing factors and specific attribution of freshmen's autonomous learning ability, and puts forward corresponding strategies for cultivating their autonomous learning ability, and then verifies it through teaching practice. The results show that students' autonomous learning ability is affected by cognitive style, time management and other factors, and the influence of students' learning attitude, learning motivation, concentration and other aspects on autonomous learning ability is unstable. When cultivating the ability of autonomous learning, we should pay attention to the relatively stable learning tendency, and cultivate the ability of autonomous learning from the stable learning characteristics of students.

Keywords

1. Introduction

1.1. Research Background

1.1.1. Inadaptability of Freshmen after Admission

Before and after 2021, the author served as a teaching assistant for two courses of the freshmen, named Fundamentals of Computer Application and Multimedia

Technology and Web Design. In the early days of being a teaching assistant, the author found many problems that some freshmen were difficult to adapt to the college classroom teaching mode, such as: 1) In computer classes, students were unwilling to actively think about the existing doubts, hoped that teachers would directly tell the answers, and lacked the awareness of self-searching problems and actively solving them; 2) They can't adapt to the large and extensive information in the university classroom, and can't know what to do when teachers do not lecture in full accordance with the textbooks; 3) There is little contact with hands-on courses, and they don't know how to operate during operation, so they have poor hands-on ability (Ao, 2020).

1.1.2. Attribution of Freshmen's Maladjustment

Through interviews with college freshmen and comparative analysis of the overall teaching in senior high schools and universities, the reasons for the above problems are mainly due to the great differences between college classrooms and senior high schools in terms of teaching objectives, teaching methods, learning environments, etc.:

1) Teaching objectives: In middle school, there is usually a clear teaching outline, and students' training objectives are mainly to master knowledge; In addition to the mastery of knowledge, the university stage has put forward requirements for the development of students' innovation ability, autonomous learning ability and other aspects.

2) Teaching methods and learning methods: During the middle school period, students were in a passive state of accepting knowledge, resulting in poor learning ability and self-discipline; At the university stage, learning mainly focuses on independent learning and personal discussion, which requires students to think independently and reduce their dependence on teachers.

3) Learning motivation and goal: The goal of middle school is to master the learning content, and most students' learning motivation needs to be maintained by external conditions; To enter the university, the learning motivation needs to be motivated by the students themselves, and the simple pursuit of examination results cannot meet the university's criteria for measuring outstanding students.

For a long time, the "spoon feeding education" in middle school has solved the problem of rapid knowledge acquisition to a certain extent, but has limited the development of students' autonomous learning ability. For freshmen, it is very important to explore the factors that affect their autonomous learning and formulate strategies to improve their autonomous learning ability.

1.1.3. Promoting College Students' Autonomous Learning Ability Is an Important Requirement for Talent Training

In August 2022, the Ministry of Education issued Several Opinions on Strengthening Organized Scientific Research in Colleges and Universities to Promote High level Self-reliance, emphasizing that colleges and universities should strengthen organized scientific research, comprehensively strengthen the construction of innovation system, and strive to improve students' independent innovation

ability. The cultivation of innovative talents and innovative ability has become the focus of social attention and the goal of school education, especially higher education (Cao, 2022). The ability of autonomous learning is the premise and foundation of innovation ability, which should be paid attention to by higher education. Therefore, it is an important task for higher education to cultivate high-quality talents with core competitiveness and improve the quality and level of education.

From the perspective of social development, the Internet provides a rich display platform for educational resources, and the number of resources is growing exponentially. Therefore, limited knowledge acquired only in schools cannot meet the requirements of contemporary society. People can only keep up with the pace of the times by continuing independent learning and updating their knowledge structure in time. "Lifelong learning" has become the consensus of contemporary society (Yang & Ren, 2022).

Therefore, whether from the perspective of national strategy or the trend of social development, college students' autonomous learning ability is increasingly important. And college freshmen are facing an important transition from high school to college. To help them improve their independent learning ability and adapt to the learning life of the university as soon as possible not only meets the basic requirements of the state for "innovative talents", but also helps students adapt to social development.

1.2. Research Questions

Based on the research background, the author chooses a combination of qualitative and quantitative methods to measure and attribute freshmen's autonomous learning ability, carry out theoretical research and teaching practice, and mainly focus on three aspects:

1) Finding problems: investigate the current situation of freshmen's autonomous learning ability, and conduct a more objective and comprehensive investigation in combination with questionnaires and interviews.

2) Analysis of problems: Through theoretical and data analysis, this paper discusses the reasons for the current situation of freshmen's autonomous learning ability, and lays a foundation for the formulation and implementation of strategies.

3) To solve the problem: formulate the cultivation strategy of freshmen's autonomous learning ability, and evaluate the cultivation strategy.

1.3. Summary

This research mainly adopts qualitative and quantitative methods to investigate freshmen's autonomous learning ability, deeply analyzes the influencing factors and specific attribution of freshmen's autonomous learning ability, puts forward corresponding strategies to cultivate freshmen's autonomous learning ability, and verifies the effectiveness of teaching strategies through teaching practice.

2. Literature Review

2.1. Research Status of Undergraduates' Autonomous Learning Ability

2.1.1. International Research on Autonomous Learning Ability

With the continuous development of lifelong learning trend of thought, the international research on autonomous learning ability has gradually deepened and matured. At the beginning of the 21st century, researchers mainly focus on how to cultivate autonomous learning ability. Della provides students with baseline data of autonomous learning tendency based on their relevant psychological characteristics to improve students' autonomous learning ability (Fazey & Fazey, 2001); Sabine Braun designs and uses small multimedia corpora for autonomous learning and teaching to help students learn independently (Braun, 2007); Catherine and Justine discussed how to develop a collaborative approach to enhance students' independent learning ability (Manathunga & Goozée, 2007).

Since the 1920s, researchers have gradually attached importance to the development of autonomous learning ability, and found that autonomous learning ability has an important impact on all aspects of students' learning, and the research on autonomous learning ability has reached a new level. Xiaorui designed a questionnaire on the influence of students' autonomous learning ability on online learning performance, and found that the preparation of autonomous learning ability, the preparation of goal plans, the use of learning content materials, the regulation of learning process, and the evaluation of learning effects had obvious effects on learning performance. The research results are of great significance to help students develop their autonomous learning ability and improve the effectiveness of teachers' guidance to students in the online learning environment (Ma, 2022). Khan and other scholars investigated the students' potential ability of autonomous learning practice in the process of implementing e-learning, and found that: the students participating in the research seem to have a clear view on the potential ability of autonomous learning; Feng Wei and other scholars have designed an online autonomous English learning efficiency evaluation model based on artificial neural network, which has improved students' learning efficiency.

2.1.2. Domestic Research on Autonomous Learning Ability

The research on autonomous learning ability in China is becoming more and more detailed. At the beginning of the 21st century, researchers paid attention to the cultivation of autonomous learning ability of students from primary school to university (Cui, 2003) and the cultivation of autonomous learning ability of students in distance education (Feng, 2003). Since 2009, research on autonomous learning ability has seen the development of relevant evaluation tools (Zhang & Li, 2009), evaluation tools (An & Lan, 2010), and research on the influencing factors of autonomous learning ability (Liu & Zhang, 2009). In addition, since 2010, more and more researchers have combined autonomous learning ability

with a variety of learning methods. Ma Lingling, a scholar, has introduced the project driven teaching method in college English teaching, so that students can cultivate their autonomous learning ability by completing a series of tasks under the guidance of teachers and the cooperation of classmates (Ma, 2010); Sun Jiyu and other scholars used problem-based teaching to carry out burn and plastic surgery teaching, which has achieved good results in improving medical students' autonomous learning ability (Sun, Luo, Tang, & Wei, 2010). Xing Lihui and others improved the students' initiative in learning by using the behavior guided teaching method, and cultivated students' comprehensive abilities in many aspects, such as independent learning, analysis and problem solving (Xing, Wei, & Zhang, 2012). The number of relevant researches on the cultivation of autonomous learning ability is still increasing, which can prove that the cultivation of students' autonomous learning ability is still an important part of the current educational scene.

2.2. Research on the Development of Autonomous Learning Ability

2.2.1. The Connotation of Autonomous Learning Ability
Autonomous learning ability refers to students' independent learning activities, which should run through the whole process of learning activities, including students' clear cognition of their own learning goals; reasonable strategies for the learning process; being able to monitor and evaluate their own learning process and reflect and summarize (Zhang, 2022).

2.2.2. Influencing Factors of Autonomous Learning Ability
The research on the influencing factors of autonomous learning ability is of great value to the cultivation of students' autonomous learning ability. LN Rufaidah summarized the influencing factors of autonomous learning ability as learning environment. He believes that by carrying out creative learning activities, students can reasonably analyze problems, formulate assumptions, propose solutions, and finally solve problems independently. Lou believes that the four learning environment factors that affect college students' autonomous learning ability are achievement-oriented teaching philosophy, knowledge-based curriculum, teacher centered teaching mode, and curriculum evaluation system based on summary evaluation (Lou, 2021). Wang put forward that intelligence, motivation, learning strategies and other internal factors can affect students' autonomy, and learning autonomy is also restricted by external factors such as learning environment, teachers, and education system (Wang, 2020).

2.2.3. The Measuring Method of Autonomous Learning Ability
The measurement methods of autonomous learning ability can be divided into qualitative and quantitative methods (Pang, 2003). Qualitative methods include interview, observation, thinking aloud evaluation and trace analysis. Although the evaluation method of thinking aloud makes the thinking process explicit, it may make the subjects pay too much attention to the elaboration of their inner

activities, which may affect the effect of autonomous learning. Zimmerman and Martinez-Pons of the City University of New York designed the SRLIS, which describes eight different learning situations that are common in learning. The information obtained by this method is more in-depth and accurate, but the requirements for information induction and analysis are high. Trace analysis is an evaluation method that analyzes the "marks" left by students in the learning process, such as underline, annotation, and notes, and then infers their learning strategies and effects. This method can objectively infer the autonomous learning strategies that students adapt to, but there is too much redundant information in it, and the subjects are easy to be ignored without explicit behavior.

Quantitative method mainly refers to the data collection and analysis method of questionnaire survey. The most used and authoritative measurement tools for autonomous learning abroad include the Learning and Study Strategies Inventory (LASSI), the Motivated Strategies for Learning Questionnaire (MSLQ) and the Survey of Academic Self-regulation (SASR) (Dugan, 2007). These three scales all cover anxiety, interest, motivation, learning strategies, self-monitoring, and other components, but there is a slight difference in the name and classification of each dimension.

In addition to the above methods, there are tracking log technology, structural measurement technology and micro analysis measurement technology abroad (Cheng, 2010). These technologies mainly reflect the students' autonomous learning level through the emotional elements in the learning process, the use of learning strategies and the monitoring of the learning process.

3. Research Design

3.1. Selection of Research Objects

This research takes the 2021 undergraduate freshmen of Beijing Normal University as the research object, and randomly selects 70 freshmen from the 2021 education department and 72 freshmen from the environment college (with both liberal arts and sciences, excluding the influence of professional nature), a total of 142. These students have just entered the university, and have formed a relatively stable cognitive style, learning methods, learning methods, and have certain learning ability in the long-term college entrance examination preparation, with certain particularity and representativeness.

3.2. Research Scheme Design

3.2.1. Research Ideas & Framework

Based on research questions and research status at home and abroad, the author has developed a research scheme as shown in Figure 1, aiming to propose effective strategies to improve students' autonomous learning ability by attributing the measurement results of autonomous learning level, and organize teaching practice activities to test the effectiveness of strategies, to guide teachers to improve teaching and improve learners' learning effect.
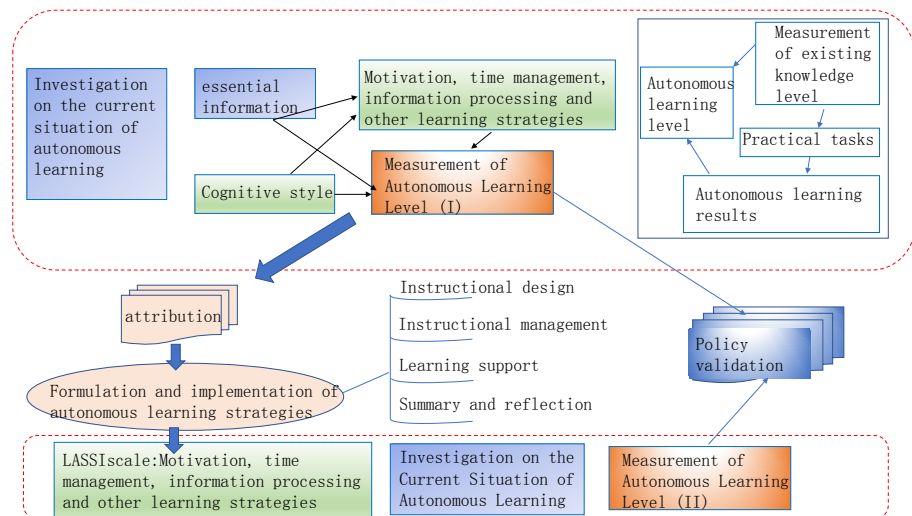
Figure 1. Research plan and process.

First, based on the literature, the author finds that students' motivation will affect their attitude and persistence in the process of autonomous learning. Therefore, emotional factors such as motivation and attitude are also important factors affecting the ability of autonomous learning. In addition, cognitive style will affect students' choice of learning strategies, and then affect their learning ability. Therefore, the author initially regards learning motivation and cognitive style as important factors affecting the development of students' autonomous learning ability. In view of this, the author decided to use LASSI and EFT strategies to do a pre-test on learners before teaching practice, to initially establish the key factors affecting the development of students' autonomous learning ability.

Secondly, based on the pre-test data and analysis, the key factors affecting the development of students' autonomous learning ability are preliminarily established, and on this basis, the information technology curriculum teaching design for the design and cultivation of autonomous learning ability is made, and the teaching environment is prepared for teaching practice, variable control is studied, and appropriate subjects are selected.

Third, based on preset strategies, teaching practice activities are organized and research process is strictly controlled to ensure its scientific and rigorous nature; In this process, data will be collected from multiple perspectives such as knowledge and skills development, indicators of autonomous learning ability, and changes in students' comprehensive literacy.

Fourth, the collected learning strategy data, cognitive style data and autonomous learning level data are analyzed for correlation and difference, and in-depth data mining is used to explore the key factors affecting autonomous learning ability and effective training strategies.

Finally, according to the results of data analysis, we further optimize the training strategies of autonomous learning ability, and intervene the students' learning process based on the new strategies. To judge the effectiveness of the

training strategy through multiple iterations.

3.2.2. Research Tool

1) LASSI Scale

In this study, LASSI scale was used to measure learning motivation, attitude and other learning intentions and learning strategies; LASSI is an internationally accepted self-regulated learning ability scale with good reliability and validity.

2) EFT and Cognitive Style Questionnaire

EFT and self-designed cognitive style questionnaire were used to investigate learners' cognitive style. EFT was a revised version of the mosaic figure test of the School of Psychology of Beijing Normal University, and new complex figures were added on this basis.

3.2.3. Research Process Control and Guarantee

1) Strict process control

In order to exclude the influence of learners' existing knowledge level on subsequent experiments, the author made an interview with learners when designing autonomous learning tasks, and selected the content that learners have low knowledge as the main source of design; The reliability and validity of the scales used in the research were tested to ensure the preciseness of the research results.

2) Strictly constrain or control the studied variable

From the external performance of learners, the autonomous learning ability of most learners is not only affected by their own inherent time management ability, autonomous learning strategies and other factors, but also by the cognitive style of students and the level of existing subject knowledge. Therefore, in the research, the author requires students to complete the predetermined autonomous learning tasks at the specified time, and reflects their autonomous learning ability by checking their autonomous learning level (change). In this process, the measurement of the existing knowledge level will be presented in the form of multiple-choice questions, while the autonomous learning tasks that learners need to complete are mainly practical problems. The autonomous learning level of students will be the difference between the autonomous learning task score and the existing learning level score, which is the reflection of the students' true autonomous learning ability.

3.3. The Thought of Teaching Design Oriented to the Cultivation of Autonomous Learning Ability

The LASSI scale includes three categories: willingness to learn, self-regulation and learning skills. It involves ten dimensions: attitude, motivation, anxiety, concentration, time management, self-testing, learning assistance, information processing, key points of choice and examination strategies (Weinstein et al., 1987). It comprehensively includes the influencing factors of autonomous learning ability. The relevant research in psychology also confirms that students' cognitive style and learning strategy level will also have an impact on autonom-

ous learning ability, and cognitive style will affect autonomous learning ability by influencing the choice and use of learning strategies. Therefore, according to the definition of autonomous learning ability, the author will measure students' autonomous learning ability with the LASSI scale, and organize teaching practice activities and collect data from the perspective of field dependent field independent cognitive style classification to explore the differences in autonomous learning ability of students with these three cognitive styles (field independent, intermediate, field dependent).

In this study, the presupposition cognitive style has significant differences in the dimensions of self-testing, learning assistance, information processing and selection of key points at the level of learning strategies. Therefore, this study will explore the impact of students with different cognitive styles from the above four dimensions and design training strategies accordingly.

Based on this, the four dimensions of anxiety, time management, motivation and attitude, which are significantly related to the results of autonomous learning, mainly start with teaching management, and promote students to improve their self-efficacy and time management ability through various means to stimulate motivation and time management intervention; For the four dimensions of self-testing, learning assistance, information processing and selection points that show significant differences in cognitive style, we should provide learners with learning support to promote their autonomous learning through reasonable design of teaching, based on task driven, with heterogeneous grouping of cooperative learning as the core, and with thinking guidance as the main line.

4. The Design and Implementation of the Training Program for Autonomous Learning Ability

4.1. Preliminary Determination of Influencing Factors of Autonomous Learning Ability from Pre-Test Data

In order to explore the influencing factors of students' autonomous learning ability and prove that the change of learners' autonomous learning ability is really caused by the above factors, the author collected, measured, and tested the pre-test data of the research object to ensure the smooth progress of the research.

4.1.1. Pre-Test for Research Object

1) The design of autonomous learning task

Different students have different levels of knowledge. The students with higher level of knowledge completed the learning tasks faster and with higher quality, and the performance of autonomous learning tasks was relatively good, on the contrary, it was the opposite. Therefore, the achievement of autonomous learning tasks will enlarge the gap between existing knowledge levels. In order to eliminate the influence of students' existing knowledge and experience, the author interviewed students through learning platform, QQ and email, and then

selected the content with low familiarity of the research object for task design. After comparison, we finally designed the task for the content of Photoshop. The reason is that most students have not contacted Photoshop before, which ensures that the students' existing learning level is basically consistent; Photoshop involves image processing, which is easy to arouse students' interest and stimulate their learning motivation; Finally, the saved image in PSD format retains the layer information, which is easy to evaluate the operation process of students. Considering the number of tasks and the delicacy of operation, 1 hour is given for this autonomous learning task.

2) Reliability and validity of the scale

The study used LASSI scale (Figure 2) to measure freshmen's motivation, anxiety, attitude, and other learning intentions and learning strategy levels, and to distinguish the dimensions of direct and indirect effects of autonomous learning ability, to provide a basis for the formulation of strategies.

After a large amount of data measurement, the LASSI scale gives a reference to the correlation coefficients of each dimension, as shown in the following Table 1. By comparing with the correlation coefficients of each dimension provided by the LASSI scale, the data are basically consistent. In addition to anxiety and information processing, anxiety and self-testing, anxiety and learning assistance, attitude and self-testing, information processing and examination strategies, other dimensions are significantly related, which proves the reliability of this data measurement.

Table 1. Correlation analysis of data in different dimensions of LASSI scale.

	anxiety	attitude	Concentration	information processing	motivation	Self-testing	Select key points	Learning Aids	time management	Examination strategy
anxiety	1.000									
attitude	.273	1.000								
Concentration	.505	.583	1.000							
information processing	.118	.263	.269	1.000						
motivation	.256	.525	.529	.413	1.000					
Self-testing	.012	.068	.276	.429	.181	1.000				
Select key points	.554	.402	.564	.305	.464	.268	1.000			
Learning Aids	.074	.305	.380	.385	.508	.433	.378	1.000		
time management	.470	.533	.804	.220	.444	.348	.536	.386	1.000	
Examination strategy	.442	.442	.507	.147	.443	.184	.595	.249	.594	1.000

number	title	1	2	3	4	5
1	I can concentrate on my study.					
2	I can 't summarize what I just heard or read.					
3	I always try to connect what I am learning with my own experience.					
4	I find it difficult to stick to my own learning plan.					
5	In the process of taking exams and writing learning papers, I find that I always misunderstand the meaning of the problem and lose points.					

Figure 2. LASSI scale (partial).

According to the definition of self-regulated learning, the characteristics of field independent and field dependent cognitive style students, this study assumes that field independent students have greater advantages in self-regulated learning than field dependent students, so they will show a higher level of self-regulated learning. In order to determine the types of students' cognitive styles, EFT and questionnaire were used to determine.

The cognitive style questionnaire was designed according to the different learning tendencies of field independent and field dependent students in online learning. There are twenty questions in total. Each question has two options, A and B. Option A describes the learning tendency of field dependent people in different situations, and option B describes the learning tendency of field independent people. If the number of choices A is obviously more than B, it is field dependent; On the contrary, it is field independent. In this test, EFT is scored according to the accuracy of the subjects' sketching of simple figures.

In the data collected, the number of choices of most subjects A or B is between 6 and 14. Considering the number of subjects, this study divides cognitive styles into three types: field independent, intermediate, and field dependent. In order to clearly define the boundaries of the three cognitive styles, the study analyzed and discussed the five grouping methods of cognitive style data and LASSI scale data, namely, 5/15 (the number of B ≤ 5 is field dependent, the middle type is between 5 - 15, and the field independent type is greater than 15, the same below), 6/14, 7/13, 8/12, and 9/13.

The analysis found that the scores of different cognitive style types determined by 5/15 and 6/14 in each dimension of the LASSI scale were similar, while 7/13 was closer to 8/12 and 9/13. Therefore, this study determined 7/13 as the classification basis for students of three cognitive styles. Among all subjects, 33 were field independent, 22 were field dependent, and 87 were intermediate type. Most of the subjects' cognitive styles had no obvious tendency, and had the characteristics of both field independent and field dependent cognitive styles.

The following is a comparison of the scores in each dimension of the LASSI scale by 6/14 and 7/13 grouping (Figure 3 and Figure 4).

It can be seen from the comparison of the above figure that the differences between the two grouping methods after determining the cognitive style types are mainly reflected in the scores of the intermediate types in each dimension of

the LASSI scale, which is also the reason why 7 and 13 were finally determined as the basis for the classification of the three cognitive style types.

After data collection and analysis, the correlation coefficient between the results of the cognitive style questionnaire and EFT test scores is .597, and the sig value is. 03, showing a significant correlation, which proves the reliability and validity of the questionnaire.
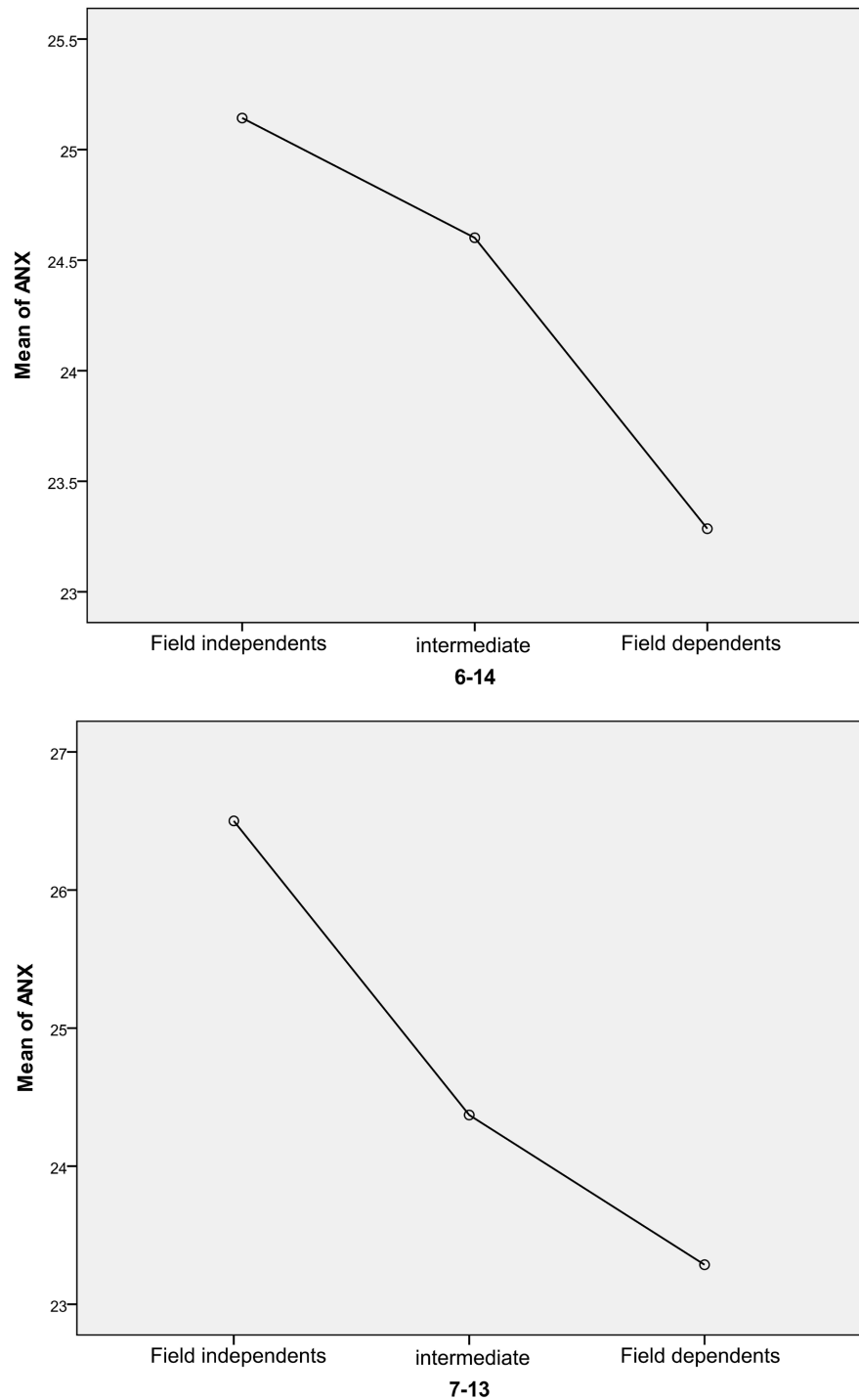

Figure 3. Anxiety dimension.

Figure 4. Concentration dimension.
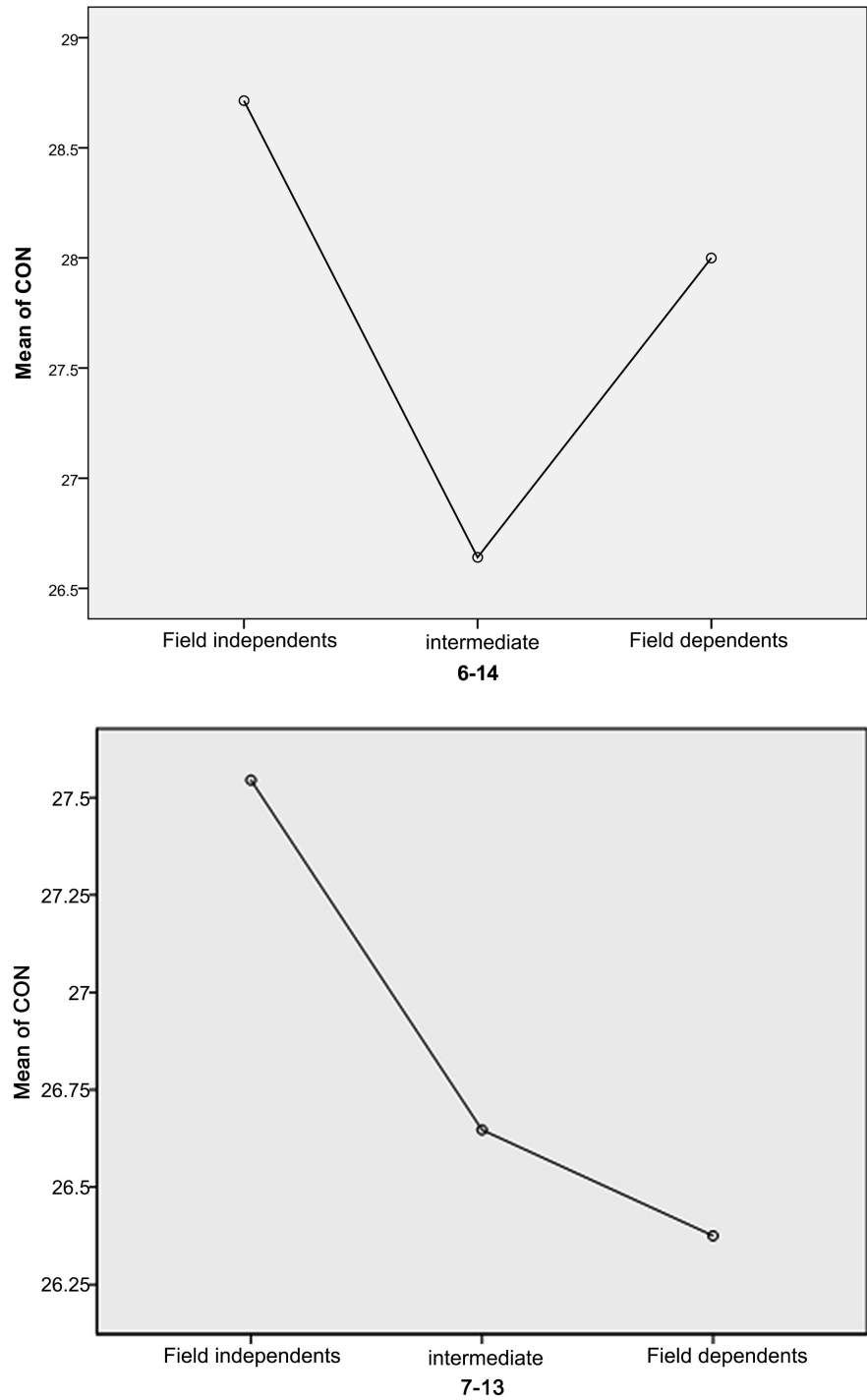
4.1.2. Characteristics of Pre-Test Data

Based on the earlier measurement of the effect of autonomous learning, the questionnaire conclusion of LASSI scale, and the measurement data of cognitive style, the attribution of autonomous learning ability can be realized by means of correlation and difference analysis, to provide effective guidance and intervention for students.

1) Differences in cognitive styles among the dimensions of LASSI scale

To explore the influence of different cognitive styles on learning strategies and learning intentions, 50 students with significant cognitive styles were selected from 142 subjects, including 12 field independent students, 25 intermediate type students and 13 field dependent students. Single factor ANOVA was conducted on the measurement results of these 50 students in ten dimensions of the LASSI scale, using the LSD method. The results showed that:

a) The students of the three cognitive styles have significant differences in the four dimensions of self-testing, information processing, learning assistance and selecting key points. Compared with the field dependent students, the field independent students show higher abilities in using self-testing strategies, information processing and selecting key points, while the field dependent students show higher abilities in using learning assistance; However, there is no significant difference in other six dimensions, such as concentration, motivation, etc.

b) In addition to learning assistance, the scores of the three types of students in the other nine dimensions are: the field independent students are the highest, the middle type students are the second, and the field dependent students are the last. The dimensions of the three cognitive style types with significant differences in each dimension of the LASSI scale are shown in the following Table 2.

To sum up, students with different types of cognitive styles have reached a significant level of difference in the four dimensions of self-testing, information processing and learning assistance, and key points of choice. Therefore, field independence shows a higher level of learning strategies than field dependence. However, field dependent learners also have advantages in making good use of learning aids.

2) The relationship between autonomous learning effect and cognitive style, LASSI dimensions

In this study, the effect of autonomous learning is correlated with most dimensions of the LASSI scale, and the correlation between anxiety, time management, motivation, attitude, and the results of autonomous learning reaches a significant level. The specific data are as follows in Table 3.

The data results show that although the learning intention and learning strategies involved in the LASSI scale are factors that affect students' autonomous learning ability, the emotional factors of students' learning intention, such as anxiety level, time management ability, motivation and learning attitude, play a more direct and significant role.

4.2. Based on the Pre-Test Conclusion, Establish Effective Training Strategies, and Implement Them

Teaching strategy is an integral part of teaching design, that is the teaching program plan and the teaching implementation measures taken to achieve the teaching objectives and adapt to the cognitive needs of students in specific teaching situations.

Table 2. Students with different cognitive styles have significantly different dimensions.

	Average of four dimensions			
	Self-testing	information processing	Learning Aids	Select key points
Field independents	24.67	27.21	24.17	26.16
Intermediate type learners	22.40	25.92	25.16	24.31
Field Dependents	22.00	24.25	26.88	23.42
Sig	.033*	.003*	.031*	.018*

*representative sig value is less than 0.05.

Table 3. The dimensions in LASSI scale that are significantly related to autonomous learning outcomes.

		anxiety	time management	motivation	attitude
Autonomous learning results	Pearson's correlation coefficient	.771	.723	.578	.545
	Sig	.000**	.000**	.001**	.005**

**representative sig value is less than 0.01.

4.2.1. Teaching Design

In the practice of information technology teaching, the author insists on "intensive teaching and more practice". Under the guidance of PBL (problem-solving based learning) and CL (collaborative learning) theories, the author organically combines classroom teaching, after-school learning and heterogeneous grouping cooperative learning, focuses on guiding students' thinking, and carries out autonomous learning and inquiry learning.

1) Task driven

In the teaching process, learning tasks are carefully designed according to the teaching content of each lesson, and large learning tasks are decomposed from top to bottom according to the logical relationship between teaching requirements and knowledge points. Classroom tasks are required to be typical and can stimulate students' interest, guide students to decompose tasks, specify specific operations required to complete tasks, pay attention to the organization of sub tasks, and ensure that adjacent sub tasks are progressive in knowledge difficulty.

2) Heterogeneous grouping centered on cooperative learning

The preliminary survey data shows that field independent students have greater advantages than field dependent students in terms of learning strategies such as self-testing, information processing and key points selection, but field dependent students are slightly better at learning assistance. Therefore, in order to realize the complementary advantages and mutual learning of different learning styles, the study adopts heterogeneous grouping for group activities.

3) Thinking guidance as the main line

In the teaching process, heuristic teaching is adopted, and attention is paid to the guidance of students' process and method thinking, so that students can not

only "know what is," but also "know what is," and pay attention to the guidance of solutions and problem-solving ideas to help students establish the awareness of independent problem solving.

4.2.2. Teaching Management

The cultivation strategy of autonomous learning ability in teaching management realizes the organic unity of teaching and management. Through the using of diversified teaching evaluation, students' learning enthusiasm is improved, while helping students to reasonably plan their learning progress and improve their time management ability.

1) Stimulate students' learning motivation

Stimulating and maintaining students' learning motivation will help them establish clear learning goals, improve their enthusiasm and sustainability of learning, and enhance their sense of self-efficacy to achieve a virtuous circle. To this end, the evaluation of students should be specific, using a combination of grades and comments, the evaluation of students is more comprehensive.

2) Reasonably plan learning progress and improve time management ability

In many courses of the university, there is little interaction between teachers and students. Teachers take classes seriously, but seldom investigate how much the students understand and digest in this class, and do not know much about the students' learning. In addition, the students themselves have poor self-control, which results in that many students seldom study hard at ordinary times and only rush to learn or complete their homework in the last few weeks of the term.

4.2.3. Learning Support

Providing students with learning support in terms of learning environment and conditions will help meet the learning needs of different students, conform to the "student-centered" teaching philosophy, and play an important role in promoting the improvement of autonomous learning ability.

1) Combination of network courseware and online communication platform

It usually takes the combination of building online courses and organizing learning forums. On the one hand, teachers should put the teaching content of each course, the detailed description of the operation steps of the case, and various types of learning resources on the teaching platform; On the other hand, the platform should also provide a forum for students to communicate on their own, so that students can discuss and exchange skills and problems in operation after class.

2) Organizing learning resources based on knowledge management

In order to help students, understand the content to be learned at the initial stage and quickly acquire the desired knowledge points in the learning process, such as teaching courseware, classic examples, excellent works, forum posts and other related content, the platform provides students with a knowledge map, that is, a navigation system based on the knowledge network map.

3) Encourage students to choose their own resource types and reorganize and innovate

Different students have different learning habits and preferences. Therefore, teachers use different types of presentation methods for the same learning content on the platform to meet the needs of different types of students.

4.3. Collect Research Data Based on Teaching Practice

One semester after the implementation of autonomous learning ability training strategies, the author again measured their learning strategy level, learning motivation, attitude, anxiety, and other learning intentions with LASSI scale, and compared with the previous data. In addition, the author also designed a new round of autonomous learning tasks to realize the investigation of students' autonomous learning level after the implementation of the autonomous learning ability training strategy.

From the perspective of the research plan, the data indicators that can better feedback the development level of students' final autonomous learning ability should be reflected in the final autonomous learning task. For this task, the author chose the "Dreamweaver website production" module, because most students did not use Dreamweaver to produce comprehensive websites, ensuring that the initial level was basically the same; In addition, website production can comprehensively examine students' learning ability, and the website produced can reflect the details of students' production, which is convenient for a more comprehensive and objective evaluation. In the final autonomous learning task, the author investigated whether the students had used Dreamweaver and how well they mastered it, and how to add hyperlinks in Dreamweaver. Considering the number of tasks and the delicacy of operations, the author strictly limited the task completion time to 1 hour.

As the same as the pre-test strategy, the post-test for students' autonomous learning ability still needs to be implemented through "the achievement of new learning tasks—existing knowledge level". Therefore, the last round of autonomous learning tasks also includes the measurement of existing knowledge level and the measurement of autonomous learning task performance. In the design of autonomous learning task, the author requires students to use Photoshop to realize the layout of web pages, and use CSS to edit the text style of web pages. At least one hyperlink should be included in the web pages, and multimedia materials such as pictures or Flash should be inserted into the web pages. Compared with the previous autonomous learning tasks, the workload and difficulty of this autonomous learning task have increased. The author gives a score for each operation, and the total score is the same as the previous score. After the students submit their works, the author evaluates them in a timely manner to accurately measure the completion of new learning tasks.

5. Research Results and Discussion

After a year of college life, students have made great progress due to changes in teaching mode and learning habits. In this case, the effect of autonomous learning is used again to reflect students' autonomous learning ability, and the learn-

ing motivation and learning strategies are measured based on the LASSI scale, to verify the effectiveness of autonomous learning ability training strategies based on data analysis.

5.1. Changes of Post-Test Data in All Dimensions of LASSI Scale and Their Reasons

5.1.1. Overall Changes of Post-Test Data in Each Dimension of LASSI Scale

After the implementation of the strategy, the LASSI scale is used to measure and collect the students' learning strategy level again. After processing, the average score of each dimension of the students is obtained and compared with the previous data. It was found that among the ten dimensions of the LASSI scale, only anxiety control and time management reached a significant level of change, and both had significant increases. However, the scores of attitudes, motivation and concentration did not rise, but tended to decline, but the extent of decline did not reach a significant level, while the scores of other dimensions rose slightly, as shown in Table 4.

After comparing the pre and post-test data of LASSI scale, the post-test data did not show a very significant upward trend in general, which indicates that the overall increase of students' learning strategy level is not obvious.

The author should pay attention to the fact that the measurement results of the attitude, concentration, and motivation dimensions of the research objects in the LASSI scale declined. These three dimensions are related to the study intention of the research objects, and the concentration dimension is related to self-regulation in the learning process. In senior high school, academic performance is a key indicator of student evaluation, and learning motivation and goals are very clear. After entering the university, most freshmen still maintain a high enthusiasm for learning, so they can have a high level of learning attitude and motivation. However, in universities, grades are no longer the only way to evaluate students. Most students are recognized by others from participating in school activities and playing their own strengths. Therefore, it is not difficult to understand the decline of the measurement results of attitude, concentration, and motivation dimensions in general.

5.1.2. Comparison of Learning Strategies between Male and Female Subjects in Pre-Test and Post-Test and Analysis of the Causes

This study conducted a comparative analysis of the learning strategy levels of the subjects of different genders in the experimental group. The results showed that in the pre-test data, boys scored higher than girls in all dimensions of the LASSI scale, but in the post-test data, girls surpassed boys in almost all dimensions, and reached a significant level in anxiety, attitude, concentration, motivation, choice points and other dimensions. In addition to anxiety, time management and examination strategy, the scores of male students have increased, while the scores of other dimensions have declined to varying degrees, and the decline in concentration, motivation and choice points has reached a significant level.

Table 4. Comparison of pre-test and post-test data of LASSI scale.

	Mean value of pre-test data	Mean value of post-test data	Sig
Anxiety control	24.43	27.06↑	.019*
attitude	30.08	29.95↓	.331
Concentration	26.71	26.29↓	.465
information processing	25.71	25.94↑	.405
motivation	28.56	27.58↓	.327
Self-testing	22.85	23.14↑	.415
Select key points	26.42	26.62↑	.216
Learning Aids	26.57	26.98↑	.305
time management	25.26	27.75↑	.023*
Examination strategy	25.83	26.25↑	.318

*representative sig value is less than 0.05.

Through the intervention of the research objects in practice, the learning strategy level of girls has been greatly improved overall, and has surpassed that of boys. In order to explore the reasons for this result, the performance of boys in the whole intervention process was explored. The main reasons are as follows: 1) The number of male students in all research subjects is relatively small. Among the subjects who participated in the whole experiment, there were 19 boys and 51 girls. The number of girls was more than twice that of boys. Therefore, individual changes in male subjects are very likely to cause changes in the overall trend of male students. 2) Through the performance of male students in the process of implementing the strategy of autonomous learning ability, it is found that the average value of male students' participation in the platform, that is, the online time of the platform and the posts participating in the discussion, is less than that of female students. In addition, boys' performance in their daily homework is also unsatisfactory. After the teacher gave feedback to the daily work of the research object, only a few of the boys could modify and resubmit according to the teacher's feedback, and most of them only submitted once. Girls are more active than boys in the whole process.

5.1.3. Pre- and Post-Test Comparison and Cause Analysis of Different Dimensions of LASSI Scale for Students with Different Cognitive Styles

In order to explore the influence of autonomous learning strategies on students with different cognitive styles, the author compared the pre-test and post-test data of 50 previous students. The research found that field independent students and field dependent students have made progress in all dimensions of the LASSI scale, while the middle type students have increased in anxiety and time management dimensions, and the dimensions of choice points and learning assistance are basically the same, other dimensions have decreased to varying degrees, and the decline in concentration and motivation dimensions has reached a significant level. See Table 5 for details:

Table 5. A pre and post-test comparison of learning strategies of students with different cognitive styles.

	Learning Style Type	Pre-test data	Post-test data
Anxiety	Field independents	26.06	26.18
	Intermediate type learners	24.31	25.58↑
	Field Dependents	23.42	24.13
Concentration	Field independents	27.55	28.31
	Intermediate type learners	26.65	24.35↓
	Field Dependents	26.38	27.31
Motivation	Field independents	28.85	29.94
	Intermediate type learners	28.60	26.33↓
	Field Dependents	27.38	28.53
Self-testing	Field independents	24.67	25.31
	Intermediate type learners	22.40	21.40↓
	Field Dependents	22.00	23.13
Attitude	Field independents	30.67	32.06
	Intermediate type learners	30.72	29.56↓
	Field Dependents	29.58	30.60
Information processing	Field independents	27.21	27.50
	Intermediate type learners	25.92	25.49↓
	Field Dependents	24.25	26.13
Select key points	Field independents	26.16	27.63
	Intermediate type learners	24.31	24.42↓
	Field Dependents	23.42	26.60
Learning Aids	Field independents	24.17	28.50
	Intermediate type learners	25.16	25.14↓
	Field Dependents	26.88	28.07
Time management	Field independents	26.90	27.31
	Intermediate type learners	25.16	26.74↑
	Field Dependents	24.17	25.00
Examination strategy	Field independents	26.06	27.31
	Intermediate type learners	25.73	25.33↓
	Field Dependents	25.54	26.27

5.2. A Post-Test Analysis of the Effect of Autonomous Learning

The exploration of autonomous learning cannot sacrifice the teaching quality. Therefore, in addition to focusing on the development and change of learners' autonomous learning ability, the author also reflects the learning effectiveness of students in the autonomous learning mode through the evaluation of the quality of students' works. After the implementation of the strategy, the author made a comparative analysis of the students' achievements in the third work and the first work. The analysis found that the quality of the third work was significantly improved compared with the previous work (sig value was .031). As shown in Table 6.

In addition, in order to explore the changes of autonomous learning results of different types of groups, the author also conducts a comparative analysis of the quality of works of different cognitive styles of research objects. By comparing the pre-test and post-test data of the autonomous learning results of the students with three learning styles of field independence, intermediate type, and field dependence, it is found that the post-test results of the three groups are improved compared with the pre-test results, of which the field dependence is most significantly improved (T = 5.724, sig = .009). Specific data are shown in Table 7.

To sum up, in the information technology course teaching, the introduction of the teaching model oriented to the cultivation of autonomous learning ability has not led to a decline in the overall teaching quality. Moreover, the quality of the works of different types of learners has been improved, and students' learning enthusiasm and initiative have also been greatly improved.

5.3. Analysis Conclusion

Based on the above data analysis results, a stable research conclusion is formed by comparing the changes of the measurement results of different cognitive styles in different dimensions of the LASSI scale and the changes of autonomous learning results.

Table 6. Pre- and post-test comparison of all students based on autonomous learning teaching model.

	First work achievements (M ± SD)	Achievements of the third work (M ± SD)	T	Sig
All students	71.41 ± 7.39	80.93 ± 6.71	3.971	.031*

*representative sig value is less than 0.05.

Table 7. A pre- and post-test comparison of autonomous learning results among students with different cognitive styles.

Field independents	68.33 ± 7.38	80.93 ± 9.51	1.927	.046*
Intermediate type learners	58.48 ± 7.91	70.64 ± 8.39	2.871	.018*
Field Dependents	57.69 ± 6.78	78.23 ± 6.37	5.724	.009**

*representative sig value is less than 0.05; ** representative sig value is less than 0.01.

1) Changes of measurement results of subjects in different dimensions of LASSI scale

The author should pay attention to the decline of the measurement results of the attitude, concentration, and motivation dimensions of the subjects on the LASSI scale. These three dimensions are related to the willingness of the subjects to learn, and the concentration dimension is related to self-regulation in the learning process. In senior high school, the key indicators of student evaluation, learning motivation and goals are very clear. After entering the university, most of these freshmen still maintain a high enthusiasm for learning, so they can have a high level of learning attitude and motivation. However, in universities, grades are no longer the only way to evaluate students. Most students are recognized by others from participating in school activities and playing their own strengths. Therefore, it is not difficult to understand the decline of the measurement results of attitude, concentration, and motivation dimensions in general.

There was a significant difference between different genders in each dimension of the LASSI scale. In the initial survey, boys were better than girls, while in the later survey, girls exceeded boys in each dimension. On the one hand, the number of male students in the study is small, and the standard deviation of the measurement results, namely, the fluctuation range, becomes larger, indicating that changes in the individual measurement results of male students will cause changes in the overall measurement results of male students; On the other hand, boys did not actively participate in the implementation of the strategy of cultivating autonomous learning ability. The reasons for the change of boys' measurement results were also explained from their online time on the platform, the number of posts they participated in, and their attitude towards teachers' feedback.

Among the subjects of different cognitive styles, the subjects of field independence and field dependence types have improved in all dimensions of the LASSI scale, although the former is still slightly higher than the latter, the difference between the two is not significant. The intermediate type of research objects showed a downward trend.

2) Changes in the effectiveness of autonomous learning

In general, before and after the implementation of autonomous learning ability training strategy, the change of autonomous learning results has reached a significant level, indicating that the level of autonomous learning of the research object has been significantly improved. From the perspective of different groups of research objects, girls' autonomous learning results are significantly better than boys', showing the opposite results to the pre-test; There is no significant difference between the autonomous learning results of subjects with different cognitive styles, but the middle type learners' performance is the worst among the three, and the proportion of boys in the middle type subjects can explain this problem.

3) Main influencing factors of autonomous learning ability

Among the factors that affect autonomous learning ability explored in this

study, motivation, attitude, concentration, and other self-efficacy factors are significantly related to autonomous learning results in the early measurement results, but in the post-test data, the correlation is significantly reduced. This contrast not only confirms the conclusion (1), but also shows that the impact of the above dimensions on autonomous learning results is unstable.

However, after the implementation of the autonomous learning training program, the changes of students with different cognitive styles in information processing, time management, key points of choice and other aspects are consistent with the changes of autonomous learning level. From the pre and post-test data, the measurement results of autonomous learning level of those with higher scores in the above dimensions are also better, indicating that the above dimensions have a stable and obvious impact on autonomous learning ability; The strategy of cultivating autonomous learning ability formulated for the above dimensions has achieved remarkable results.

It can be seen from this that time management, information processing and other learning strategy factors and cognitive styles are the continuous and stable learning characteristics of students. When cultivating autonomous learning ability, we should pay attention to this relatively stable learning tendency, and cultivate autonomous learning ability from the stable learning characteristics of learners.

6. Conclusion

This research has trained students' autonomous learning ability from the aspects of stimulating students' learning motivation, heuristic teaching, group mutual aid learning, learning resource construction and targeted teaching design, and has intervened students for a semester accordingly, thus forming a more stable teaching method. The data analysis shows that the implementation of autonomous learning ability training strategy has significant effect and is of great value to the improvement of freshmen's autonomous learning ability. At the same time, it plays an important role in helping freshmen adapt to college learning and teaching methods as soon as possible.

After one academic year of follow-up research and empirical analysis, we measured, intervened and re measured the autonomous learning ability of 2021 freshmen from the Department of Education and the School of Environment of Beijing Normal University. Through a series of measurements, interventions and analyses based on time series, relatively stable research results have been formed. The research confirms that: 1) The freshmen face significant changes in learning and psychology after entering the university. Through the research, we know that the freshmen are not adapted to the high pressure and anxiety in learning. Among them, the poor autonomous learning ability is the key problem; 2) The factors of self-regulation, such as learning strategies and time management, are the stability factors that affect the ability of autonomous learning. Therefore, the cultivation of freshmen's autonomous learning ability should be carried out

from the perspectives of autonomous learning strategy development and time management ability cultivation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

An, Z. F., & Lan, S. Z. (2010). Development of Evaluation Tools for Students' Autonomous Learning Ability in Modern Distance Open Education. *Journal of Open Learning, No. 1,* 24-27.

Ao, Y. P. (2020). My View on C-Language Teaching for Applied Undergraduates Guided by Training of Practical Application Ability. *Computer Knowledge and Technology, 16,* 187-188.

Braun, S. (2007). Designing and Exploiting Small Multimedia Corpora for Autonomous Learning and Teaching. In *Corpora in the Foreign Language Classroom* (pp. 29-46). Brill.

Cao, K. Y. (2022). Research on the Path of Building College Students' Innovation and Entrepreneurship Ability in the New Era. *Shaanxi Education, No. 9,* 61-63.

Cheng, H. Y. (2010). The New Trend of Technology Development in Measuring Self-Regulated Learning in Western Countries. *Education Science, 26,* 92-96.

Cui, H. F. (2003). The Cultivation of Students' Autonomous Learning Ability in Information Technology Teaching. *Chinese Journal of Distance Education, No. 15,* 58-59.

Dugan, R. F. (2007). *Examining the Construct Validity of Academic Self-Regulation Using the Survey of Academic Self-Regulation.* Unpublished Doctoral Dissertation, University at Albany, State University of New York.

Fazey, D. M. A., & Fazey, J. A. (2001). The Potential for Autonomy in Learning: Perceptions of Competence, Motivation, and Locus of Control in First-Year Undergraduate Students. *Studies in Higher Education, 26,* 345-361.
https://doi.org/10.1080/03075070120076309

Feng, C. Q. (2003). The Cultivation of Students' Autonomous Learning Ability in Distance Education. *China Educational Technology, No. 3,* 63-66.

Liu, L. D., & Zhang, W. J. (2009). The Influence of Majors' Self-Efficacy on Their Autonomous Learning Ability. *Bridge of Century, No. 11,* 118-119.

Lou, L. L. (2021). Cultivation of Students' Autonomous Learning Ability in Application-Oriented Universities. *Theory and Practice in Language Studies, 11,* 422-429.
https://doi.org/10.17507/tpls.1104.12

Ma, L. L. (2010). An Empirical Study on Developing Students' Autotomy Learning Ability through Project-Based Learning. *Journal of Shanxi Radio & TV University, 15,* 54-55.

Ma, X. R. (2022). Influence Study of Learners' Independent Learning Ability on Learning Performance in Online Learning. *International Journal of Emerging Technologies in Learning, 17,* 201-213. https://doi.org/10.3991/ijet.v17i09.30925

Manathunga, C., & Goozée, J. (2007). Challenging the Dual Assumption of the "Always/Already" Autonomous Student and Effective Supervisor. *Teaching in Higher Education, 12,* 309-322. https://doi.org/10.1080/13562510701278658

Pang, W. G. (2003). Evaluation Methods of Autonomous Learning. *Journal of Psychological Science, 26,* 882-884.

Sun, J. Y., Luo, X. Q., Tang, Z. X., & Wei, L. P. (2010). Exploration of Problem-Based Teaching in Improving the Ability of Independent Learning and Clinical Practice of Burn and Plastic Surgery Students. *Journal of Clinical and Experimental Medicine, 9,* 1667-1668.

Wang, G. Q. (2020). On the Strategies to Cultivate College Students' Autonomous English Learning Ability in the New Era. *English Language Teaching, 13,* 94-99. https://doi.org/10.5539/elt.v13n11p94

Weinstein, C. E., Palmer, D., & Schulte, A. C. (1987). *Learning and Study Strategies Inventory (LASSI).* H & H Publishing.

Xing, L. H., Wei, H. J., & Zhang, M. (2012). The Influence of Behavior Guidance Teaching Method on Students' Autonomous Learning Ability. *Journal of Modern Medicine & Health, 28,* 1578-1579.

Yang, N., & Ren, J. L. (2022). Exploration of Lifelong Learning Path for Learners in the Era of We-Media. *Modern Distance Education, No. 4,* 92-96.

Zhang, A. Z. (2022). Analysis of College Students' Autonomous Learning Ability and Its Improvement Countermeasures. *Western China Quality Education, 8,* 35-37.

Zhang, X. Y., & Li, X. H. (2009). Manufacture of Evaluation Tool for Self-Learning Ability of Nursing Specialty Students. *Chinese Nursing Research, 23,* 639-640.