The Role of Blended Instructional Models Based on Deep Learning Theory in Enhancing Students' Autonomous Learning Ability in Chinese Higher Vocational Colleges

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Abstract: In recent years, the continuous development of information technology has made traditional teaching methods gradually withdraw from the trend. Also, the blended instructional models has become the mainstream. The requirements for students' autonomous learning ability in the current environment have been further improved. The research in this paper is based on constructivist theory, cognitive load theory, metacognitive theory, and blended learning theory of cognition. Then this paper investigates the role of blended instructional models, which is based on deep learning theory, in improving the autonomous learning ability of students in Chinese higher vocational colleges and universities through questionnaire surveys and using statistical software for analysis data. The results of the study showed that the blended instructional models based on deep learning could promote students' deep learning and improved their mental health literacy and autonomous learning ability.

Keywords: Autonomous Learning Ability; Blended Instructional Model; Deep Learning; Higher Vocational Students; Mental Health Education.

1 Introduction

With the non-stop improvement of facts technology, science has delivered a most important and exceptional alternative in the area of educating and learning. The most apparent is the alternate in instructing methods, which are progressively shifting toward digitalization. In terms of current teaching, traditional teaching methods are no longer adapted to the changing requirements of the times. New communication tools have forced teachers to make changes, making it a great challenge for them to teach. Therefore, it is very necessary to cultivate students' autonomous learning ability in conjunction with the new teaching concepts developed in the new situation. According to the Ministry of Education, the goal of high vocational education is to "cultivate high-quality skilled personnel who can seek knowledge and learn". This "knowing" and "being able to learn" means that students are able to actively explore new knowledge and are good at autonomous learning ability. Thus, they are better able to survive in the information age, which is characterized by rapid updating of knowledge and skills and high demands for career development.

Autonomous learning ability does not simply require learners to take the initiative to learn scientific and cultural knowledge or to master a particular skill. Rather, it requires learners to be able to mobilize their cognitive abilities, including dialectical thinking and reflective strategies, according to complex and changing social situations. Ultimately, the goal of solving complex problems can be achieved, and a series of personality and social development of the learners themselves can be realized. Therefore, autonomous learning ability refers to the ability of students to acquire cultural knowledge independently without relying on others. On the basis of mastering technical skills, it is a kind of literacy that forms the ability to solve practical problems, the ability to cope with problems and the ability of lifelong learning.

In current years, a giant variety of academic practices have proven that the use of blended instructing techniques can spotlight the distinctive predominant roles of instructors and college students, respectively. In the mastering process, this technique can spotlight the predominant function of students so that college students can maximize their enthusiasm, independence and creativity. In the instructing process, this approach can spotlight the most important position of the teacher so that the trainer can step by step encourage the students' wondering via the layers of guidance, the student's

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potential to examine on their personal has an extraordinary effect[1-3].

Therefore, this research in this paper is based on constructivist theory, cognitive load theory, metacognitive theory, and blended learning theory of cognition. Then we investigates the role of blended instructional models, which is based on deep learning theory, in improving the autonomous learning ability of students in Chinese higher vocational colleges and universities through questionnaire surveys and using statistical software for analysis data.

2 Literature review

Blended instructional models

Initially, blended instructing was once broadly speaking understood as a new way of learning. Scholars believed that this new way of instructing emphasized the integration of records science and performed a main function in the instructing process. Bliuc consider that blended instructing is a product of the growth of the instances and a new way of learning. It makes the teacher, the scholar and the educating aid ring together so that the three realize the aggregate of online and offline interaction [4]. Yen and different pupils accept as true that blended instructing is a large alternative to the ordinary instructing mode, which adjustments the relationship between students, instructors and instructing resources. The following most important features include: first, the problem function adjustments from instructors to students. Second, the interplay between the three is closer. Third, the contrast mechanism is extra comprehensive, such as formative and summative evaluation, so that this new instructing mode is reinterpreted as a new "learning experience[5]." Goodyear [6] argues that mixing is no longer simply an aggregate of online and offline teaching. However, as a substitute, a gradual highlighting of the centrality of the scholar and the introduction of new mastering surroundings for the student so that educating and tutoring can be efficaciously blended.

In China, pupils such as Huang [7]consider that the scientific sketch of the direction ought to be carried out on the foundation of blended teaching. They trust that the route format ought to consist of three principal parts, namely, front-end evaluation design, useful resource design, and educating comparison design. Ye and Chen [8,9] trust via research that they have to make accurate use of sequential mastering things to do to enhance the effectiveness of educating and gaining knowledge of the technique of blended teaching so that the typical instructing shape is changed.

Deep Learning Theory

There have been many studies on the concept of deep learning at home and abroad, Ference and Roger first proposed the concept of deep learning in 1976. Later, researchers have made many achievements from the basis of their research. Domestic research on deep teaching started later, but the degree of attention has been increasing, and the fields involved have been expanding[10-13]. Parsons [14] believes that deep learning is a learning process that improves one's migration ability through the accumulation of self-learning. Junco R and Cotton SR [15]Deep learning is a method in which learners exercise one's logical thinking skills by solving writing problems and thus engage in the self-construction of a knowledge system. Hall [16] and other scholars in their studies have found that learning environments affect the extent and effectiveness of deep learning and that students are more inclined to choose deep environments centered around learning activities and learning methods. Zhang and Wu [17,18]studied the concept, prevalence technique and traits of deep learning from three dimensions, and on the foundation of the theoretical basis of the study, they went similarly to outline the notion of deep mastering from the cognitive and affective motor ability level.

Autonomous Learning Ability

After the 1990s, lookup on autonomous learning ability started out to entice extensive interest from students from all life. According to Pang, the enrichment of students' cognitive strategies and the stimulation of intrinsic motivation can improve students' autonomous learning ability. According to Yan, the significance of teachers' guidance in cultivating students' autonomous learning ability should not be underestimated. Yang pointed out that teachers' instruction lies in educating college students to do matters in the proper way and supplying fundamental assistance in actual time is a wonderful way to enhance students' autonomous learning ability[19-22].

In foreign countries, Zimmerman firstly put forward the concept of autonomous learning ability. The so-called impartial gaining knowledge of capacity is the capability of college students to take duty for their personal impartial studying, to have the ability to not rely on others to supervise their own learning and to bear the consequences of their learning or enjoy the results of their learning independently. Little has similar insights into the definition of independent learning, and he emphasizes the importance of the independence of the autonomous learning ability. Whether it is "taking accountability for one's very own impartial learning," "not relying on others to suppose critically, or taking private duty for the penalties or results of one's learning," it is a structure of "independently adopting studying behaviors". This skill that college students who can assume independently and make and put in force their very own options are viewed to have a sure diploma of unbiased mastering ability[23-26]. Dickinson, on the basis of his own research, will be autonomous learning ability is

summarized as the ability to learn independently and correct learning attitude. Specifically, the process of continuous self-feedback and self-adjustment of students according to their own learning status in the learning process is a manifestation of the ability to learn independently. The correct attitude to learning is that students can only be considered to have a correct attitude if they are always the first person responsible for independent learning.

In general, scholars focus on two aspects: one is the research on the autonomous learning ability of higher vocational students in a certain subject, such as English, mathematics, chemistry, information technology, tourism and so on. The second is the research on the status quo and problems of autonomous learning ability of higher vocational students, such as higher vocational students with learning burnout, anorexia, serious inferiority complex and other problems. There is no research on blended instructional models based on deep learning theory to cultivate the autonomous learning ability of higher vocational students. Therefore, we choose the blended teaching based on deep learning theory to cultivate the autonomous learning ability of middle school students as the research direction to provide theoretical guidance and practical support for cultivating the autonomous learning ability of higher vocational students.

3 Methodology

Research Object

In this study, the chosen lookup topics are the college students of two instructions in Heilongjiang Agricultural Economics Vocational College, one of which serves as a manipulated classification and the different as an experimental class; the wide variety of each training is 50, and the experimental route is college Mental health education. The experimental classification makes use of blended instructing based totally on deep learning theory to enhance autonomous learning ability, whilst the manipulated classification makes use of usual educating techniques to domesticate autonomous learning ability. A questionnaire survey was once first carried out to analyze the modern-day scenario of students' autonomous learning ability as nicely as the troubles in this vocational school. Before and after carrying out the experimental study, measurements were taken on the two concern instructions taking part in the experiment, with the reason of conducting pre- and post-tests and evaluating and inspecting the records of the vocational college students in this experimental learn in order to confirm whether or not the mannequin built in this learn about is high-quality or not, and with any luck to higher enhance the autonomous learning ability of the vocational students.

Questionnaire Design

The questionnaire of this study is the Questionnaire on Autonomous Learning Ability of Higher Vocational Students, which is mainly designed by Wang [27-30] to investigate the autonomous learning ability of higher vocational students. The questionnaire consists of two parts; the front section is the fundamental data of the students, such as gender, specialty, etc.; the different section is a survey of the Current status and needs of the 5 dimensions of the autonomous learning ability of higher students. In this study, the scoring approach in the authentic scale used to be modified to Likert five-point scale scoring technique for scoring. The primary framework of the questionnaire is proven in Table 3.1.

Table 3.1 Framework of the Survey Questionnaire on the Current Status of Vocational School Students' Autonomous Learning Abilities

Level 1 Indicator	Level 2 Indicator	Elements or Factors	Questionnaire Item Number
Factual Questions	Personal Aspect	Gender	1
		Class	2
		Major	3
	Family Aspect	Parents' Educational Background	4
		Family Situation or Family Background	5
Autonomous learning ability	Learning motivation	Initiative in acquiring knowledge	6,7
		Sense of value	8,9
		Self-responsibility	10,
		Self-efficacy	11,12
	Learning strategies	Summarization strategy	13

|		
	Elaboration strategy	14,15
	Organization strategy	16
	Revision strategy	17
	Planning	18,19
Self-monitoring	Time Management	20,21
	Learning Willpower	22
	Process Monitoring	23
	Self-assessment	24
	Self-summary	25,26
Self-regulation	Self-evaluation	27
	Self-reinforcement	28,29
	Physical environment	30,31
Learning environment	Social environment	32
	Digital environment	33

Research Hypothesis

The hypotheses of this study include three points: first, after the experiment, the autonomous learning ability of college students in the experimental type that contains blended educating primarily based on deep learning theory has increased. Second, the autonomous learning ability carrying out blended instructing based totally on deep learning principle is greater than that of the regular educating class. Third, the blended instructing cultivation method based totally on a deep learning theory developed in this find out about is tremendous and wonderful for the cultivation of students' autonomous learning ability in greater vocational colleges.

Experimental Variables

In this study, the independent variable is two different instruction model; the experimental category was once taught the use of blended getting to know primarily based on deep learning theory, and the manage type was once taught the usage of usual teaching. Students' autonomous learning ability is used as the dependent variable. In order to limit the interfering variables in this learn-about and make certain the authenticity and effectiveness of the experimental effect, the two problem instructions chosen in this learn-about have identical majors, the students' levels in all aspects are roughly the same, and the teaching contents, teaching environment, lecturers, teaching time and teaching resources of the two subject classes are kept the same in all aspects in the experiment.

Theoretical basis of the study

Under the guidance of relevant theories, the connection between core literacy, deep learning and blended learning was analyzed, as shown in Figure 3.1.
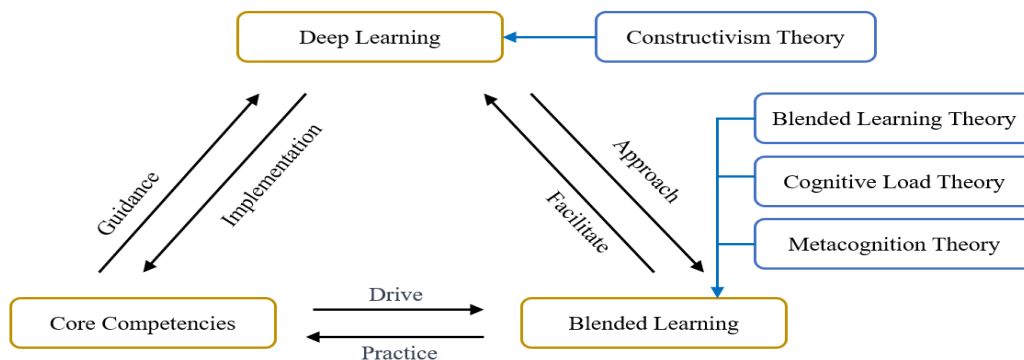
Fig. 3.1 The Foundation of Blended Learning Theory based on the Concept of Deep Learning

(1) Constructivist Theories

Among the personal constructivist theories that are relevant to this study are generative learning theory and cognitive flexibility theory[31-33]. Generative learning theory emphasizes the learner's subjectivity and that the learner should take the initiative to construct information in a meaningful way. The cognitive flexibility theory advocates that students should be provided with the necessary information needed to understand new knowledge but should be left with a wide space for knowledge construction, and learners should be able to relate the acquired knowledge to specific situations to solve practical problems. The social constructivist theory emphasizes that students construct new experiences by participating in concrete, practical activities and peer cooperation and mutual assistance in completing tasks.

(2) Cognitive Load Theory

In 1988, cognitive psychologist John proposed the cognitive load theory. This theory considers the cognitive load of the learner, which is composed of dimensions reflecting the task, reflecting the learner characteristics, reflecting the mental load, and mental effort. Among them, task characteristics consist of task form, complexity, and instructional steps; learner characteristics consist of expertise level, age, and spatial ability. The cognitive load concept suggests that there are three sorts of cognitive load: inside cognitive load, exterior cognitive load, and associated cognitive load. Internal cognitive load relies upon the main on project and learner traits and the interplay between them. The most important purpose for exterior cognitive load is incorrect academic design. In the procedure of teaching, we ought to decrease the exterior cognitive load and limit the interior cognitive load so that the complete cognitive load is inside the tolerance of person newbies[34].

(3) Metacognition Theory

Metacognition refers to the self-monitoring and regulation of self-perception by learners, and metacognitive research has an important role to play in developing reflective behavior and critical spirit in students[35]. An important feature of deep learning is the input of higher-order thinking by the learner during the learning process, while metacognition emphasizes the individual's monitoring, regulating, and evaluating of self-cognition, which is a comprehensive ability that focuses on higher-order thinking skills.

(4) Theory of Blended Instructing

Blended instructing refers to the mixture of online and offline teaching, combining the blessings of both, enhancing the shortcomings of regular educating strategies as tons as possible, and combining the benefits of face-to-face instructing and online teaching in order to acquire the excellent instructing effect, which is a quite new educating method[36]. Regarding the mastering environment, blended instructional models can successfully aid students' unbiased getting to know thru cellular gadgets (cell phones, computers, etc.), and the mastering things to do are now not solely restrained to the classroom, however additionally permit college students to examine every time and anywhere, and the area of gaining knowledge of is determined by way of themselves. Regarding learning resources, learning resources in traditional teaching methods are usually teaching materials, books, tutorials, etc., while blended teaching resources, which are mainly online resources such as audio and video resources, image resources, picture resources and animation resources, are not only limited to books and teaching materials, and the learning resources are very rich and varied. This form is more conducive to students' active learning and self-construction of knowledge. Regarding teaching methods, blended teaching includes online teaching on the platform, independent inquiry learning in offline classes, and students' independent learning through personalized teaching resources, which fully embodies the students' main position in the teaching process.

Blended instructing model based on deep learning theory

This study divides blended teaching into a pre-course learning stage, a classroom experience and inquiry stage, and a post-course reflection and enhancement stage, as shown in Figure 3.2. The main preparations needed in the pre-course learning phase of blended teaching are (1) task-driven. Teachers design and send learning task sheets, students browse the learning task sheets and assign task activities. (2) Online learning. Teachers provide platform learning websites and learning content resources, and students enter the platform to learn new content independently. (3) Learning diagnosis. Teachers test students' self-learning effect according to the platform data; students complete unit quizzes and discussion activities. The classroom experience and inquiry stage includes (1) situational experience. Teachers create situations, guide and inspire; students participate in the experience, interactive exchange. (2) Consultation and mutual support. Teachers establish grouping mechanisms to provide learning support; students form communities and negotiate to participate in practical exploration. (3) Presentation and sharing. Teachers organize groups to report and exchange project results; groups, in turn, exchange and display project results. The post-lesson reflection and enhancement stage includes (1) consolidation and summarization. Teachers should help students to summarize and refine the core concepts and eventually form long-term memory; students should refine and structure what they have learned and the results and construct personal knowledge networks. (2) Multi-dimensional evaluation. Teachers use classroom observation method, group mutual evaluation, questionnaires, evaluation scales and other forms to carry out process and summative evaluations in multiple dimensions,

such as classroom performance, learning engagement, satisfaction, deep learning ability, etc.; students carry out self-assessment and mutual evaluation of group cooperative learning, and evaluate their satisfaction with the teaching objectives, teaching content, teaching activities and teaching effects to master their own learning. (3) Reflection and enhancement. Teachers arrange to learn reflection activities, learning to re-examine their own learning process, to achieve effective reorganization of knowledge and migration beyond, to achieve deep processing of experience, and to submit summary materials in written form.
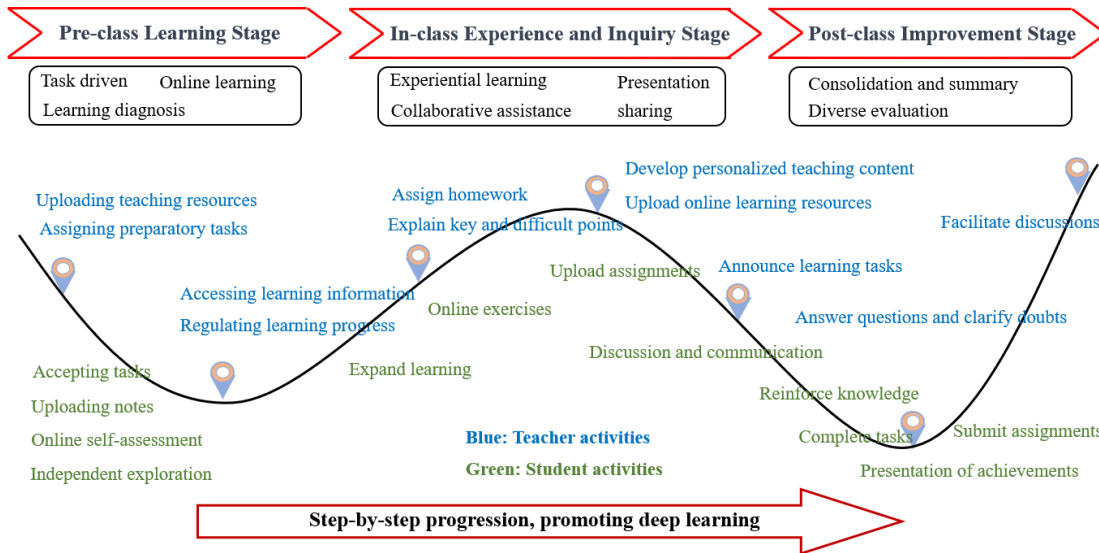
Fig. 3.2 Blended Learning Process Model

4 Results and discussion

1.Comparative analysis

(1) Analysis of the overall level pre-test for both classes

The two training in which they were positioned were measured separately, and then the recovered records were subjected to paired samples t-test of the usage of statistical software. As proven in Table 4.1 and Table 4.2, earlier than the experimental study, the autonomous learning ability of the college students in the experimental classification and the manage classification used to be essentially the same, and the autonomous learning ability of the college students in the two training was once no longer a good deal different, and there used to be no sizable distinction between the autonomous learning ability of the experimental category and the manage class. In summary, earlier than carrying out the instructing experiment, the hole between the two training of college students as topics in the autonomous learning ability is now not notably different, so it meets the simple necessities for carrying out this realistic research.

Table 4.1 Comparative Descriptive Statistics of Pre-tests between Experimental Group and Control Group

Class	Sample Size	Mean	Standard Deviation
Experimental Group Pre-test	50	3.215	.214
Control Group Pre-test	50	3.125	.239

Table 4.2 Paired-sample T-test between Experimental Group and Control Group Pre-tests

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Experimental Group Pre-test - Control Group Pre-test	.0638	.1469	.0266	.0164	.1076	2.54	39	.063

(2) Post-test analysis of the overall level of the two classes

As can be considered from Table 4.3 and Table 4.4, the college students in the experimental type had an excessively make bigger in their impartial studying capacity after the exercise of blended teaching, whilst the extent in the autonomous learning ability of the managed class, which used the normal instructing method, was once now not obvious. And there is a large distinction in the suggested fee of autonomous learning ability between the experimental category and the managed classification in the posttest. This can exhibit that the blended instructional model based totally on the deep learning theory has an effective impact on cultivating students' autonomous learning ability in higher vocational colleges and universities.

Table 4.3 Comparative Descriptive Statistics of Post-test between Experimental Group and Control Group

Class	Sample Size	Mean	Standard Deviation
Experimental Group Post-test	50	3.741	.451
Control Group Post-test	50	3.165	.237

Table 4.4 Paired-sample T-test between Experimental Group and Control Group Post-test

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Experimental Group Post-test - Control Group Post-test	.5238	.5469	.0866	.4024	.7641	7.34	39	.000

(3) Comparative analysis of pre-tests and post-tests of autonomous learning ability in experimental classes

The descriptive data of the pre-test and post-test comparisons of the independent gaining knowledge of manageable of the experimental classification are tested in Tables 4.5, which exhibit that the college students in the experimental type have expanded their autonomous learning ability after the implementation of blended educating primarily based on the deep learning theory.

From Table 4.6, it can be considered that there is a good sized distinction between the autonomous learning ability of college students earlier than and after the experiment, which shows that this experimental learn about helps to enhance the autonomous learning ability of the students and that the usage of the blended educating mannequin based totally on the principle of deep studying proposed by way of this find out about to domesticate the autonomous learning ability of the college students is effective.

Table 4.5 Comparative Descriptive Statistics between Pre-test and Post-test for the Experimental Group

Class	Sample Size	Mean	Standard Deviation
Experimental Group Pre-test	50	3.242	.226
Experimental Group Post-test	50	3.769	.479

Table 4.6 Paired-sample T-test for Pre-test and Post-test in the Experimental Group

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Experimental Group Pre-test - Experimental Group Post-test	-.5530	.5389	.0867	-.7477	-.3741	-6.34	39	.000

(4) Comparative evaluation of pre-tests and post-tests of autonomous learning ability in the manipulate class

As can be considered from Table 4.7 and Table 4.8, there is no great alternative to autonomous learning ability of college

students in the managed type earlier than and after the experiment. Therefore, instructors can accurately use one-of-a-kind educating techniques to enhance students' autonomous learning ability when teaching.

Table 4.7 Comparative Descriptive Statistics between Pre-test and Post-test for the Control Group

Class	Sample Size	Mean	Standard Deviation
Control Group Pre-test	50	3.132	.266
Control Group Post-test	50	3.181	.247

Table 4.8 Paired-sample T-test for Pre-test and Post-test in the Control Group

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Control Group Pre-test - Control Group Post-test	-.0353	.3369	.0612	-.1437	.0874	-.594	39	.532

In summary, earlier than carrying out blended instruction based totally on deep mastering theory, there is nearly no distinction between the autonomous learning ability of the potential of college students in the experimental type and the manipulated class, and there is no sizable difference. And after carrying out the experimental teaching, the autonomous learning ability of the potential of the college students in the experimental classification used to be extensively improved, which was once considerably higher than that of the manipulated class. Meanwhile, the autonomous learning ability of the manipulated classification of college students in the pre-and post-tests did now not enhance significantly, and there was once no enormous difference. Therefore, it can be concluded that the blended educating mode based totally on deep getting-to-know ideas has a full-size impact on cultivating the autonomous learning ability of college students in higher vocational faculties and universities.

2. Comparative analysis of pre-and post-tests on the dimensions of autonomous learning ability of students in experimental classes

(1) Comparative evaluation of pre-tests and post-tests of learning motivation

According to Table 4.9 and Figure 4.1, the distinction between the experimental category students' "learning motivation" earlier than and after the experimental find out about is 0.607, which suggests that the students' autonomous learning ability has an excessive degree of improvement. From Table 4.10, we can see that t=-5.641, the p-value is zero, much less than 0.05, so there is a substantial distinction between the implied price of students' " learning motivation " earlier than and after the experimental study, i.e., there is a significantly enhancement in students' "motivation to learn" in the experimental class. This suggests that the blended instructional model primarily based on the deep learning theory has a wonderful impact on enhancing students' learning motivation.

Table 4.9 Comparative Descriptive Statistics for Pre-test and Post-test of Students' Ability to Stimulate Learning Motivation

Class	Sample Size	Mean	Standard Deviation
Pre-test of the ability to stimulate learning motivation	50	3.324	.417
Post-test of the ability to stimulate learning motivation	50	3.931	.519

Fig. 4.1 Comparative Descriptive Statistics for Pre-test and Post-test of Students' Ability to Stimulate Learning Motivation

Table 4.10 Paired-sample T-test for Students' Ability to Stimulate Learning Motivation between Pre-test and Post-test

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
test of the ability to stimulate learning motivation (Pre-Post)	-.6153	.7729	.1322	-.9426	-.4234	-5.641	39	.000

(2) Comparative analysis of pre-tests and post-tests of self-monitoring

According to Table 4.11 and Table 4.12, the enhancement cost of the "self-monitoring"ability of college students in the experimental type is the absolute best amongst the 5 dimensions, which shows that blended instructing model based totally on deep studying concept can domesticate students' self-monitoring capacity well, and the enhancement impact is noticeably obvious. The giant enlarge in the suggested cost of self-monitoring capability of college students in the experimental type suggests that college students can set their personal getting-to-know dreams nicely when studying in the blended educating mode based totally on the deep mastering theory, and they can distinguish the understanding that is extra beneficial to them and pick out the know-how that is appropriate for them to learn, so as to make certain that their gaining knowledge of meets their personal needs.

Table 4.11 Comparative Descriptive Statistics for Pre-test and Post-test of Students' Self-monitoring Ability

Class	Sample Size	Mean	Standard Deviation
Pre-test of students' self-monitoring ability	50	2.814	.617
Post-test of students' self-monitoring ability	50	3.943	.539

Table 4.12 Paired-sample T-test for Self-Monitoring Ability between Pre-test and Post-test

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Pre-test of students' self-monitoring ability - Post-test of students' self-monitoring ability	-1.16	.9329	.1522	-1.426	-.8234	-7.521	39	.000

(3) Comparative Analysis of Learning Strategies before and after the Experimental Study

From Table 4.13 and Table 4.14, it can be considered that there is a good-sized distinction between the pre and publish capability of students' "learning strategy" ability. Thus, it can be viewed that the experimental category students' "learning strategy" capability has considerably improved, which skill that the blended instructing model based totally on the deep learning theory has a large impact on enhancing students' gaining knowledge of method ability.

Table 4.13 Comparative Descriptive Statistics for Pre-test and Post-test of Students' Ability to Use Learning Strategies

Class	Sample Size	Mean	Standard Deviation
Pre-test of Ability to Use Learning Strategies	50	2.931	.367
Post-test of Ability to Use Learning Strategies	50	3.513	.429

Table 4.14 Paired-sample T-test for Pre-test and Post-test of Ability to Use Learning Strategies

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Pre-test of Ability to Use Learning Strategies - Post-test of Ability to Use Learning Strategies	-.512	.5429	.0862	-.7413	-.3213	-6.14	39	.000

(4) Comparative analysis of pre-and post-tests of self-regulation

Table 4.15 and Table 4.16 exhibit that the "self-regulation" capacity of college students in the experimental classification has improved, indicating that blended instructing model based totally on deep learning theory is nice in enhancing students' self-regulation ability.

Table 4.15 Comparative Descriptive Statistics for Pre-test and Post-test of Self-regulation Ability

Class	Sample Size	Mean	Standard Deviation
Pre-test of Self-regulation Ability	50	3.271	.517
Post-test of Self-regulation Ability	50	3.546	.529

Table 4.16 Paired-sample T-test for Pre-test and Post-test of Self-regulation Ability

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Pre-test of Self-regulation Ability - Post-test of Self-regulation Ability	-.292	.7429	.1262	-.5413	-.0321	-2.31	39	.027

(5) Pre- and post-test comparative analysis of learning environment

According to Table 4.17, it can be considered that the experimental type students' capability of "learning environment" has barely improved, which is the smallest enhancement among the 5 dimensions. From Table 4.18 and Figure 4.2, it can be viewed that there is no considerable distinction between the suggested values of students' "learning environment" potential earlier than and after; that is to say, there is no apparent enhancement in students' "learning environment" ability, that is to say, blended instructing based totally on the idea of deep learning theory of fails to enhance students' capacity of evaluating mastering effects effectively, which capability that blended educating primarily based on the deep learning theory of is now not capable of decorating students' capacity of evaluating gaining knowledge of outcomes. That is to say, the blended

instructing model based totally on the deep learning theory fails to enhance students' capacity to evaluating mastering effects, mostly due to the fact college students have ample cognizance of growing a mastering environment and their potential to create mastering surroundings is additionally rather strong. Therefore, it is tough to enhance the student's capacity to create gaining knowledge of environments in the subsequent experimental teaching.

Table 4.17 Comparative Descriptive Statistics for Pre-test and Post-test of Students' Ability to Create a Learning Environment

Class	Sample Size	Mean	Standard Deviation
Pre-test of the Ability to Create a Learning Environment	50	3.661	.587
Post-test of the Ability to Create a Learning Environment	50	3.746	.639

Table 4.18 Paired-sample T-test for Pre-test and Post-test of Students' Ability to Create a Learning Environment

	Mean	Standard Deviation	Standard Error of Mean	95% Confidence Interval for the Difference		t	df	Sig. (2-tailed)
				Lower Limit	Upper Limit			
Pre-test of the Ability to Create a Learning Environment - Post-test of the Ability to Create a Learning Environment	-.0792	.8629	.1362	-.3413	.2321	-.531	39	.567
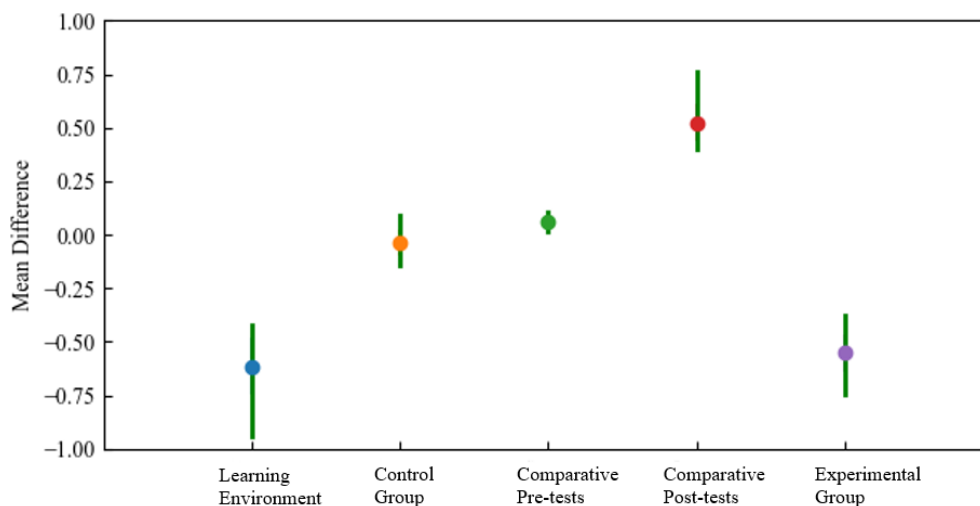
Fig. 4.2 Paired-sample T-test summary

After ending and inspecting the data, it is determined that the posttest implies that the experimental classification is substantially greater than the posttest suggests of the class, with an enormous difference, which suggests that the blended instructing based deep learning theory developed in this find out about is most efficient to the typical instructing approach in cultivating the autonomous learning ability of the college students in higher vocational schools and universities. In addition, without the distinction between the posttest imply, and the pretest implies of the dimension of developing getting to-know surroundings capability in the experimental class, the posttest ability of all the different dimensions is extensively greater than the pretest mean, which can confirm that the blended instructing mode based totally on deep getting to know idea built in this find out about can successfully domesticate the autonomous learning ability of college students in higher vocational colleges.

5 Conclusions

(1) In the instructing of Mental health education class, following the blended instructing models based totally on deep learning, the grades of the experimental classification and the manage class earlier than and after had been in contrast and analyzed. The common ratings of the two instructions were shut earlier than the implementation of blended teaching. However, after the implementation of blended instructing models, the ratings of the two training differed significantly. The common rating of the experimental type used to be substantially greater than that of the class. The assessment consequences exhibit the effectiveness of the blended instructing models based totally on deep learning.

(2) During the blended teaching process based on deep learning, an equal dialogic teacher-student relationship was established in the online platform, which stimulated a positive emotional state. Based on the standards, three stages of learning objectives were designed before, during and after the class to proceed from shallow to deep and ultimately promote deep learning. The after-school personalized learning stage homework is layered and accompanied by complete homework video explanations, suitable for students at all stages of learning. Every time students complete a stage of learning, they will carry out self-evaluation and reflection in a timely manner, through which students gradually learn reflective learning, improve their ability to learn and develop higher-order thinking. Through this sequence of activities, college students are inspired to interact in-depth, mastering and enhancing their mental health literacy and autonomous learning ability.

This study adopts the method of quantitative analysis and utilizes the questionnaire to investigate the learning effect of students under the blended instructional models, and has achieved certain research results. However, there are still some deficiencies:

(1) Limitations of the research sample. This study mainly focuses on the students of Heilongjiang Agricultural Economics Vocational College as the research object, the sample selection is limited and the sample size is small. There is no research study with a large sample to argue the effect of blended instructional models on the fruit of students' autonomous learning ability.

(2) The research methods are relatively single. The research methods used in this study are fewer, mainly including the literature research method, questionnaire survey method and data analysis method. The research methods are more single and general, and more research methods are not used.

Conflicts of Interest Statement

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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