Implementation of Cooperative Learning Method to Enhance the Students' Learning Ability and Students' Core Competencies

Siyong Tang

A Thesis Submitted in Partial Fulfillment of Requirements for

degree of Master of Education in Curriculum and Instruction

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ABSTRACT

As a creative and effective teaching organization form and teaching strategy, cooperative learning method plays an important role in education and teaching. The purpose of this article's research is to use cooperative learning teaching methods to improve students' learning abilities and students' core competencies. The research sample is a total of 60 students in two classes of the physics major of Guangxi Normal University for Nationalities. Each class has 30 students. They are divided into a control group and an experimental group according to the class: Method 1: Control group is taught using traditional teaching methods; Method 2: Experimental group used cooperative learning teaching method for teaching. Research tools: (1) Traditional teaching method teaching design and cooperative learning method teaching design. (2) One student learning ability questionnaire. The same questionnaire is used for pre-test and post-test. The confidence value range of the student learning ability questionnaire is 0.67-1.00. (3) One student core literacy questionnaire. The same questionnaire is used for pre-test and post-test. The confidence value range of the student core literacy questionnaire is 0.67-1.00. The questionnaire was designed using a Likert scale, the questionnaire used a 5-point scale, and the mean and standard deviation were used to analyze the data.

The research results are as follows: (1) The learning ability after Implementation of cooperative learning method is higher than that of traditional teaching method ($P<0.05$). (2) The core competencies after Implementation of cooperative learning method teaching is higher than that of traditional teaching method ($P<0.05$).

Keyword : Cooperative learning, Instructional design, Learning ability, Core competencies

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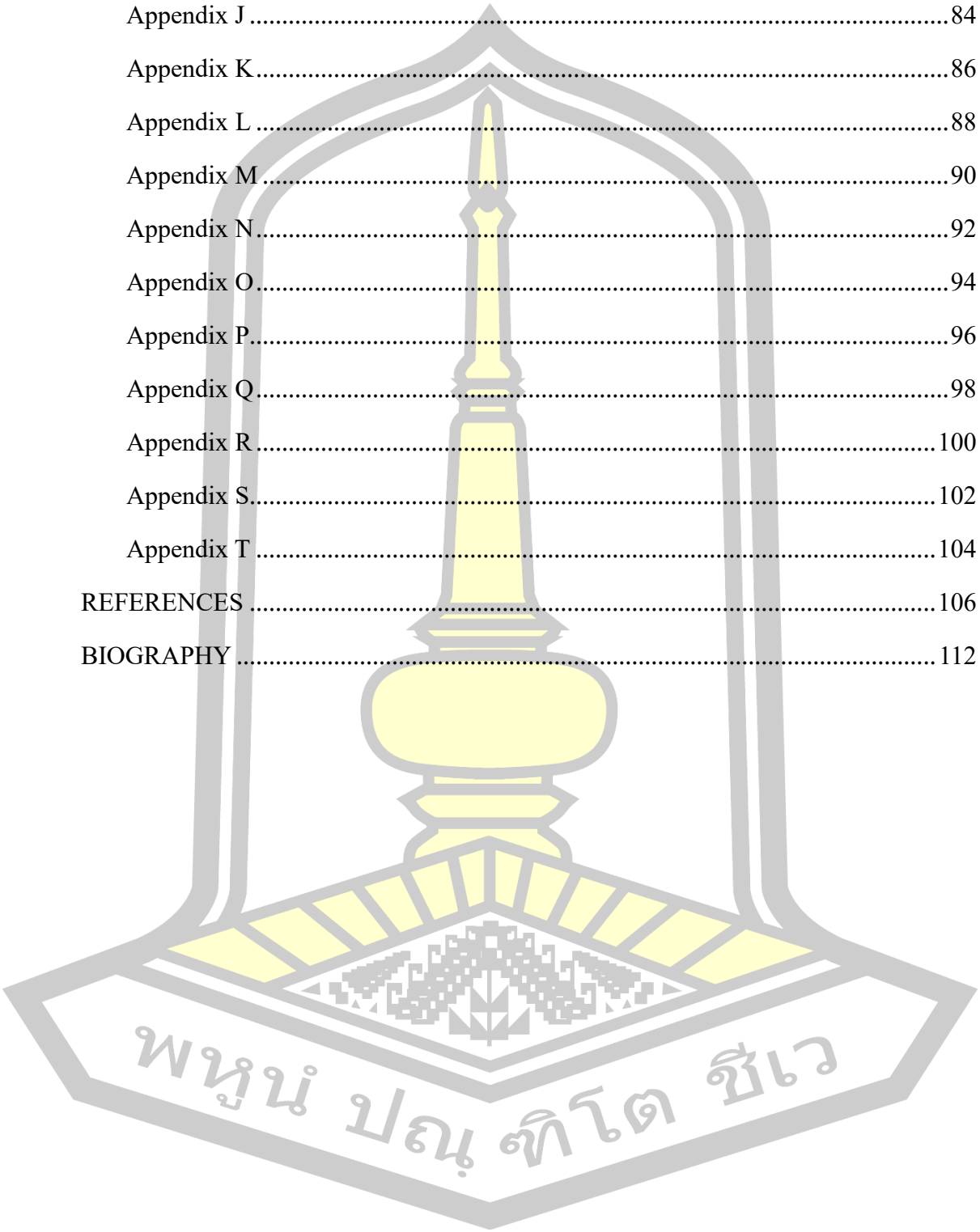

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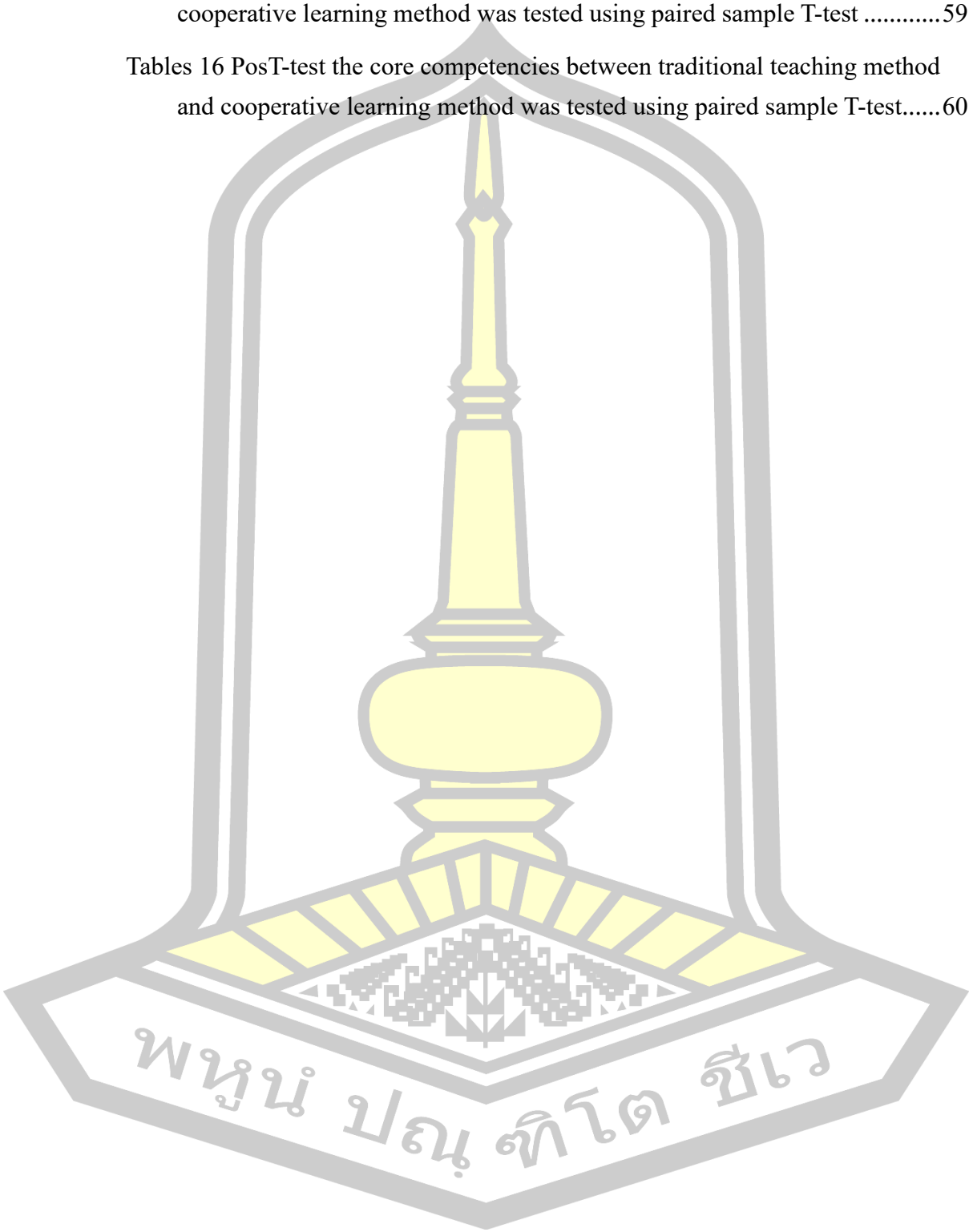

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CHAPTER I

INTRODUCTION

1.1 Background

As my country's education reform continues to deepen, more and more education researchers realize that simply cultivating students' basic knowledge and skills can no longer meet the needs of future society. At present, finding ways to enhance students' learning abilities and students' core competencies has become a consensus in the education community. How to enhance students' learning abilities and students' core competencies has always been a hot topic among education scholars. Ouane, (2009) explains in this way, "The illiterates of the future will no longer be illiterate people, but people who have not learned how to learn." Learning ability is the ability to learn. It is a generalized experience formed under the influence of environment and education. Learning ability is a part of human ability, and it is also a very important part. Everyone has the ability to learn, but the gap in learning ability will affect learning efficiency and learning results. Roy et al., (2020) clearly defines core competencies as “the necessary character and key abilities that students gradually form in the process of receiving education at the corresponding school stage to meet the needs of personal lifelong development and social development.” Core competencies clearly tell us what factors need to be prioritized: 1. Core competencies are curricular factors related to the adult society, life and career that students will face in the future, Therefore, core competencies is in the adult society; 2. Core competencies only refers to those characters and abilities that meet the necessary conditions we usually know, and the function of the necessary conditions is to draw the bottom line and establish the threshold. Russell, (2016) further interpretation: Core competencies “represent the minimum common requirements that should be achieved and are indispensable competencies for every individual.” Kavic, (2002) Students’ core competencies refer to the necessary qualities and key abilities that students should possess and be able to adapt to the needs of lifelong development and social development. The purpose of

integrating students' core competencies in education and teaching is to "all-round development of people" as the core and lay a solid foundation for students' lifelong development. It can be seen that students' learning ability and students' core competencies are complementary to each other, which is why many researchers in the education field are looking for ways to enhance students' learning ability and students' core competencies. Enhancing students' learning abilities and students' core competencies is better for students' all-round development and adaptation to lifelong development. This shows the importance of research on enhance students' learning abilities and students' core competencies.

(1) It is well known that students with strong learning ability and core competencies have high learning efficiency, but how to enhance students' learning ability and core competencies is one of the problems currently faced by the education community. X. Liu, (2014) believes that the reasons for students' low learning ability and core competencies are: 1. Improper education methods. Modern education has a curriculum system based on age groups, but it has lost the essence of "education". Education emphasizes the cultivation and all-round development of talents, but it only treats students as a whole and does not pay attention to the development of students' unique abilities. It only focuses on the transmission and acquisition of knowledge, but lacks the cultivation of students' unique abilities. At the same time, modern education focuses too much on theoretical knowledge and neglects the cultivation of practical abilities. 2. Limited cognitive level. Many people are often limited by their own "IQ" and believe that they are inferior to others, thus doubting their own abilities. This way of thinking hinders the development of their own abilities. 3. Lack of exercise. If we want to develop our own abilities, the most basic requirement is to practice to gain true knowledge, that is, countless exercises can test and enhance our abilities. However, in modern life, we often lack opportunities to practice and practice due to various reasons. 4. Lack of observation. Observation is the first step in developing abilities. For a person who lacks observation skills, it is difficult for him to achieve further growth and

progress no matter how hard he works. 5. Fixed thinking patterns. Many people are accustomed to thinking about problems in their own way and always adopt the same way of thinking to analyze complex problems. This way of thinking will make us ignore the diversity and variability of the problem, and thus fail to discover the essence and essence of the problem. 6. Lack of directionality. Many people often do not have particularly clear learning goals and directions, and do not know how to make plans and advance step by step. In short, learning ability and core competencies can be enhanced through continuous learning and practice. Only when we truly understand the abilities we lack and achieve repeated training through high-quality, can we stimulate our inner value and potential. Break the bottleneck of learning and achieve maximum self-development and enhancement.

(2) With the continuous in-depth reform of education, more and more attention has been paid to enhancing students' learning abilities and core competencies. However, there are relatively few effective ways to truly enhance students' learning abilities and core competencies. N. Zhang, (2015) Research shows that the reasons for the difficulty in enhancing students' learning abilities and core competencies are: 1. The atmosphere for learning abilities and core competencies is not strong. Affected by the strong impact of the material economy, people's understanding of learning abilities and core competencies is insufficient. It is only limited to some scholars and has not attracted strong attention in the entire society. 2. Educators, families, and students lack understanding of learning abilities and core competencies, resulting in greater resistance. In modern education, especially among basic educators, there is not a strong sense of recognition of learning abilities and core competencies as leaders in talent cultivation. Although education reform has gone through a period of time, focusing on the cultivation of students' "three-dimensional goals", they pay more attention to the cultivation of "knowledge and skills". Learning ability and core competencies embody the two goals of "process and method" and "emotional attitude and value". It is natural that learning ability and core competencies are not taken seriously. 3. Learning abilities

and core competencies run through the curriculum standards, but with different emphasis. In the currently implemented curriculum standard system, learning abilities and core competencies are both reflected, but the differences are large. In the current curriculum standard system, aspects such as learning literacy, language literacy, and scientific literacy are mentioned more frequently, while life management ability, adaptability, and conflict resolution ability are mentioned less frequently. In order for students to adapt to future social life and form lifelong learning abilities and core competencies, learning abilities and core competencies such as life management ability, adaptability, and conflict resolution skills are particularly important. Efforts must be made to resolve this difference so that students can develop in an all-round way. Become a person suitable for future society. 4. Learning abilities and core competencies do not contribute enough to talent cultivation. Quality education is a talent training model that has been vigorously promoted by the country in the past 30 years. Making education "quality" is the goal that quality education continues to pursue. It is recognized by the majority of educators, but learning ability and core competencies are not yet recognized. However, learning abilities and core competencies are integrated into quality education and at the same time are higher than quality education. Because learning ability and core competencies pay more attention to the reality of life and practical ability, they are adapted to contemporary economic and social development, and are also the inevitable way to future social talents. The development of students' learning abilities and core competencies requires students to adapt to future social development and acquire key abilities and essential qualities for lifelong learning. Then it is necessary to conduct in-depth research and development of students' learning abilities and core competencies to form a complete system to guide them. Talent cultivation.

(3) The current teaching method is still dominated by traditional teaching methods, which have some advantages and disadvantages. Bhavsar et al., (2022) believe that the advantage of traditional teaching methods is that it helps teachers play a leading role,

can systematically impart subject knowledge, promote emotional communication between teachers and students, and promote the collision of inspiration between students and teachers in teaching courses. , enhance learning efficiency and lower investment costs. These advantages should continue to be carried forward. Yuan et al., (2014) believe that traditional teaching methods are also not conducive to comprehensively enhancing the comprehensive quality of teachers, not conducive to broadening the horizons and knowledge of teachers and students, not conducive to cultivating students' independent learning abilities, and not conducive to enhancing teaching efficiency. and other shortcomings. These shortcomings indicate that traditional teaching methods are relatively single, rarely use modern teaching equipment, have low requirements for teachers and students, and lack two-way information exchange and integrity guarantees of teaching content. Therefore, we should make full use of the advantages of traditional teaching and combine it with modern teaching methods and equipment to enhance the overall quality of teachers, broaden the horizons of teachers and students, students' independent learning abilities, and enhance teaching efficiency. Only in this way can we better adapt to the development of the times and meet the learning needs of students.

In response to the above existing problems, how to solve the shortcomings of traditional teaching methods and enhance students' learning abilities and students' core competencies, a new cooperative learning method was applied. This article elaborates on the characteristics and advantages of the cooperative learning method, effectively applies the advantages of the cooperative learning method to the classroom, and focuses on enhancing students' learning abilities and core competencies. Effectively carrying out cooperative learning method teaching requires enhancing students' enthusiasm and initiative in learning, and cultivating students' cooperation and exploration spirit.

1.2 Research purpose

This article is to implement of cooperative learning methods to enhance students' learning abilities and students' core competencies. Implement of cooperative learning

methods to stimulate students' enthusiasm and initiative in learning and enhance learning efficiency. Purpose :

(1) Compare the learning abilities of students in cooperative learning method and traditional teaching.

(2) Compare the core competencies of students in cooperative learning method and traditional teaching.

1.3 Research hypothesis

(1) After implementing cooperative learning method, students' learning ability is higher than that of traditional teaching method.

(2) After implementating cooperative learning method, students' core competencies is higher than those of traditional teaching method.

1.4 Research scope

1.4.1 Population and sample

The population of This article is students majoring in physics at Guangxi Normal University for Nationalities. The physics major has 6 classes with a total of 184 students. Through cluster random sampling, two classes were selected for the teaching experiment. Each class has 30 students, and a total of 60 students will participate in this teaching experiment. Then the two selected classes were randomly assigned into class A and class B, with class A as the control group using traditional teaching, and class B as the experimental group using cooperative learning method.

1.4.2 Content

(1) Teaching method content

Two classes in the physics major use two different teaching methods. Method 1: The control group uses traditional teaching methods; Method 2: The experimental group uses cooperative learning methods.

The control group and the experimental group used the same teaching content and two different teaching methods. After two different teaching methods, compare the learning abilities and core competencies of students in Method 1: the control group

applies traditional teaching methods and Method 2: the experimental group applies cooperative learning method.

(2) Content of dependent variable

The dependent variables studied in this article are students' learning abilities and core competencies. Implement of cooperative learning methods to enhance students' learning abilities, and Implement of cooperative learning methods to enhance students' core competencies.

1.4.3 Research variables

1. Independent variables : two different teaching methods

(1) Cooperative learning method.

(2) Traditional teaching method.

2. Dependent variables

(1) Students' learning abilities.

(2) Students' core competencies.

1.4.4 Duration

The research time of this article lasts for two months from November 2023 to December 2023. The overall arrangement is as follows:

The first stage: pre-test. Send the learning ability questionnaire and core competencies questionnaire to the experimental students to fill out and collect them in time and make statistics. Obtain the pre-test learning ability and core competencies of the experimental students , and observe the students in the two classes while conducting the experiment. Are there any significant differences before? The experiment was conducted for two months without significant differences .

The second stage: After the posT-test, the learning ability questionnaire and core competencies questionnaire will be sent to students to fill out and collected in time and statistics will be collected to obtain the post- test learning ability and core competencies of the experimental students , and observe the students in the two classes. Are there any significant differences after the experiment ?

1.5 Terminology

1.5.1 Teaching methods

Teaching methods are the general term for the behaviors teachers and students take in teaching activities in order to achieve teaching goals and teaching task requirements during the teaching process, including the following two methods:

(1) Traditional teaching method.

The traditional teaching method is a teacher-centered, book-centered and classroom-centered teaching model. Teachers give systematic and detailed explanations, and students passively master a large amount of knowledge. Before the start of class, students mainly rely on students to take the initiative to preview through books. In class, the teacher will explain the knowledge in the book systematically and carefully. Students imitate teachers to achieve the purpose of learning. After class, they complete homework assigned by the teacher.

(2) Cooperative learning method

Cooperative learning method is a teaching design for cooperative learning before teaching activities, including grouping students into heterogeneous groups, guiding students to engage in cooperative learning and communication within and between groups, and advocating the formation of mutual help, mutual love, and mutual encouragement among group members. Relationship. It is a teaching strategy that achieves team awareness, accomplishes learning goals together, and ultimately uses the performance of the entire group as the judging criterion.

1.5.2 Learning ability

Learning ability is the method and technique of learning. With such methods and techniques, after learning knowledge, professional knowledge will be formed; learning the methods and techniques of how to execute will form execution ability. Learning ability is the basis of all abilities.

Students' learning ability is one of the important indicators for evaluating their personal qualities. Learning ability includes the ability to draw inferences from one

example, analyze and solve problems, the rationality of thinking logic and the flexible use of learning methods. The indicators used in This article to evaluation students' learning ability include five dimensions: reading ability, comprehension ability, memory, concentration and creativity.

The assessment method of students' learning ability adopts questionnaire and follows the Likert scale design. The students' learning ability questionnaire is designed to measure five items: reading ability, comprehension ability, memory, concentration and creativity. The questionnaire uses a 5-level scale. The questions in the questionnaire design should be simple and clear, the sentences should be popular, and double negatives should be avoided.

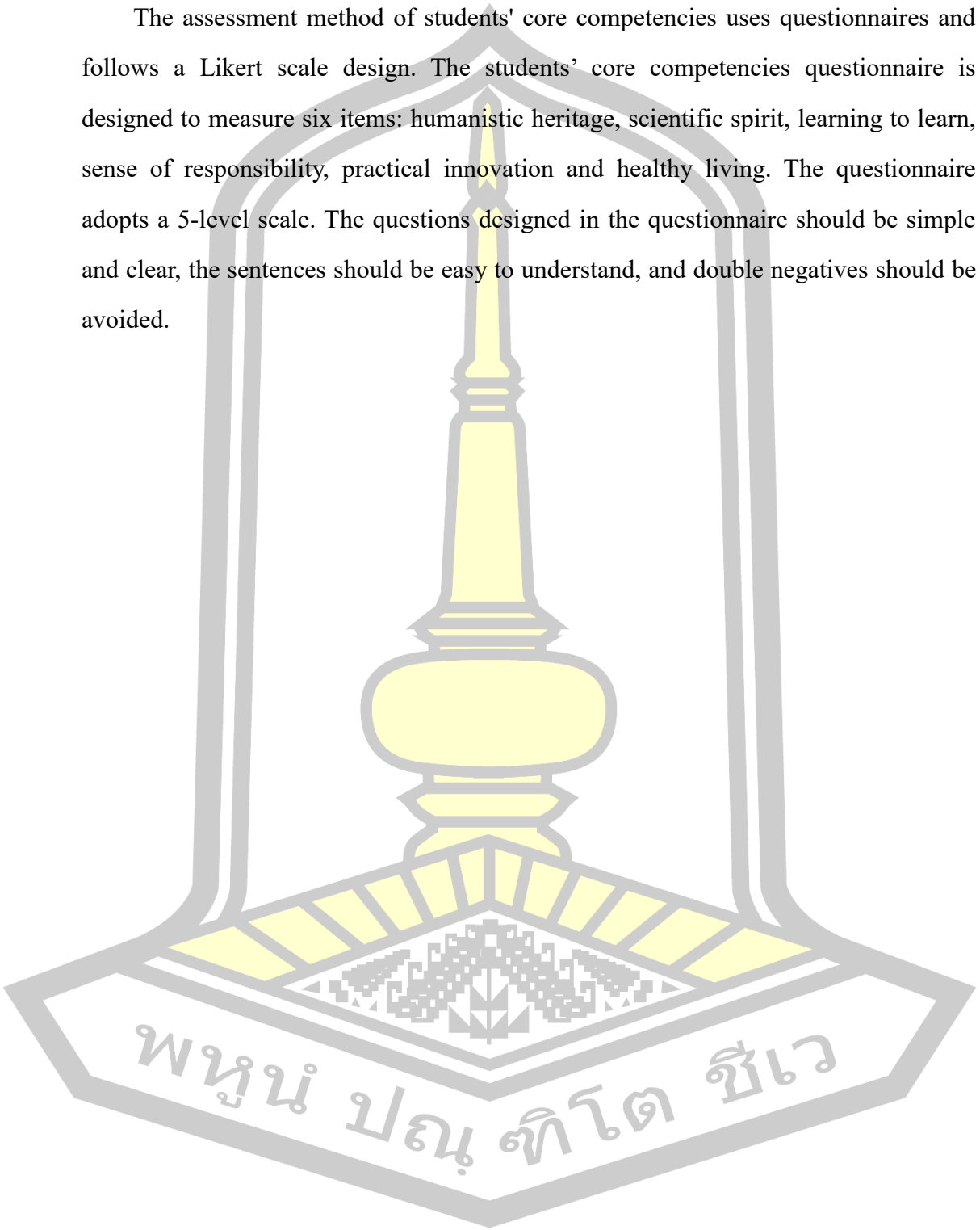
1.5.3 Core competencies

Core competencies are the necessary characters and key abilities that students gradually develop to meet the needs of personal lifelong development and social development during the education process at the corresponding school stage. It is a combination of students' knowledge, skills, emotions, attitudes, values and other requirements; it is process-oriented, focusing on students' understanding in the training process, rather than being result-oriented; at the same time, core competencies have both stability and openness Nature and development are a dynamic optimization process that accompanies lifelong sustainable development and advances with the times. It is the basic guarantee for individuals to adapt to future society, promote lifelong learning, and achieve all-round development.

Assessment of students' core competencies: 1. Clarify the connotation and requirements of core competencies, and formulate specific and operable evaluation standards. 2. Establish students' core competencies files to record the development of students' core competencies at each stage of schooling. 3. Conductcore competencies evaluations regularly, provide timely feedback on evaluation results, and promote students' self-reflection and enhancement. The indicators used to evaluation core competencies in This article include six dimensions: humanistic heritage, scientific

spirit, learning to learn, healthy living, responsibility, and practical innovation.

The assessment method of students' core competencies uses questionnaires and follows a Likert scale design. The students' core competencies questionnaire is designed to measure six items: humanistic heritage, scientific spirit, learning to learn, sense of responsibility, practical innovation and healthy living. The questionnaire adopts a 5-level scale. The questions designed in the questionnaire should be simple and clear, the sentences should be easy to understand, and double negatives should be avoided.



CHAPTER II

LITERATURE REVIEW

In This article, the researcher studied the following relevant literature and research and proposed the following topics:

2.1 "Electrical Engineering" course

2.2 Teaching model

2.3 Learning ability

2.4 Core competencies

2.5 Related research

2.6 Conceptual framework

2.1 "Electrical Engineering" course

The "Electrical Engineering" course is an important professional basic course for non-electrical majors in higher engineering colleges. Its main task is to lay a good theoretical foundation and necessary basic skills training for students to learn professional knowledge and engage in engineering and technical work. The course teaching content is shown in Table 1

Tables 1 Course teaching content table

Teaching content (teaching knowledge points)	Main difficulty
Unit 1 Basics of circuits concepts and basic laws	Basic concepts of circuits, ideal components, Kirchhoff's laws.
Unit 2 Circuit analysis	Resistors in series and parallel, resistor star connection, delta connection, equivalent power supply transformation, branch current method, node voltage method, superposition theorem, equivalent power supply theorem.
Unit 3 Sine AC electricity steady state analysis of road	Three elements of sinusoidal quantities, circuit rules in phasor form, sinusoidal alternating current with series and parallel components, power of sinusoidal

Teaching content (teaching knowledge points)	Main difficulty
	alternating current, enhancement of power factor, and resonant circuit.
Unit 4 Three-Phase circuit	Basic concepts of three-phase circuits, analysis of symmetrical three-phase circuits, power in three-phase circuits.
Unit 5 Dynamic circuits transient analysis	There are three elements: switching law and circuit initial value, first-order RC circuit transient analysis, first-order RL circuit transient analysis, and first-order dynamic circuit transient analysis.
Unit 6 Transformers	Working principles and performance indicators of magnetic circuits and transformers.
Unit 7 DC motor	Structure and classification of DC motors, working principle of DC motors, shunt DC motors, series DC motors.
Unit 8 Three-phase asynchronous electricity motivation	The working principle and circuit analysis of three-phase asynchronous motors, the electromagnetic torque and mechanical characteristics of three-phase asynchronous motors, the starting, speed regulation and braking of three-phase asynchronous motors, the nameplate and technology of three-phase asynchronous motors.
Unit 9 Modern electric motors	Servo motor, speed generator, stepper motor.
unit 10 Relay contactor control	Commonly used in low-voltage control circuits, basic control links, and motor protection links.

The course teaching content is divided into 10 units, including: basic concepts and laws of circuits, circuit analysis, steady-state analysis of sinusoidal AC circuits, three-phase circuits, transient analysis of dynamic circuits, transformers, DC motors, three-phase asynchronous motors, modern motors, Relay contactor control.

2.2 Teaching model

2.2.1 Traditional teaching method

Traditional teaching method is a teacher-centered, book-centered, and classroom-centered teaching model. It usually adopts the " five-stage teaching method ": organizing teaching, reviewing old lessons, explaining new lessons, consolidating new lessons, and assigning homework. The characteristic of this teaching model is that the teacher dictates and writes on the blackboard, and the students listen and take notes. Teachers can flexibly adjust teaching content and methods based on students' responses and progress. The advantage of traditional teaching method is that it can ensure the basic quality and efficiency of teaching and students' basic knowledge and skills. However, it also has some shortcomings, such as ignoring students' initiative and creativity and instilling knowledge into students as dead things, resulting in students' lack of interest and motivation in learning. Regarding traditional teaching method, many scholars have given their views:

Hadžimehmedagić & Akbarov, (2014) It is believed that traditional education is teacher-led interaction, teaching is teacher-centered, and activities and demonstrations follow the steps of the textbook. In the traditional teaching method, the teacher is at the center of the classroom and prepares lessons according to an established pattern, including review of previous material, repetition, introduction of new topics, grammar, reading, translation, practice and error correction on these topics every day are included in the class. Dobbs, (2008) believes that traditional teaching method refers to the traditional teaching method in which teachers teach content in class and students learn through lectures and classroom activities. Allen et al., (2016) believe that traditional teaching method refers to the traditional teaching method in which students and teachers interact face-to-face in a physical classroom environment. Hyun et al., (2017) It is believed that the traditional teaching method model often results in a situation where teachers instill one-way teaching and students passively accept it. It is not difficult to see that the shortcomings of the traditional teaching model are very obvious.

The key is that students, as cognitive subjects, are always in a position of passively receiving knowledge throughout the teaching process. Students' initiative in learning is ignored or even suppressed.

Overall, traditional teaching method places the teacher as the primary source of knowledge and relies on structured curriculum and assessment to facilitate learning. The advantage of traditional teaching method is that it can ensure the standardization, systematicness and efficiency of teaching, and it can also enhance the emotional communication between teachers and students. The shortcomings of traditional teaching method are that it ignores students' personality, creativity and initiative, and does not make full use of information technology to expand teaching resources and means.

2.2.2 Cooperative learning method

Cooperative learning method is frequently used among researchers and practitioners. But what does cooperative learning mean? What, how and why do we collaborate? Schuster & Perelberg, (2004) cooperation is often explained from an economic perspective, focusing primarily on the tangible results obtained by individuals, which are also dependent on the actions of others, and rarely on the actual behaviors used when collaborating. In Skinnerian and game-theoretic models, the potential consequences of the social dimension associated with cooperative behavior are minimized by anonymous subjects acting individually in physically isolated rooms. Kaplan & Ruffle, (2012) The cooperative learning method is a structured, systematic teaching strategy that can be used at any grade level and in most school subjects. Gillies, (2016) cooperative learning is widely recognized as a teaching practice that promotes socialization and learning for students from pre-K to higher education and across diverse subject areas. It requires students to work together to achieve a common goal or complete group tasks—goals and tasks that they would not be able to complete on their own. The purpose of this article is to review advances in cooperative learning research and practice and explore factors that help explain its success. In particular, the

review focuses on the key elements that contribute to its success and the role that teachers play in developing student thinking and learning when implementing this teaching practice in their classrooms. Gillies, (2014) cooperative learning is widely recognized as a teaching practice that promotes socialization and learning for students from kindergarten to college and across subject areas. Cooperative learning involves students working together to achieve a common goal or complete a group task. Tran, (2013) cooperative learning is where knowledge and skills are built through mutual interaction between participants. Therefore, in the process of applying cooperative learning, interactive tasks and cooperative courses should be designed and applied in the classroom to help students work and learn together to achieve common goals.

Over the past three decades, interest in cooperative learning has grown rapidly with the publication of studies that clearly demonstrate how cooperative learning can be used to promote reading and writing, scientific concept development, mathematical problem solving, and higher levels of achievements in thinking and reasoning. It has also been shown to facilitate interpersonal relationships with students with different learning and adjustment needs and with students from different cultural and ethnic backgrounds.

In short, cooperative learning method is a special cooperative teaching method. Cooperative learning method, also known as collaborative learning teaching, is one of the teaching organization methods widely used in the world. It can enhance the classroom atmosphere, greatly enhance students' academic performance, and further enhance students' interpersonal skills, thinking and discussion skills, expression and communication skills, etc. The smooth development of cooperative learning method must have five effective factors, namely: positive interdependence, face-to-face facilitative interaction, personal responsibility, interpersonal skills, and group processing. When implementing cooperative learning and teaching, these five factors need to be implemented throughout the cooperation, and the cooperative learning and teaching process must be standardized to prevent the incomplete details from affecting

the efficiency of cooperative learning.

(1) Positive interdependence

(2) Face-to-face interaction

(3) Personal responsibility

(4) Interpersonal skills

(5) Group processing

(1) Positive interdependence

Positive interdependence is a psychological tendency in which an individual realizes that there is an interdependent relationship with others that helps each other through thick and thin. Positive interdependence includes goal interdependence and resource interdependence. Goal interdependence means that in teaching activities, students must realize that their learning goals need to be based on the goals of the entire group. Only when the group tasks are completed can it represent the student's individual learning standards; resource interdependence It means that each member of the group has part of the resource information to complete the learning task. Members in the group need to integrate the resource information they own in order to complete the group learning goals. Positive interdependence helps enhance members' interpersonal skills and enhances members' collective sense of honor and belonging. In this form, students not only ensure the completion of their own learning tasks, but also help other members of the group complete their learning tasks. In this way collaborative learning is highly efficient.

(2) Face-to-face mutual promotion

When carrying out cooperative learning and teaching activities, group members are required to communicate face-to-face and interact, and exchange their own learning resources and learning results in close discussions and exchanges. Through intense discussion of problems, students finally solve their doubts and complete their learning goals through joint efforts. In face-to-face interaction, students help each other and enhance together, which creates a deep trust in each other. At the same time, the

interaction also reduces students' tension and anxiety about learning. Face-to-face interaction based on positive interdependence creates cooperative learning. Completely different effect.

(3) Personal responsibility

Positive interdependence is the basis of cooperation, and personal responsibility is the guarantee of cooperative learning. In the cooperative learning process, each member of the group should be divided into responsibilities. Everyone should take on corresponding learning tasks and ensure that responsibilities are assigned to each person. Members should be responsible for themselves as well as others, and do their best to complete the group goals. Cooperative learning is judged based on the overall performance of the group, but each member's efforts are directly related to the group's evaluation. Everyone is a key factor in the group's success and has an unshirkable responsibility.

(4) Interpersonal skills

In cooperative learning, students not only have the ability to complete learning tasks but also have certain interpersonal communication skills. Cooperative learning is achieved through communication. Each student is an independent individual with his or her own unique insights and ideological activities. Students are communicating When there is disagreement on a certain point of view and how to solve a problem, it is easy to cause conflicts and contradictions among members. We must learn to use interpersonal skills to resolve conflicts skillfully so that cooperative learning can be successfully completed. High-level interpersonal skills are the guarantee for smooth operation of cooperative learning and promotion of student development.

(5) Group processing

Group processing means that under the leadership of the team leader, each member of the group successfully completes the learning tasks in a cooperative manner according to the learning tasks given by the teacher. In addition, group processing also means that after the cooperation, the group members complete the learning tasks

according to their own cooperation. Self-Evaluation the performance of the group, summarize the problems that occurred in the cooperation link, and provide feedback on the group cooperative learning at this stage, and make effective planning and design for the next cooperative learning to enhance the quality of cooperative learning.

In short, the connotation and characteristics of cooperative learning include the interaction between students and the interdependence and influence among cooperative group members, and the process of jointly achieving learning goals.

In summary, the traditional teaching method is a teaching model that is teacher-centered, book-centered and classroom-centered. In the classroom, teachers impart theoretical knowledge from books to students, and students participate in listening to lectures, taking notes, and doing tasks. Practice, students do homework after class, and the teacher corrects the homework. The cooperative learning method refers to mutual learning in which students have a clear division of responsibilities in order to complete common tasks. Cooperative learning encourages students to work together for collective and individual interests and realize their ideals in the process of completing common tasks.

2.3 Learning ability

2.3.1 Meaning

Many scholars have given their own opinions on learning ability. Wang, (2009) pointed out that learning ability is “students’ awareness and ability to actively use and actively adjust learning strategies, broaden learning channels, and strive to enhance learning efficiency.” Yuan et al., (2014)pointed out that learning ability is the consciousness and ability that students gradually form during the learning process to actively use, actively debug and strive to enhance. Luo & Yu, (2017) pointed out that learning ability means students can self-manage their learning methods, develop good learning habits, obtain learning resources from multiple channels, and carry out learning independently and efficiently.

In summary, learning ability refers to the learner's ability to accept new knowledge

and new information, and use the received knowledge and information to understand, analyze and solve problems. It mainly includes perception, memory, thinking, imagination, etc. Relative to learning, it is basic intelligence and the basic factor that produces learning ability.

2.3.2 Element

Learning ability is a person's basic skill. A person with good learning ability will learn a lot of new things and benefit himself. A person with poor learning ability may accomplish nothing. Since learning ability is so important, Learning capabilities include the following elements:

(1) Reading ability. Reading ability refers to our ability to process all visual information. The process of reading is a series of complex mental activities involving students' attention, perception, understanding, imagination, and memory.

(2) Comprehension ability. Comprehension ability refers to a person's memory ability to understand things and even knowledge.

(3) Memory. Memory is the ability to remember, retain, re-understand and reproduce the content and experience reflected in objective things. Memory is a dynamic selection process, divided into three stages: encoding, storage, and retrieval. Moreover, memory is not a recorder that accurately records life, but is selective.

(4) Concentration. Concentration, also known as attention, refers to a mental state when a person concentrates on a certain thing or activity. Concentration is also an important factor in determining academic performance.

(5) Creativity. Creativity includes the ability to keenly discover problems, the ability to foresee and Evaluation, the ability to seek directions and ways to solve problems, and the ability to complete certain operations and test assumptions, etc. The level of creativity mainly depends on experience, knowledge, methods and psychological quality.

2.3.3 Importance

Learning ability is a person's ability to quickly acquire knowledge and make it

valuable. Yang Fujia, President of Fudan University, said: " In this modern era where information updates rapidly, what can widen the gap between people is no longer how much knowledge and information they master, but the learning ability to quickly absorb new knowledge. As long as you acquire the learning ability, you can counterattack on the spot! " . Whether a person has a strong learning ability depends entirely on whether the person has a clear goal, strong willpower, rich theoretical knowledge, and a lot of practical experience.

2.3.4 Evaluation

Use questionnaires to assess student learning abilities. The questionnaire used a Likert scale. Questionnaire design should follow the five principles of effectiveness, simplicity, personalization, scientificity, and innovation and determine the theme. It should follow the five basic steps of determining survey objects, reviewing data, designing questions, enhancing the questionnaire, and pre-survey five principles:

(1) Effectiveness. First of all, the questionnaire survey should first state the purpose of the questionnaire, promise that the private information of the respondents will not be leaked, so that the respondents are willing to fill in the questionnaire; secondly, the questionnaire questions should be appropriate, and too many questions should not affect the accuracy of the questionnaire; thirdly, the words used in the questionnaire should be close to life and easy to understand. Avoid uncommon words and other words that may affect the respondent's understanding of the questionnaire questions, thus affecting the quality of the questionnaire.

(2) Simplicity. A complete questionnaire requires careful consideration in design to avoid duplication and procrastination and ensure that the content and proportion of the questions are reasonable.

(3) Personalization. Only by adhering to the principle of humanity can we better take care of the emotions of the respondents on issues involving their personal privacy. The principle of humanization is also reflected in adapting measures to local conditions and doing as the locals do.

(4) Scientific. Designers need to be precise in their choice of words, and the design of questions should avoid substituting personal subjective opinions and emotions, or inducing the respondents. It will affect the personal judgment of the respondents, which is undesirable and unscientific. Questions need to be raised in a neutral attitude to ensure their scientific nature.

(5) Innovation. Questionnaire designers must be good at thinking and dare to break through to find more attractive ways to design questionnaires.

Five basic steps:

(1) Finalize the topic and target the survey group. When designing a questionnaire, you must first determine the survey theme and target group. The theme is the scope of the questionnaire question design. The design of the questionnaire is launched around a specific theme, and the expression method is designed according to the characteristics of the survey objects and survey groups.

(2) Check information. By collecting and consulting relevant information to understand the question settings used by other similar researchers when conducting relevant surveys, you can avoid many detours and use the essence to lay the foundation for questionnaire design.

(3) Design the topic. The question is the core of the questionnaire. You should focus on the five principles mentioned above, revise it repeatedly, and avoid lightning by yourself.

(4) Enhance the questionnaire. After the first draft of the questionnaire is designed, the designer should consider the following questions about the questionnaire: the necessity of the questions, whether the number of questions is reasonable, whether the questions in the questionnaire are comprehensive, whether the proportion of open questions is appropriate, and whether obvious fonts are used in the questionnaire instructions.

(5) Preliminary investigation. In order to ensure the quality of the questionnaire, a pre-survey, that is, a predictive survey, is required before conducting the formal survey.

In order to detect and solve problems in time.

This article used a questionnaire method to assess learning ability. The questionnaire design follows five principles and five basic steps, and a reasonable students' learning ability questionnaire is designed according to the components of learning ability (See Appendix A).

2.4 Core Competencies

2.4.1 Meaning

Many scholars have given their own views on core competencies: Kavic, (2002)pointed out that the research on core competencies is oriented towards achieving the harmonious development of man and society, and clarified the connotation of core competencies, which are situation- and action-oriented and are knowledge and the combination of skills, emotional attitudes and values that enable the ability to successfully perform the job requirements. Coombs, (1996) systematically elaborated on the purpose of basic education reform: that is, to students' basic knowledge and basic skills, students' international vision, students' conscious learning ability and thinking ability, and students' individualization and socialization, thereby forming Japan's unique core competencies system. Sulaiman & Shahrill, (2015) pointed out that core competencies are dynamic learning resources that will continue to change with changes in the internal and external environment.

In summary, core competencies are the necessary characters and key abilities that students gradually form in the process of receiving education at the corresponding school stage to meet the needs of personal lifelong development and social development. It is a combination of students' knowledge, skills, emotions, attitudes, values and other requirements; it is process-oriented, focusing on students' understanding in the training process rather than being result-oriented; at the same time, core capabilities have both stability and openness, development, is a dynamic optimization process that accompanies lifelong sustainable development and advances with the times. It is the basic guarantee for individuals to adapt to the future society, promote lifelong learning,

and achieve all-round development.

2.4.2 Element

Core competencies are divided into three aspects: cultural foundation, independent development, and social participation, and are comprehensively expressed as six elements: humanistic heritage, scientific spirit, learning to learn, healthy living, responsibility, and practical innovation.

(1) Humanistic heritage. It mainly refers to the basic abilities, emotional attitudes and value orientations formed by students in learning, understanding, and applying knowledge and skills in the humanities field. Specifically, it includes basic points such as humanistic accumulation, humanistic feelings and aesthetic taste.

(2) Scientific spirit. It mainly refers to the value standards, ways of thinking and behavioral performance formed by students in learning, understanding and applying scientific knowledge and skills. Specifically, it includes basic points such as rational thinking, critical questioning, and the courage to explore.

(3) Learn to learn. It mainly refers to the comprehensive performance of students in the formation of learning awareness, selection of learning methods, and assessment and regulation of learning processes. Specifically, it includes basic points such as being willing to learn, being diligent in reflection, and being aware of information.

(4) Healthy life. It mainly refers to the comprehensive performance of students in understanding themselves, developing their body and mind, and planning their lives. Specifically, it includes basic points such as cherishing life, enhancing personality, and self-management.

(5) Responsibility. It mainly refers to the emotional attitudes, value orientations and behavioral methods formed by students in dealing with relationships with society, the country, and the world. Specifically, it includes basic points such as social responsibility, national identity, and international understanding.

(6) Practice innovation. It mainly refers to the practical ability, innovative consciousness and behavioral performance formed by students in daily activities,

problem solving, adapting to challenges, etc. Specifically, it includes basic points such as labor awareness, problem solving, and technology application.

2.4.3 Importance

Core competencies play a fundamental and supportive role in students' development. It is the foundation of students' development and the pillar of students' development, supporting students' future development. The cultivation of core competencies enables students to have the necessary character and key abilities to move toward life and the future. The introduction of core competencies has filled the curriculum reform with new vitality, enriched its connotation, and further demonstrated the concepts of people-oriented and student development as the core. Core competencies are directly and deeply related to the deepening of curriculum reform. This direct and deep connection is mainly reflected in the fact that it stipulates the direction and purpose of curriculum reform, is the core goal of curriculum reform, and is the fundamental basis for textbook compilation, education and teaching, examination evaluation, and system management.

2.4.4 Evaluation

The core competencies assessment in This article also used a questionnaire survey. The questionnaire used a Likert scale. Questionnaire design follows five principles and five basic steps. Based on the six elements of core competencies: humanistic heritage, scientific spirit, learning to learn, healthy living, sense of responsibility, and practical innovation, a reasonable students' core competencies questionnaire was designed (See Appendix B).

2.5 Related research

2.5.1 Foreign research

(1) Research on cooperative learning method

In the early 19th century, cooperative learning education theory was introduced to the United States from the United Kingdom. The United States carried out educational reforms and promulgated the "National Defense Education Act" to implement it in

teaching in order to promote the progress of democratization in the United States through educational reform. At that time, racial discrimination in American society was seriously unfavorable. It is suitable for the development of society, and the cooperative learning method model can alleviate the situation of racial discrimination and achieve equal educational opportunities. Therefore, the introduction of cooperative learning into school classrooms has been recognized and vigorously promoted by many scholars and society. With the in-depth research on cooperative learning by the Johnson brothers in the United States, an upsurge in cooperative learning research started in the United States in the mid-20th century. In the mid-1980s, the United States made substantial progress in the theory of cooperative learning and also made considerable progress in the application of cooperative learning. With some insights, the cooperative learning method model was later introduced from the United States to European and American countries and Japan. Many countries now widely use cooperative learning method strategies in the teaching of various subjects in primary and secondary schools.

Felder & Brent, (2007) cooperative learning is a method of collective learning that minimizes the occurrence of these unpleasant situations and maximizes the learning and satisfaction of the performing team. Gillies, (2016) considered as a teaching practice that promotes socialization and learning of students from preschool to higher education and in different subject areas. It requires students to work together to achieve a common goal or complete a collective task - goals and tasks that they would not be able to accomplish on their own. The purpose of this article is to review advances in research and practice in cooperative learning and to explore factors that help explain the success of cooperative learning. In particular, the review focuses on the key factors that contribute to its success and the role that teachers play in developing students' thinking and learning when implementing this teaching practice in their classrooms. Slavin, (1989) It is argued that research on cooperative learning methods places great emphasis on comparing cooperative learning and traditional cooperative learning methods, focusing mainly on academic performance as an outcome of interest. Johnson

et al., (1994) believes that cooperative learning is the teaching use of small groups that enables students to work together to maximize their own and each other's learning.

Slavin, (2013) believes that cooperative learning refers to a teaching model in which students learn knowledge in the form of group discussions and complete learning tasks assigned by teachers. The overall performance or results of the group are used as the evaluation criteria for teacher rewards and student recognition. Baker & Clark, (2009) shows that cooperative learning is a classroom teaching method that is different from traditional class teaching. In classroom teaching, students are divided into groups of 3-6 people. The group is equivalent to a unit organization within the class. Students work in groups. Engage in cooperative learning. Group activities can enable students to communicate and share ideas. At the same time, students can also actively explore and think independently in groups. Slavin, (2012) believes that cooperative learning is a classroom teaching activity conducted in the form of groups. Teachers assign students to different groups according to differences in student performance, gender, and personality. Each member of the group assumes different learning tasks. The responsibility should be assigned to each person. In group activities, students should not only be responsible for their own learning efforts, but also help other students in the group to learn knowledge, and finally complete the learning tasks assigned by the teacher in the form of a group.

(2) Learning ability research

Foreign research on learning ability has a long history. As early as the ancient greek period, socrates proposed the "Midwife Art", and we will continue to sort it out along the course of time. There are also the "Grand Teaching Theory" that laid the foundation for modern education, which we are very familiar with, and Rousseau's The key issue of learning ability is that the idea of gradually developing learners' interest in learning is permeated with the idea of learning ability. Regarding relevant research on learning ability, the 1920s can be used as a node. Before the 1920s, there was almost no corresponding empirical research on learning ability. Only after the 1920s did

empirical research gradually pay attention to it. In the 1950s, learning ability became the focus of educational psychology research, and each school of thought put forward concepts related to its own school to explain independent learning ability. Since the 1960s, research on learning ability has continued to be systematic, and systematic research has been conducted on learning motivation, goals, and learning skills. In the 1970s, with the transformation of research objects and methods in humanistic psychology and subject education, learning ability was valued in society. With the continuous and in-depth research on learning ability, three major questions gradually emerged in the 1980s: first, what is learning ability? Second, what is the intrinsic relationship between autonomy, motivation, and metacognition? Third, whether it is possible to Taught through acquired effort. In the 1990s, more extensive research was conducted on the nature, mechanism, and relationship between learning ability and performance. At the beginning of the 20th century, experimentalism and pragmatism gradually emerged. Experts in various fields turned their perspective to students' passive learning methods and strongly criticized this. They advocated active learning ability, highlighting the status and importance of learning ability.

There are six popular theoretical models of learning ability abroad Zimmerman, (2000) a theoretical model of learning capabilities based on the perspective of social learning theory, with clear stages, a cyclical model and focusing on learners' performance in completing tasks; Ranellucci et al., (2015) a theoretical model of learning ability based on the perspective of goal attainment and emotion, combined with (meta)cognitive and motivational elements of learning ability; Boekaerts, (1995) theoretical model of learning ability based on metacognitive perspective; Pekrun, (1992) a theoretical model of learning ability based on a motivational perspective; Borkowski et al., (2000) based on bridging the gap between metacognition and learning ability , an autonomous learning model with two-layer characteristics is proposed; Puustinen & Pulkkinen, (2001) a theoretical model of learning capabilities based on a cooperative learning perspective.

(3) Core competencies research

The exploration and research on core competencies in foreign countries started earlier than in our country, and they have continued to make progress in the long-term exploration. The framework systems proposed for core competencies also have their own characteristics. After years of development, the research on core competencies has attracted the attention of many countries and organizations, and the research contents of different countries and organizations are also further enriched and developed. The organizations, institutions and countries that have had greater influence so far are mainly the United Nations Educational, Scientific and Cultural Organization, the International Organization for Economic Cooperation and Development, the European Union, the United States, Japan and other countries.

Veldhuis, (1997) the study of core competencies is oriented towards the realization of the harmonious development of people and society, and clarifies the connotation of core competencies, which are situation- and action-oriented, a combination of knowledge and skills, emotional attitudes and values, and can satisfy Abilities required to perform the job successfully. Gordon, (1998) systematically elaborated on the purpose of basic education reform: cultivating students' basic knowledge and basic skills, cultivating students' international vision, cultivating students' conscious learning and thinking abilities, and cultivating students' individuality and social development. ization, thus forming Japan’s unique Core competencies system. Hafeez et al., (2002) develop the " 21st Century Core Competencies Framework " , which includes three areas: learning and innovation skills, life and career skills, and information media and technology skills. "Core Competencies in Developing Education: Experiences and Lessons from Some International and National Countries" published by Bolt-Lee & Foster, (2003) proposed that core competencies are essential competencies for people to adapt to society and live a good life; and in "Toward a Lifelong Life" Learning - What Every Child Should Learn" proposes to develop core competencies and establish the concept of lifelong learning. It also points out that in the basic stage of students,

students should "physical health, social emotions, written communication, learning methods and cognition, science and technology" and other core competencies. Loddenkemper et al., (2006) released the final version of eight core competencies to promote education and training reform and a frame of reference for lifelong learning, including technological literacy and mathematical literacy, learning to learn, entrepreneurship and initiative , communication in mother tongue, Cultural awareness and expression, communication in foreign languages, digital literacy, and social and civic literacy.

In summary, it can be seen that the research on core competencies of the United Nations Educational, Scientific and Cultural Organization and the European Union is oriented towards lifelong learning, the research on core competencies of the International Organization for Economic Co-operation and Development is oriented towards the realization of human social development, while the United States and Japan focus on development capabilities. From the research on the connotation of core competencies to the construction of the framework system, it reflects the recognition and continuous research enthusiasm of foreign scholars for core competencies. The core competencies frameworks formulated by these countries and regions are also reasonably constructed based on their own national conditions. Develop a scientific talent training model, which has very important reference value for the research and development of core competencies in our country.

2.5.2 Domestic research

(1) Cooperative learning method research

F. Liu, (2021) in the paper, he pointed out that cooperative learning is a teaching strategy system that takes students' mutual cooperation in groups as the main method, anticipates the completion of expected teaching goals, and provides rewards based on the group's performance. Zhu, (2021) it is pointed out that cooperative learning takes groups as the main organizational model, and uses a variety of factors to promote joint learning among group members. The evaluation of cooperative learning needs to

comprehensively consider individual performance and group collective performance. Zhao, (2021) pointed out that cooperative learning is implemented in the classroom using a heterogeneous group model. In-depth communication and communication among members can speed up goal achievement, and the final reward also needs to be based on group performance as the main measurement criterion. Gu, (2021) pointed out that the cooperative learning method strategy focuses on several important modules such as teaching content selection, grouping method selection, task allocation method, cooperative learning process focus, and evaluation summary implementation. Chen, (2021) it is pointed out that the enhancement of the effectiveness of cooperative learning should be continuously optimized from the perspectives of group construction, clear division of labor and responsibilities, selection of learning methods, guidance of cooperation process, etc.

(2) Research on learning ability

Pang & Liu, (2000) it is believed that students' learning ability is essentially to actively regulate and control all aspects of learning or the entire learning process. It has characteristics such as initiative, effectiveness and relative independence; students' learning ability relies on self-awareness and metacognitive development. Level, intrinsic learning motivation, learning strategies, volitional control and other internal conditions and external conditions such as educational guidance; the cultivation of students' learning ability can start from two levels: enhancing the teaching model and providing guidance on certain specific aspects of student learning. Wang, (2009) the degree of development of students' learning ability depends on the teacher's educational and teaching ideas, the current status of school education development, and is also restricted by the quality of students. Educators have the responsibility to students' learning abilities and lay a solid foundation for students' lifelong development. Driven by the wave of educational reform , educators are faced with both opportunities and severe tests in cultivating students' learning abilities. X. Zhang, (2005) believes that learning ability is the learner’ s ability to accept new knowledge and information, and

use the received knowledge and information to understand, analyze and solve problems, mainly including perception, memory, thinking and imagination. and other comprehensive skills.

(3) Research on core competencies

Compared with other countries and regions, my country started researching core competencies relatively late. my country's core competencies were officially proposed in 2014, but Chinese scholars had already begun research on core competencies before that, but they are still in the preliminary development stage. Domestic researchers' research on core competencies can be summarized into the following three points:

The first is the connotation of core competencies. X. Liu, (2014) believes that core competencies are the key abilities that students possess in different fields and in different situations. It is also the ability of students to learn and accept new things, and it is also the ability of students to cooperate with others to continuously enhance themselves. Xu, (2016) it is believed that core competencies, as key competencies, should not only adapt to individual development and social development, but also meet the requirements of national conditions and international competition. Therefore, core competencies are a way to and develop students' ability to adapt to the modern social environment. In addition, Lin, (2016) defines the concept of core competencies as: the necessary characters and key abilities that students gradually develop to meet the needs of personal lifelong development and social development in the process of receiving education at the corresponding school stage.

The second is to sort out relevant international results. Pei & Yang, (2013) the EU's core competencies system is sorted out and studied, and it is pointed out that my country should focus on basic education reform on curriculum reform and subject structure. When designing the teaching system, it is necessary to pay attention to the interaction between different subjects, as well as the interaction between theory and practice. interactive. N. Zhang, (2015) sorted out UNESCO's research on core competencies from the perspective of viewpoints and backgrounds, analyzed and elaborated on its

specific framework, and based on this, provided a certain basis for the development of relevant research on core competencies in China. enlightenment and provide new ideas for future research in our country. Zhuo, (2016) according to different value concepts, the international core competencies system is summarized into four categories, and a systematic and specific analysis is conducted to provide reference for the construction of my country's core competencies system.

The third is the construction of core competencies system. Xin et al., (2013) analyzed the studentcore competencies models of the United States, Japan and the International Crganization for Economic Co-operation and Development, and put forward certain ideas for the construction of China's core competencies models from two aspects: curriculum reform and educational evaluation. Xin & Jiang, (2015) based on China's national conditions, it is proposed that the construction of thecore competencies model of Chinese students should be centered on socialist values, and the construction of core competencies should pay attention to systematicity, and emphasize that the main way to promote the implementation of core competencies is curriculum. Lin, (2016) the Core competencies research group led by Lin Chongde conducted research on the development of students' core competencies system proposed by our country. After three years of scientific procedures and methods, it was gradually implemented and finally established the overall framework of Chinese students' core competencies.

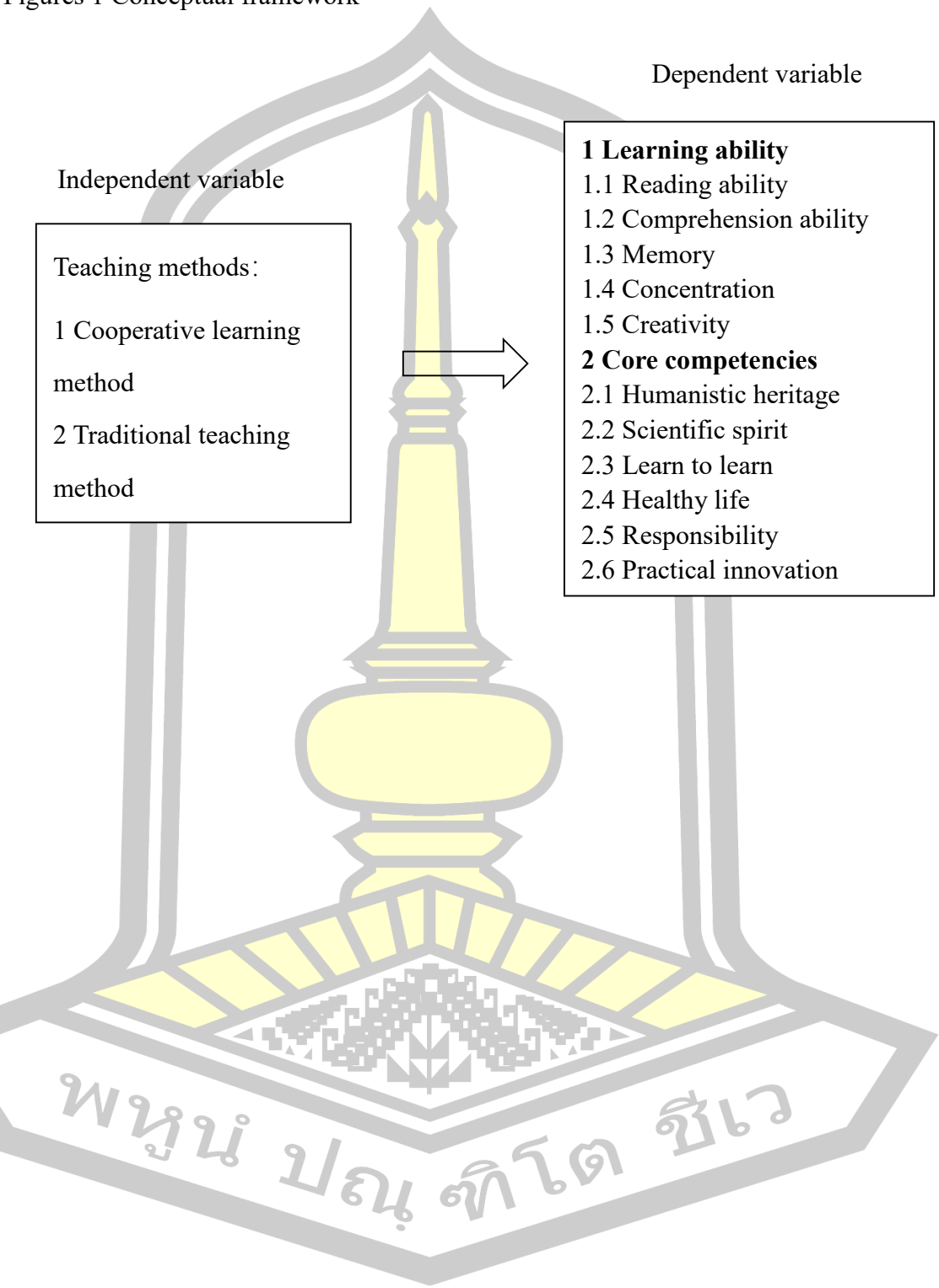
2.6 Conceptual Framework

The independent variables of This article are two teaching methods, namely traditional teaching method and cooperative learning method. The traditional teaching method is a teacher-centered, book-centered and classroom-centered teaching model. In the classroom, the teacher imparts the theoretical knowledge in the book to the students. The students participate in listening to the lectures, taking notes, and doing exercises. After class, the students do your homework and the teacher will correct it. The cooperative learning method is a special cooperative teaching method. The

cooperative learning method, also known as collaborative learning teaching, is one of the most widely used teaching organization methods in the world. The connotation and characteristics of the cooperative learning method include the interaction between students and the interdependence and influence among cooperative group members, as well as the process of jointly achieving learning goals. The dependent variables include students' learning abilities and students' core competencies. Learning ability refers to the learner's ability to accept new knowledge and information, and use the received knowledge and information to understand, analyze and solve problems. Core competencies are the necessary characters and key abilities that students gradually develop to meet the needs of personal lifelong development and social development in the process of receiving education at the corresponding school stage.

In This article, two types of teaching were applied to two classes respectively. Group 1 used the traditional teaching method as the control group, and group 2 used the cooperative learning method as the experimental group. Research tool: The questionnaire used Likert scale and the data were analyzed using normal distribution and standard deviation. Observe the learning situation of the two classes and analyze the questionnaire results on learning abilities and core competencies.

Figures 1 Conceptual framework



CHAPTER III

RESEARCH METHODS

This article conducts research on the implementation of cooperative learning in the university's "Electrical Engineering" course to enhance students' learning abilities and students' core competencies. In order to conduct the research smoothly, the following procedures are provided to conduct the following research.

3.1 Population and sample

3.2 Experimental study

3.3 Research instruments

3.4 Construction and quality of instrument

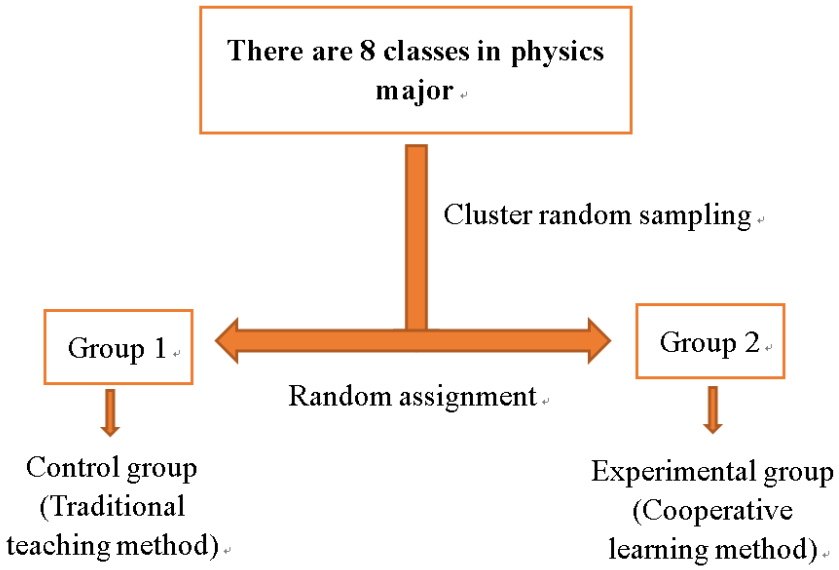
3.5 Measurement and data collection

3.6 Statistics used in data analysis

3.1 Population and sample

The population of this article is students majoring in physics at Guangxi Normal University for Nationalities. There are 8 classes in the physics major with a total of 245 students. Two classes were selected through cluster random sampling. All students in group 1 and group 2 of the 2021 physics major were selected to participate in the experiment, using random allocation. group 1 served as the control group, using traditional teaching methods, with 30 students; group 2 served as the experimental group, using cooperative learning methods, with 30 students. A total of 60 students participated in the experiment study.

Figures 2 Population and sample



Among them, group 1 served as the control group, with 16 boys and 14 girls participating in the traditional teaching method experiment, and group 2 served as the experimental group, with 13 boys and 17 girls participating in the cooperative learning method experiment. A total of 60 students participated in this experiment, including 29 boys and 31 girls (See Table 2).

Tables 2 Sample and sample size

Sample in teach of two group	Male	Female	Sample size	Rework
Method 1 (Traditional teaching method)	16	14	30	Control group
Method 2 (Cooperative learning method)	13	17	30	Experimental group
Total	29	31	60	

3.2 Experimental study

3.2.1 Preparation before experimental research:

Tables 3 Preparation checklist before experimental research

Traditional Teaching Mode l	Cooperative learning method
1. Search for relevant information on traditional teaching mode l, Teacher-centered	1. Search for information about cooperative learning and teaching
2. Clarify key points	2. Clarify key points
3. Make courseware PPT	3. Processing videos and information
4. Formulate teaching de sign	4. Formulate teaching design
5. Formulate Teaching classes and schedule	5. Formulate Teaching classes and schedule
6. Formulate questionnaire	6. Formulate questionnaire

(1) Search for relevant information using the keywords cooperative learning and "electrical engineering" courses. According to the requirements of the syllabus, clarify the key points and difficulties of the teaching content, and prepare for resource preparation and classroom discussion; conduct secondary processing of cooperative learning resources, text materials, courseware materials, etc., and finally formulate the " There are two teaching designs for the "Electrical Engineering" course, the teaching design of the traditional teaching model and the cooperative learning method design.

(2) Review the relevant information on the learning ability and core competencies questionnaire, consider the breadth and depth of the questions, and ensure a comprehensive understanding of the validity and scientific nature of the respondents. Make sure your questions are clearly worded and avoid ambiguities or puns. After review and recommendation by experts, a students' learning ability questionnaire (See Appendix A) and a students' core competencies questionnaire (See Appendix B) were developed.

The preparation work before the teaching experiment of the two teaching modes is generally the same. Clarify the key points, formulate teaching design, formulate teaching courses and schedule, and formulate questionnaires. Based on cooperative learning and "Electrical Engineering" related materials. Search for related materials based on the traditional teaching method model. The traditional teaching model is

teacher-centered. Courseware is produced based on the cooperative learning method model, and courseware is produced based on the traditional teaching model.

3.2.2 Teaching experiment process:

This teaching experiment is planned to be completed in eight weeks, with three classes per week, each class is 40 minutes, and there is a 10-minute break between classes. The two groups studied the same teaching content and adopted different teaching models. The experimental group adopted the cooperative learning method model, while the control group adopted the traditional teaching method model.

Tables 4 Teaching classes and schedule

Weekly class schedule	Time /hours	Study unit	Group		Date	Time
1	0.5	Pre-test	(Traditional teaching mode)		2023.11.02	8:00am -8:30
			(Cooperative learning method)		2023.11.03	8:00am -8:30
1	3	Resistor in series Resistors in parallel	(Traditional teaching mode)		2023.11.02	8:30am - 11:30
			(Cooperative learning method)		2023.11.03	8:30am -11:30
2	3	Resistors in series and parallel	(Traditional teaching model)		2023.11.09	8:30am - 11:30
			(Cooperative learning method)		2023.11.10	8:30am -11:30
3	3	Resistive star connection Resistive delta connection	(Traditional teaching model)		2023.11.16	8:30am - 11:30
			(Cooperative learning method)		2023.11.17	8:30am -11:30
4	3	Wheatstone bridge Equivalent transformation	(Traditional teaching model)		2023.11.23	8:00am -11:30
			(Cooperative learning method)		2023.11.24	8:00am -11:30
5	3	Branch current method Node voltage	(Traditional teaching model)		2023.11.30	8:30am - 11:30
			(Cooperative	learning	2023.12.01	8:30am

		method	method)			-11:30
6	3	Superposition theorem	(Traditional teaching model)		2023.12.07	8:30am - 11:30
			(Cooperative learning method)		2023.12.08	8:30am -11:30
7	3	Thevenin's theorem Norton's theorem	(Traditional teaching model)		2023.12.14	8:30am - 11:30
			(Cooperative learning method)		2023.12.15	8:30am -11:30
8	3	Maximum power transfer theorem	(Traditional teaching model)		2023.12.21	8:30am - 11:30
			(Cooperative learning method)		2023.12.22	8:30am -11:30
8	0.5	Pos-test	(Traditional teaching model)		2023.12.21	11:30am -12:00
			(Cooperative learning method)		2023.12.22	11:30am -12:00

In the first week of the experiment, a pre-test was conducted. The students' learning ability questionnaire (See Appendix A) and the students' core competencies questionnaire (See Appendix B) were distributed to the two classes for investigation. The questionnaires were collected after the test was completed.

From the first to the eighth week of the experiment, classroom teaching was conducted. The experimental group used cooperative learning method, that is, cooperative learning method teaching design cases (See Appendix F), and the control group used traditional teaching method, that is, traditional teaching design cases (See Appendix E).

After the classroom teaching in the eighth week of the experiment, a back-end test was conducted immediately. The students' learning ability questionnaire (See Appendix A) and the students' core competencies questionnaire (See Appendix B) were distributed to the two classes for investigation. Immediately after the test was completed, Take back the questionnaire.

3. After the teaching experiment is completed

Collect the learning ability and core competencies questionnaires of the experimental group and the control group, organize and analyze the data, compare the differences in learning ability and core competencies of the experimental group and the control group, and after SPSS analysis, record the experimental results and perform statistical analysis, and finally summarize.

4. Four basic steps in research design:

(1) Understand the current research status, definition of core concepts, and analysis of related factors related to cooperative learning at home and abroad, so as to lay a solid theoretical foundation for further research.

(2) Clarify the research method, prepare a questionnaire, and use the questionnaire method, test paper test and statistical analysis method to understand the application of cooperative learning in the "Electrical Engineering" class of Guangxi Normal University for Nationalities and students' attitudes towards cooperative learning methods, and analyze relevant data , discovered the problems of applying cooperative learning in the "Electrical Engineering" classroom, analyzed the causes, and proposed enhancement methods.

(3) Carry out two months of practical teaching, apply the cooperative learning method to the experimental group, continue to be proficient in the application of cooperative learning methods, and let students master the cooperative learning method.

(4) Pre-test and posT-test of the teaching process, analyze the changes in learning performance at each stage from the initial use of cooperative learning method to the use of cooperative learning method, and use test papers and questionnaires to understand the impact of cooperative learning on students after teaching what changes are there in enhancing learning ability and cultivating core competencies? Finally, we carefully organize, summarize and reflect on this research.

5. Teaching design

(1) Search for relevant information about "Electrical Engineering" courses and

cooperative learning as keywords. According to the requirements of the syllabus, study how to apply the cooperative learning method to the "Electrical Engineering" course, and finally formulate the teaching design of the "Electrical Engineering" course after expert review and recommendation.

(2) Check relevant information on learning ability and core competencies test papers to understand the changes in students' learning attitudes before and after learning. After review and recommendation by experts, a students' learning ability and core competencies questionnaire will be formulated one week before the start of the experiment. The students' learning ability and core competencies questionnaire will be distributed within one week after the end of the experiment. After the experimental study, the differences in learning abilities and core competencies of students in the experimental group and the two control groups were compared.

3.3 Research instruments

This article used the following 3 tools:

(1) 2 types of teaching designs

① Traditional teaching method teaching design (See Appendix E)

Traditional teaching method teaching design is based on the teaching content of this section, course requirements and student age characteristics, emphasizing teacher teaching, teaching centered on teachers, teaching materials, and classrooms, and presetting suitable classroom teaching processes in advance.

Traditional teaching method teaching design includes five parts: teaching analysis, teaching strategies, teaching process and teaching effect. Teaching analysis starts with selecting teaching materials, then clarifying the purpose of teaching, and finally determining the key and difficult points of teaching. Teaching strategies are teaching strategies centered on teachers, teaching materials and classrooms. The teaching process involves teachers imparting knowledge to students through explanations, demonstrations, displays, etc. The teaching process is divided into three parts: pre-class, classroom teaching and after-class application. The focus is on the in-class teaching

part. In-class teaching is divided into course introduction, comment analysis, experimental exploration, induction and summary, circuit simulation and time-limited self-test 6 link. The teaching effectiveness process assessment is 20%, the operation assessment is 60%, and the theoretical assessment is 20%.

② Cooperative learning method teaching design (See Appendix F)

The cooperative learning method teaching design is based on the age characteristics of the students, combined with the teaching content, course requirements and requirements of this section, and encourages students to work together for collective and personal interests, realize their ideals in the process of completing common tasks, and preset in advance Suitable classroom teaching process. Good teaching design can highlight key points, break through difficulties, focus on students' multiple ability training, and allow students to complete teaching goals in a relaxed and harmonious atmosphere.

The cooperative learning method teaching design includes five parts: teaching analysis, teaching strategies, teaching process and teaching effect. Teaching analysis starts with selecting teaching materials, then clarifying the purpose of teaching, and finally determining the key and difficult points of teaching. Teaching strategies are student-centered teaching strategies. The teaching process encourages students to work together for collective and individual interests and realize their ideals in the process of completing common tasks. The teaching process is divided into three parts before class, cooperative learning in class and application after class. The focus is on the teaching part in class, which includes the introduction of children's learning situations in the classroom, clear tasks, cooperative exploration, communication and feedback, inductive evaluation, circuit simulation and time-limited self-test. 7 links. The teaching effectiveness process assessment is 20%, the operation assessment is 60%, and the theoretical assessment is 20%.

Teaching arrangement: This teaching experiment is planned to last for two months from November 2023 to December 2023, with three classes per week, each class is 40

minutes, and there is a 10-minute break between classes. The two groups studied the same teaching content and adopted different teaching models. The control group used traditional teaching methods, and the experimental group used cooperative learning methods.

Tables 5 Teaching schedule

Weekly class schedule	Study unit	Date
1	Resistor in series	2023.11.02
	Resistors in parallel	2023.11.03
2	Resistors in series and parallel	2023.11.09
		2023.11.10
3	Resistive star connection	2023.11.16
	Resistive delta connection	2023.11.17
4	Wheatstone bridge	2023.11.23
	Equivalent transformation	2023.11.24
5	Branch current method	2023.11.30
	Node voltage method	2023.12.01
6	Superposition theorem	2023.12.07
		2023.12.08
7	Thevenin's theorem and Norton's theorem	2023.12.14
		2023.12.15
8	Maximum power transfer theorem	2023.12.21
		2023.12.22

(2) There are 2 measuring tables, including

① Learning Ability questionnaire (See Appendix A)

Students' learning ability is assessed using a questionnaire, which is designed using a Likert scale and uses a 5-level scale. The questionnaire design should follow the five principles of effectiveness, conciseness, personalization, scientificity and innovation and finalize the theme, and follow the five basic steps of targeting the survey group, accessing data, designing questions, enhancing the questionnaire and pre-survey.

The students' learning ability questionnaire is designed to measure five items, namely reading ability, comprehension ability, memory, concentration and creativity.

② Core competencies questionnaire (See Appendix B)

Students' core competencies are assessed using a questionnaire, which is designed using a Likert scale and uses a 5-level scale. The questionnaire design should follow the five principles of effectiveness, conciseness, personalization, scientificity and innovation and finalize the theme, and follow the five basic steps of targeting the survey group, accessing data, designing questions, enhancing the questionnaire and pre-survey. The students' core competencies questionnaire is designed to measure six items, namely humanistic heritage, scientific spirit, learning to learn, responsibility, practical innovation and healthy living.

3.4 Construction and quality of the instrument

3.4.1 Structure and quality of instructional design

To design cooperative learning instruction, follow the following steps:

(1) Conduct research and analysis on the "Electrical Engineering" course, and understand the course syllabus, etc.

(2) Determine that the learning content is suitable for the classes participating in the experiment. This article selected chapter 2 " Circuit Analysis Method " of "Electrical Engineering " to create a traditional teaching method design (See Appendix E) and a cooperative learning classroom teaching design (See Appendix F), divide the content of " Circuit Analysis Method " into 4 knowledge points, as shown in Table 6.

Tables 6 "Electrical Engineering" course content table

Module	Node	Knowledge points that need to be mastered
Circuit analysis method	1. Series and parallel connection of resistors	1) Series connection of resistors 2) Resistors in parallel 3) Mixed connection of resistors

	2. Connection of resistors	1) Resistive star connection 2) Resistive delta connection 3) Wheatstone bridge 4) Equivalent transformation of resistance star connection and delta connection
	3. Equivalent transformation of power supply	1) Branch current method 2) Node voltage method 3) Superposition theorem
	4. Equivalent power theorem	1) Thevenin's theorem 2) Norton's theorem 3) Maximum power transfer theorem

(3) Submit the adopted content to formulate two teaching designs, namely cooperative learning classroom teaching design and traditional teaching method design, to the "Electrical Engineering" course experts. At least three experts will check the effectiveness of the teaching design content according to the requirements of the syllabus, and make modifications based on the experts' suggestions.

(4) Hand over the modified cooperative learning method design to three experts to verify the correctness of the content. The list of experts is as follows:

① Yu Xiaoying, professor, has been engaged in higher education for 27 years, currently working as a mathematics and physics professor at Guangxi Normal University for Nationalities

With the deputy dean of the school of electronic Information;

②Li Fansheng, professor, has been engaged in higher education for 26 years, currently working as a mathematics and physics professor at Guangxi Normal University for Nationalities

With the Secretary of the Academic Affairs Office of the School of Electronic Information;

③Wei Jinming, associate professor, has been engaged in university education for

19 years, and currently works as a physics professor at Guangxi Normal University for Nationalities

Department chair.

(5) Obtain the instructional design review form from 3 experts for inspection, and measure it with IOC. The scores are: 1, 0, -1. 1 means agree, 0 means pending, and -1 means disagree. The IOC index must be between -1 ~ 1. The value range of the IOC indicator should be greater than 0.5 to prove its correctness and applicability. If the IOC index is below 0.5, further revisions are required. The IOC result of traditional teaching method design is 0.90 (See Appendix G), and the IOC result of cooperative learning classroom teaching design is 0.93 (See Appendix H), which can be used for actual teaching.

(6) Apply the two teaching designs to actual classroom teaching, and continuously enhance and perfect the teaching content in the application.

3.4.2 Questionnaire construction and quality

(1) Students' learning ability questionnaire, the questionnaire adopts Likert scale. Understand the changes in students' learning abilities, the formation of groups in cooperative learning, and whether teachers participate in cooperative learning and cooperation. Ways to assess learning. There are 21 questions in the students' learning ability questionnaire. The questionnaire was divided into two parts. The first part is the student's personal information, with a total of 1 question. The second part includes 20 questions on 5 sub-items: reading ability, comprehension ability, memory, concentration, and creativity. (See Appendix A, Table 7)

Tables 7 Students' learning ability questionnaire assessment items

project	Measurement content	Question number
learning ability	1.Reading ability	1 to 4
	2.Comprehension ability	5 to 9
	3. memory	10 to 13

	4 .Concentration	14 to 17
	5. creativity	18 to 20

From Table 7, the students' learning ability questionnaire evaluation item table, we can know that the learning ability assessment uses 5 sub-items to evaluation, of which reading ability is tested with questions 1 to 4, comprehension ability is tested with questions 5 to 9, and memory is tested with 10 to 9 questions. 13 questions are used to test, concentration is tested with 14 to 17 questions and creativity is tested with 18 to 20 questions.

(2) Students' core competencies questionnaire, the questionnaire adopts Likert scale. The class of this experiment was investigated, and students' core competencies wered mainly through two types of "Electrical Engineering" classroom teaching designs and practical teaching. The students' core competencies questionnaire includes six items: humanistic heritage, scientific spirit, learning to learn, healthy living, responsibility, and practical innovation. Questionnaire 2 has a total of 24 questions. The questionnaire was divided into two parts. The first part is the student's personal information, with a total of 1 question. The second part includes 23 questions in 6 sub-items. (See Appendix B, see Table 8)

Tables 8 Sub-item list of students' core competencies questionnaire

Project	Measurement content	Question number
Core competencies	1.Humanistic heritage	1 to 3
	2.Scientific spirit	4 to 8
	3.Learn to learn	9 to 12
	4.Responsibility	13 to 17
	5.Practice innovation	18 to 20
	6.Healthy Living	21 to 23

From Table 8, the students' core competencies questionnaire evaluation item table, we can know that the core competencies assessment uses 6 sub-items to evaluation, of which humanistic heritage is tested with questions 1 to 3, scientific spirit is tested with

questions 4 to 8, and learning to learn is tested with questions 9 to 12, questions 12 are used to test responsibility, questions 13 to 17 are used to test responsibility, practical innovation is tested using questions 18 to 20, and healthy living is tested using questions 21 to 23.

Questionnaire construction steps:

(1) Questionnaire design: First, according to research needs, refer to other scholars' papers to formulate a preliminary questionnaire;

(2) Ask school instructors and experienced teachers to make revisions;

(3) Finalize the specific content of the questionnaire and prepare it into a questionnaire;

(4) Submit the questionnaire form to three experts to verify the correctness of the content. The list of experts is as follows:

① Xiaoying Yu, professor, has been engaged in higher education for 27 years, and is currently the deputy dean of the School of Mathematical Physics and Electronic Information of Guangxi Normal University for Nationalities;

② Fansheng Li, professor, has been engaged in higher education for 24 years and is currently the Secretary of the Academic Affairs Office of the School of Mathematics, Physics, Chemistry and Electronic Information of Guangxi Normal University for Nationalities;

③ Jinming Wei, associate professor, has been engaged in university education for 19 years and is currently the director of the Physics Department of Guangxi Normal University for Nationalities.

Questionnaire review form from 3 experts, check it, measure it with IOC, and score: 1, 0, -1. 1 means agree, 0 means pending, and -1 means disagree. The IOC index must be between -1 ~ 1. The value range of the IOC indicator should be greater than 0.5 to prove its correctness and applicability. If the IOC index is below 0.5, further revisions are required.

① The students' learning ability questionnaire is 0.90, which can be used for

experimental investigations. (See Appendix C)

② The students' core competencies questionnaire is 0.89 and can be used for experimental surveys. (See Appendix D)

3.5 Data collection

Explore the impact of students using two different teaching models to learn the same knowledge on students' learning abilities and core competencies in the "Electrical Engineering" course. During the data collection phase of this article, each test data was collected according to the following steps.

(1) Distribute and collect learning ability questionnaires to understand the students' pre-learning situation before the experiment begins. Through the results of the learning ability questionnaire, it is known what level the students' learning ability is when using traditional teaching. What is the level of students' learning ability after cooperative learning method? A total of 120 questionnaires were distributed in this article, 120 valid test papers were withdrawn, and 0 invalid test papers were withdrawn. The returned questionnaires can be used for analysis in this experiment.

(2) Distribute and collect core competencies questionnaires to understand the students' pre-learning situation before the experiment begins. Through the results of the core competencies questionnaire, we can know what the students' core competencies level is when using traditional teaching. What is the level of students' core competencies after cooperative learning and teaching? In this article, a total of 120 questionnaires were distributed, 120 valid test papers were collected, and 0 invalid test papers were recovered. The returned questionnaires can be used for analysis in this experiment.

3.6 Statistics used in data analysis

1. Statistics for checking tool quality

(1) Content effectiveness of the learning management program, us e the following formula to determine (IOC)

$$\text{IOC} = \frac{\sum R}{N}$$

IOC stands for acceptance index

ΣR stands for expert summation

N stands for number of experts

(2) Determination of the quality of learning achievement tests, us e the following formula to determine (IOC)

$$IOC = \frac{\sum R}{N}$$

IOC stands for acceptance index

ΣR stands for expert summation

N stands for number of experts

(3) Determination of learning attitude test quality, we e the following formula to determine (IOC)

$$IOC = \frac{\sum R}{N}$$

IOC stands for acceptance index

ΣR stands for expert summation

N stands for number of experts

2. Basic statistics

(1) Average value by using the following formula

$$\bar{X} = \frac{\sum X}{N}$$

$\bar{X}$ stand s for sample mean

Σ X stands for s um of the data in the sample

Nstands for the sample size

(2) Standard deviation using the following formula

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{N - 1}}$$

SD stands for the sample standard deviation

X stands for the value of each data piece

$\bar{X}$ stands for the sample mean

N stands for the sample size

(3) T-test formula

The T-test formula used in this article is 2 independent sample T-test formula (Witte & Witte, 2017)(Witte & Witte, 2017)(Witte & Witte, 2017)(Witte & Witte, 2017)

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)}}$$

$\overline{X_1}$&$\overline{X_2}$ stand s for the mean of the two groups of samples respectively.

S_1^2&S_2^2 stand s for the variance of the two groups of samples respectively

n_1&n_1 stands for the sample size

CHAPTER IV

DATA ANALYSIS RESULTS

Statistical analysis of experimental data refers to data measured by experiments, which must be scientifically analyzed and processed in order to reveal the relationship between various physical quantities. The process of obtaining conclusions from raw data is usually called data processing. Correctly processing the data recorded in the experiment will help us scientifically understand the objective laws of the measured or studied objects, choose appropriate experimental data processing methods, minimize errors, and make the experimental data infinitely close to the results under ideal conditions. This is experimental data the point of processing. The purpose of This article is that cooperative learning method teaching is of great help to the cultivation of students' learning abilities and core competencies. The results of the research data analysis are as follows:

4.1 The learning ability between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test)

4.2 The core competencies between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test)

4.3 The learning ability between traditional teaching method and cooperative learning method was tested using paired sample T-test.

4.4 The core competencies between traditional teaching method and cooperative learning method was tested using paired sample T-test.

4.5 Experiment summary

4.1 The learning ability between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test).

Normality test of students' learning ability: It is easy to see from Table 9 and Table 10 that the p-values of the measurement content are all greater than 0.05, indicating that the students' learning ability pre-test and posT-test are in line with the normal distribution. The next step can be to conduct a T-test .

Tables 9 Pre-test the learning ability between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test)

Measurement content	Teaching methods	Statistics	df	Sig.(p-value)
Reading ability	Method 1 (traditional teaching method)	.956	30	.238>0.05
	Method 2 (cooperative learning method)	.956	30	.237>0.05
Comprehension	Method 1 (traditional teaching method)	.967	30	.458>0.05
	Method 2 (cooperative learning method)	.966	30	.438>0.05
Memory	Method 1 (traditional teaching method)	.945	30	.126>0.05
	Method 2 (cooperative learning method)	.944	30	.118>0.05
Concentration	Method 1 (traditional teaching method)	.958	30	.272>0.05
	Method 2 (cooperative learning method)	.943	30	.107>0.05
Creativity	Method 1 (traditional teaching method)	.952	30	.192>0.05
	Method 2 (cooperative learning method)	.965	30	.424>0.05

Note: From Table 9, it can be concluded that the p-values are all greater than 0.05, indicating that the students' learning ability in both pre-test is in line with the normal distribution. The next step can be to perform a T-test.

Tables 10 PosT-test the learning ability between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test)

Measurement content	Teaching methods	Statistics	df	Sig.(p-value)
Reading ability	Method 1 (traditional teaching method)	.960	30	.302>0.05
	Method 2 (cooperative learning method)	.942	30	.105>0.05
Comprehension	Method 1 (traditional teaching method)	.962	30	.34>0.05
	Method 2 (cooperative learning method)	.963	30	.362>0.05

Measurement content	Teaching methods	Statistics	df	Sig.(p-value)
Memory	Method 1 (traditional teaching method)	.960	30	.321>0.05
	Method 2 (cooperative learning method)	.952	30	.186>0.05
Concentration	Method 1 (traditional teaching method)	.943	30	.112>0.05
	Method 2 (cooperative learning method)	.958	30	.269>0.05
Creativity	Method 1 (traditional teaching method)	.947	30	.142>0.05
	Method 2 (cooperative learning method)	.948	30	.146>0.05

Note: From Table 10, it can be concluded that the p-values are all greater than 0.05, indicating that the students' learning ability in both posT-test is in line with the normal distribution. The next step can be to perform a T-test.

4.2 The core competencies between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test)

Normality test of students' core competencies: From Table 11 and Table 12, it is found that the p-values of the measurement content are all greater than 0.05, indicating that the pre-test and posT-test of students' core competencies are in line with the normal distribution, and the next step is to conduct a T-test.

Tables 11 Pre-test the core competencies between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test)

Measurement content	Teaching methods	Statistics	df	Sig.(p-value)
Humanistic heritage	Method 1 (traditional teaching method)	.960	30	.301>0.05
	Method 2 (cooperative learning method)	.955	30	.236>0.05
Scientific spirit	Method 1 (traditional teaching method)	.951	30	.176>0.05
	Method 2 (cooperative learning method)	.934	30	.062>0.05
Learn to learn	Method 1 (traditional teaching method)	.945	30	.126>0.05

	Method 2 (cooperative learning method)	.950	30	.172>0.05
Responsibility	Method 1 (traditional teaching method)	.943	30	.109>0.05
	Method 2 (cooperative learning method)	.960	30	.312>0.05
Practical innovation	Method 1 (traditional teaching method)	.946	30	.133>0.05
	Method 2 (cooperative learning method)	.953	30	.199>0.05
Healthy lifestyle	Method 1 (traditional teaching method)	.956	30	.250>0.05
	Method 2 (cooperative learning method)	.957	30	.252>0.05

Note: From Table 11, it can be concluded that the p-values are all greater than 0.05, indicating that the students' core competencies in both pre-test is in line with the normal distribution. The next step can be to perform a T-test.

Tables 12 PosT-test the core competencies between traditional teaching method and cooperative learning method was tested using normal distribution (Shapiro-Wilk test)

Measurement content	Teaching methods	Statistics	df	Sig.(p-value)
Humanistic heritage	Method 1 (traditional teaching method)	.949	30	.156>0.05
	Method 2 (cooperative learning method)	.949	30	.164>0.05
Scientific spirit	Method 1 (traditional teaching method)	.947	30	.138>0.05
	Method 2 (cooperative learning method)	.948	30	.147>0.05
Learn to learn	Method 1 (traditional teaching method)	.947	30	.138>0.05
	Method 2 (cooperative learning method)	.959	30	.296>0.05
Responsibility	Method 1 (traditional teaching method)	.964	30	.395>0.05
	Method 2 (cooperative learning method)	.942	30	.100>0.05
Practical innovation	Method 1 (traditional teaching method)	.950	30	.172>0.05

Healthy lifestyle	Method 2 (cooperative learning method)	.957	30	.264>0.05
	Method 1 (traditional teaching method)	.954	30	.211>0.05
	Method 2 (cooperative learning method)	.940	30	.093>0.05

Note: From Table 12, it can be concluded that the p-values are all greater than 0.05, indicating that the students' core competencies in both posT-test is in line with the normal distribution. The next step can be to perform a T-test.

4.3 The learning ability between traditional teaching method and cooperative learning method was tested using paired sample T-test.

The paired sample T-test for predicting students' learning abilities is shown in Table 13: the prediction results of traditional teaching methods and cooperative teaching methods for students' learning abilities. According to the prediction significance analysis, the p-values (2-tailed) of reading ability, comprehension ability, memory, attention and creativity are 0.389, 0.719, 0.769, 0.111 and 0.522 respectively, which are all greater than 0.05 and are significant. The difference is not obvious, indicating that there is no difference in the learning ability of the two classes of students before the experiment, and the experiment can be carried out. The paired sample T-test of posT-test students' learning ability is shown in Table 14: the prediction results of traditional teaching methods and cooperative teaching methods on students' learning ability. According to the predictive significance analysis, the p-values (2-tailed) of reading ability, comprehension ability, memory, attention and creativity are all 0.000, which are all less than 0.05, indicating significance. It shows that there is a significant difference in the learning ability between Method 1 (traditional teaching method) and Method 2 (cooperative learning method).

Tables 13 Pre-test the learning ability between traditional teaching method and cooperative learning method was tested using paired sample T-test

Measurement content	Teaching method	N	$\bar{X}$	SD	df	t	p-value (2 -tailed test)
Reading ability	Method 1 (traditional teaching method)	30	-.3000	1.8781	29	-.875	. 389>0.05

Measurement content	Teaching method	N	$\bar{X}$	SD	df	t	p-value (2 -tailed test)
Comprehension	Method 2 (cooperative learning method)	30	-.1333	2.0126	29	-.363	.719>0.05
	Method 1 (traditional teaching method)	30					
Memory	Method 2 (cooperative learning method)	30	-.1000	1.8448	29	-.297	.769>0.05
	Method 1 (traditional teaching method)	30					
Concentration	Method 2 (cooperative learning method)	30	-.5333	1.7759	29	-1.645	.111>0.05
	Method 1 (traditional teaching method)	30					
Creativity	Method 2 (cooperative learning method)	30	.2000	1.6897	29	0.648	.522>0.05
	Method 1 (traditional teaching method)	30					

Note: From the data in Table 13, that the significance analysis of the paired sample t test and the sig (2-tailed) values of the students' learning ability measurement content are all greater than 0.05, so we can draw the conclusion: Method 1 (traditional teaching method) and 2 (cooperative learning method) has no significant difference in learning ability.

Tables 14 PosT-test the learning ability between traditional teaching method and cooperative learning method was tested using paired sample T-test

Measurement content	Teaching method	N	$\bar{X}$	SD	df	t	p-value (2 -tailed test)
Reading ability	Method 1 (traditional teaching method)	30	-5.9333	2.1961	29	-14.798	. 000<0.05
	Method 2 (cooperative learning method)	30					
Comprehension	Method 1 (traditional teaching method)	30	-7.1333	2.1292	29	-18.350	. 000<0.05
	Method 2 (cooperative learning method)	30					

Memory	Method 1 (traditional teaching method) Method 2 (cooperative learning method)	30 30	-5.1000	2.4684	29	-11.316	. 000<0.05
Concentration	Method 1 (traditional teaching method) Method 2 (cooperative learning method)	30 30	-5.5000	2.7761	29	-10.851	. 000<0.05
Creativity	Method 1 (traditional teaching method) Method 2 (cooperative learning method)	30 30	-4.3000	2.1995	29	-10.708	. 000<0.05

Note: From the data in Table14, we can see that in the significance analysis of the paired sample test, the p-values (2-tailed) of the students' learning ability measurement content are all 0.000, both less than 0.05, so we can draw the conclusion: Method 1 (traditional teaching method) and method 2 (cooperative learning method) have significant differences in learning ability.

4.4 The core competencies between traditional teaching method and cooperative learning method was tested using paired sample T-test.

The paired sample T-test for predicting students' core competencies is shown in Table 15: the prediction results of traditional teaching methods and cooperative teaching methods for students' core competencies. According to the prediction significance analysis, the p-values (2-tailed) of humanistic heritage, scientific spirit, learn to learn, responsibility, practical innovation and healthy lifestyle are 0.917, 0.264, 0.763, 0.645,0.349 and 0.837 respectively, which are all greater than 0.05 and are significant. The difference is not obvious, indicating that there is no difference in the core competencies of the two classes of students before the experiment, and the experiment can be carried out.

The paired sample T-test of posT-test students’ core competencies is shown in Table 16: the prediction results of traditional teaching methods and cooperative teaching methods on students’ core competencies. According to the predictive significance analysis, the p-values (2-tailed) of humanistic heritage, scientific spirit,

learn to learn, responsibility, practical innovation and healthy lifestyle are all 0.000, which are all less than 0.05, indicating significance. It shows that there is a significant difference in the core competencies between Method 1 (traditional teaching method) and Method 2 (cooperative learning method).

Tables 15 Pre-test the core competencies between traditional teaching method and cooperative learning method was tested using paired sample T-test

Measurement content	Teaching methods	N	$\bar{X}$	SD	df	t	p-value (2 -tailed)
Humanistic heritage	Method 1 (traditional teaching method)	30	0.0333	1.7317	29	.105	.917>0.05
	Method 2 (cooperative learning method)	30					
Scientific spirit	Method 1 (traditional teaching method)	30	-.4000	1.9226	29	-1.140	.264>0.05
	Method 2 (cooperative learning method)	30					
Learn to learn	Method 1 (traditional teaching method)	30	-.1333	2.4031	29	-.304	.763>0.05
	Method 2 (cooperative learning method)	30					
Responsibility	Method 1 (traditional teaching method)	30	-.2000	2.3548	29	-.465	.645>0.05
	Method 2 (cooperative learning method)	30					
Practical innovation	Method 1 (traditional teaching method)	30	-.3000	1.7251	29	.953	.349>0.05
	Method 2 (cooperative learning method)	30					
Healthy lifestyle	Method 1 (traditional teaching method)	30	-.0666	1.7604	29	.207	.837>0.05
	Method 2 (cooperative learning method)	30					

Note: From the data in Table 15, we can see that the significance analysis of the paired sample test shows that the sig (2-tailed) values of students' core competencies measurement content are 0.917, 0.264, 0.763, 0.645, 0.349 and 0.837, all greater than 0.05, so we can It is concluded that there is no significant difference in the core competencies of Method 1 (traditional teaching method) and Method 2 (cooperative

learning method), indicating that there is no difference in the core competencies of the two classes of students before the experiment, and the experiment can be carried out.

Tables 16 PosT-test the core competencies between traditional teaching method and cooperative learning method was tested using paired sample T-test

Measurement content	Teaching methods	N	$\bar{X}$	SD	df	t	p-value (2 -tailed)
Humanistic heritage	Method 1 (traditional teaching method)	30	-4.333	1.9357	29	-12.261	. 000<0.05
	Method 2 (cooperative learning method)	30					
Scientific spirit	Method 1 (traditional teaching method)	30	-8.667	2.5097	29	-18.914	. 000<0.05
	Method 2 (cooperative learning method)	30					
Learn to learn	Method 1 (traditional teaching method)	30	-5.967	2.7852	29	-11.734	. 000<0.05
	Method 2 (cooperative learning method)	30					
Responsibility	Method 1 (traditional teaching method)	30	-6.200	2.2652	29	-14.992	. 000<0.05
	Method 2 (cooperative learning method)	30					
Practical innovation	Method 1 (traditional teaching method)	30	-4.167	2.6272	29	-8.687	. 000<0.05
	Method 2 (cooperative learning method)	30					
Healthy lifestyle	Method 1 (traditional teaching method)	30	-4.533	2.2087	29	-11.242	. 000<0.05
	Method 2 (cooperative learning method)	30					

Note: From the data in Table 16, we can see that the significance analysis of the paired sample test shows that the sig (2-tailed) values of the students' core competencies measurement content are all 0.000, all less than 0.05, and the significant differences are

obvious. Therefore, we can draw the conclusion: Method 1 (traditional teaching method) and Method 2 (cooperative learning method) have significant differences in the core competencies.

4.5 Experiment summary

In summary, through the above relevant data of the experimental group and the control group, students' learning ability and students' core competencies are analyzed. The analysis results are as follows:

4.5.1 Summary of students’ learning abilities

According to the experimental results, the paired sample T-test was conducted on the learning abilities of Method 1 (traditional teaching method) and Method 2 (cooperative learning method), and the p-values (2-tailed) were both 0.000, both less than 0.05, so we can draw the conclusion: Implement of cooperative learning method can enhance students' learning ability.

4.5.2 Summary of students ’ core competencies

According to the experimental results, the paired sample T-test was conducted on the core competencies of Method 1 (traditional teaching method) and Method 2 (cooperative learning method), and the p-values (2-tailed) were both 0.000, both less than 0.05, so we can draw the conclusion: Implement of cooperative learning method can enhance students' core competencies.

CHAPTER V

CONCLUSION, DISCUSSION AND SUGGESTION

This chapter will carry out the conclusion and discussion of the article through several steps:

5.1 Conclusion

5.2 Discussion

5.3 Suggestion

5.1 Conclusion

This article compares two teaching methods, the cooperative learning method and the traditional teaching method, and formulates relevant teaching plans and implements them among physics major students of Guangxi Normal University for Nationalities. Method 1 (control group) uses traditional teaching methods, and method 2 (experimental group) uses cooperative learning methods. After the experiment, questionnaires on students' learning abilities and core competencies were collected and the questionnaire data were analyzed. The results show that applying cooperative learning methods is better than traditional teaching methods to enhance students' learning abilities and core competencies.

(1) Applying cooperative learning method can enhance students' learning ability. Using paired sample T-test, the analysis of the questionnaire data results of Method 1 (traditional teaching method) and Method 2 (cooperative learning method) to enhance students' learning ability shows that the p (2-tailed) value of the students' learning ability measurement content is both 0.000 , are all less than 0.05, and the significance is obvious. It shows that during the implementation of the cooperative learning method, students first understand the problem through the teacher's tutoring plan before class, then explore, summarize and draw conclusions through the classroom cooperative learning group, and finally master the content of the study plan after class. Practical application in the classroom to solve problems designed by the teacher, gain a sense of self-efficacy, have the confidence to learn the lesson well, and effectively enhance

students' learning ability.

(2) Applying cooperative learning method can enhance students' core competencies. Using paired sample T-test, the analysis of the questionnaire data results of Method 1 (traditional teaching method) and Method 2 (cooperative learning method) to enhance students' learning ability shows that the p (2-tailed) value of the students' learning ability measurement content is both 0.000 , are all less than 0.05, and the significance is obvious. It shows that during the implementation of the cooperative learning method, students will be more proactive in learning, communicating with each other, collaborating, constantly criticizing, being brave in innovation, and effectively enhance students' core competencies.

5.2 Discussion

The theme of This article is to implement of cooperative learning methods to enhance students' learning abilities and students' core competencies. Research method: Experimental research is used. Research process: Apply the cooperative learning method to the "Electrical Engineering" course of the physics major of Guangxi Normal University for Nationalities. After the teaching experiment of the control group (using traditional teaching method) and the experimental group (using cooperative learning method), distribute and collect students' learning ability and students' core competencies questionnaires, and conduct data statistics and data analysis. Experimental results prove that applying cooperative learning methods can enhance students' learning abilities and students' core competencies. The results are consistent with the research hypothesis of the article, and the research results support this article.

The results of this article are consistent with those of other scholars. After the experiment, a paired sample T-test was conducted on the learning abilities of students in Method 1 (traditional teaching method) and Method 2 (cooperative learning method). The significant difference in students' learning abilities between Method 1 (traditional teaching method) and Method 2 (cooperative learning method) is $P=0.000<0.05$. The significant difference in students' core competencies between Method 1 (traditional

teaching method) and Method 2 (cooperative learning method) is the significant difference is P=0.000<0.05. There are significant differences in students' learning abilities and core competencies between Method 1 (traditional teaching method) and Method 2 (cooperative learning method). The cooperative learning method has many advantages in teaching practice. First, through group discussions and cooperative learning, students can more deeply understand and digest the knowledge they have learned, rather than simply accepting and memorizing it. This helps to enhance their learning effectiveness and academic performanceSlavin, (1989). Secondly, the cooperative learning method can effectively promote the cultivation of students' communication and teamwork abilities. Within groups, students need to communicate and collaborate with each other, which helps to exercise their social skills and teamwork abilities Gillies, (2016). In addition, cooperative learning methods can also students' critical thinking and innovation abilities. Through group discussions and joint exploration, students can apply the knowledge they have learned more flexibly and develop problem-solving abilities Gu, (2021). In summary, the cooperative learning method has obvious advantages in enhancing students' learning abilities and core competencies, and deserves wider application and promotion in education and teaching.

5.3 Suggestion

In the process of implementing cooperative learning methods to enhance students' learning abilities and core competencies, we also face some challenges. First, the cooperative learning method requires greater time investment and resource support from teachers and students, including teachers needing to spend more time designing and organizing cooperative learning activities during the teaching process, and schools needing to provide more support and resources to promote cooperation. Implementation of learning. Secondly, cooperative learning requires students to have a certain sense of cooperation and ability, but some students may have individual differences, and different students have different abilities to absorb and apply in cooperative learning. In addition, teachers may face evaluation difficulties when implementing cooperative

learning. How to fairly evaluate each student's individual performance and the collaborative effect of the entire group is a challenge.

To address these challenges, we can adopt some strategies. First, schools and education departments can increase support and investment in cooperative learning methods, including providing teacher training, teaching resources, and venue support for group learning. Secondly, teachers can fully consider the individual differences of students when designing cooperative learning activities and try to set up diverse tasks and activities to meet the learning needs of different students. At the same time, teachers need to evaluate students' cooperative learning results in a variety of ways, including individual reports, group presentations, peer evaluations, etc., to ensure fairness and objectivity in evaluation. In addition, when implementing cooperative learning, teachers need to guide students to establish good cooperative habits and skills, including learning to listen, respect other people's opinions, resolve differences, etc., in order to enhance the effect of cooperative learning.

The future research directions and suggestions should focus on the continuous enhancement and optimization of cooperative learning methods in teaching practice. First, it is necessary to further explore how to combine the characteristics of different subject areas and the actual needs of students to design more targeted and practical cooperative learning tasks. Secondly, the applicability and effectiveness of cooperative learning methods in different grades, different types of schools, and different student groups can be studied in depth to better guide teaching practice. In addition, attention can be paid to the use of technological means to support the effective implementation of cooperative learning methods, such as using online platforms or applications to conduct cross-regional and cross-school cooperative learning activities. In addition, we can also explore how to evaluate and give feedback on the effectiveness of cooperative learning, and how to motivate students to participate more actively in cooperative learning. Finally, future research can also focus on the long-term impact of cooperative learning methods on students' lifelong learning abilities and core competencies to gain

a deeper understanding of the continued value of this teaching model.

Although a lot of preparation work was done in the early stage of this article, and the research was finally completed through literature review, student testing, and student questionnaires, etc., this article still has the following shortcomings. First, the number of studies studied in this survey was small and the scope of the studies was small. The subjects of this article are limited to two classes in the second year of college. Due to differences in the learning quality of students and the teaching quality of teachers in different schools and regions, the results of this article can only reflect the application of these two classes and cannot be applied to the entire urban area or even other regions across the country. Second, the design of the questionnaire needs to be optimized. The student questionnaire was compiled on the basis of previous designs, with reference to relevant literature and in conjunction with the actual teaching situation. Since the questionnaire involves many categories and items, some students may have felt bored during the filling process and filled in the answers as they pleased. This resulted in some invalid questionnaires, which greatly reduced the number of questions. the authenticity of the data. Third, the researcher's own ability and experience are insufficient, the analysis of the problem and its influencing factors are not in-depth enough, the teaching suggestions proposed are not comprehensive enough, and all aspects of cooperative learning method cannot be refined.

Appendix

Appendix A

Students' learning ability questionnaire

Dear classmates:

Hello! This questionnaire is to explore and develop cooperative learning methods to enhance students' learning abilities and students' core competencies , and to discover problems existing in teaching practice. This questionnaire only provides a basis for writing research on the paper. There is no right or wrong answer, and names are not recorded. , please feel free to answer. I hope you will fill it in carefully according to the actual situation. Thank you for your cooperation and support. I would like to express my sincere gratitude to you!

Strongly agree = 5 points Agree = 4 points Not sure = 3 points Disagree = 2 points Strongly disagree = 1 point

First part:

T1 What is your gender? ( ) A.Male B.Female

The second part:

Evaluation items	View				
	Very agree	Agree	Uncertain	Disagree	Strongly no agree
T1 You like reading very much					
T2 Do you think your reading ability is very strong?					
T3 Do you think reading and writing are closely related					
T4 Spends a lot of time reading every day					
T5 Has strong ability to think holistically					
T6 Has a strong ability to discern problems					
T7 Maintain long-term freshness and interest in things					
T8 Has better imitation ability					
T9 Can quickly grasp the					

Evaluation items	View				
	Very agree	Agree	Uncertain	Disagree	Strongly no agree
objective laws of things					
T10 I don’t often find my stuff.					
T11 Has a good impression of new things					
T12 I still remember the knowledge explained by the teacher clearly in class after class.					
T13 Able to clearly recall what happened during the week					
T14 Not easily distracted by external stimuli					
T15 Always concentrate on problems					
T16 Think attention is very strong					
T17 Don’t think of other things in class					
T18 Has a rich imagination for new things					
T19 Likes to study things they have never seen before					
T20 Likes to explore the truth of new things					

Appendix B

Students' core competencies questionnaire

Dear classmates:

Hello! This questionnaire is to explore and develop cooperative learning methods to enhance students' learning abilities and students' core competencies , and to discover problems existing in teaching practice. This questionnaire only provides a basis for writing research on the paper. There is no right or wrong answer, and names are not recorded. , please feel free to answer. I hope you will fill it in carefully according to the actual situation. Thank you for your cooperation and support. I would like to express my sincere gratitude to you!

Strongly agree = 5 points Agree = 4 points Not sure = 3 points Disagree = 2 points Strongly disagree = 1 point

First part:

K1 What is your gender? ( ) A.Male B.Female

The second part:

Evaluation items	View				
	Very agree	Agree	Uncertain	Disagree	Strongly no agree
K1 Is very knowledgeable about the history and culture of his country					
K2 Knows his own ethnic customs very well					
K3 Thinks his conversation is humorous					
K4 Always maintain a truth-seeking and pragmatic attitude towards things					
K5 Likes to pursue perfection in things					
K6 When encountering a problem, he always tries to get to the bottom of it					
K7 Always has a lot of problems to solve					

Evaluation items	View				
	Very agree	Agree	Uncertain	Disagree	Strongly no agree
K8 I very curious about new things and always wants to know how they work.					
K9 Has no pressure on learning					
K10 Is very happy to learn					
K11 Able to accept criticism and correction from others in a friendly manner					
K12 Develop goals and study plans for each subject					
K13 Protect the rights of others					
K14 Abide by laws and regulations, do not break the law or commit any crime					
K15 When you see others vandalizing public property, step forward to stop them.					
K16 takes the initiative to take on family work					
K17 Always face difficulties head on					
K18 Likes to join various student clubs					
K19 Science and technology competition plays an important role in enhancing college students' scientific and technological innovation capabilities					
K20 College students' practical and innovative abilities and personal employment					
K21 Have good work and rest habits					
K22 always pay attention to the hygiene around you and love sports					
K23 has a good attitude and is full of hope for future life					

Appendix C

Students' learning ability questionnaire expert evaluation form

Evaluation items	Expert 1	Expert 2	Expert 3	Total	IOC
T1 You like reading very much	1	1	1	3	1.00
T2 Do you think your reading ability is strong?	0	1	1	2	0.67
T3 Do you think there is a relationship between reading and writing?	1	1	1	3	1.00
T4 Spends a lot of time reading every day	1	1	1	3	1.00
T5 The ability to think holistically is very good	1	0	1	2	0.67
T6 Has a strong ability to discern problems	0	1	1	2	0.67
T7 Maintain long-term freshness and interest in things	1	1	1	3	1.00
T8 Has better imitation ability	1	1	1	3	1.00
T9 Can quickly grasp the rules of things	1	1	1	3	1.00
T10 I don't often find my stuff.	1	1	1	3	1.00
T11 Has a good impression of new things	0	1	1	2	0.67
T12 I still remember the knowledge explained by the teacher clearly in class after class.	1	1	0	2	0.67
T13 Able to clearly recall what happened during the week	1	1	1	3	1.00
T14 Not easily distracted by external stimuli	1	1	1	3	1.00
T15 Always concentrate on problems	1	1	1	3	1.00
T16 Think attention is very strong	1	1	1	3	1.00
T17 Don't think of other things in class	1	1	1	3	1.00
T18 Has a rich imagination for new things	1	0	1	2	0.67
T19 Likes to carefully observe things they have not seen before	1	1	1	3	1.00
T20 Likes to explore the truth of new things	1	1	1	3	1.00
Total					0.90

Appendix D

Students' core competencies questionnaire expert evaluation form

Evaluation items	Expert 1	Expert 2	Expert 3	Total	IOC
K1 Is very knowledgeable about the history and culture of his country	1	1	1	3	1.00
K2 Knows his own ethnic customs very well	1	0	1	2	0.67
K3 Thinks his conversation is humorous	1	1	1	3	1.00
K4 Always maintain a truth-seeking and pragmatic attitude towards things	1	1	1	3	1.00
K5 Likes to pursue perfection in things	1	1	1	3	1.00
K6 When encountering a problem, he always tries to get to the bottom of it	0	1	1	2	0.67
K7 Always has a lot of problems to solve	1	1	1	3	1.00
K8 Is very curious about new things and always wants to know how they work.	1	1	1	3	1.00
K9 Has no pressure on learning	1	1	1	3	1.00
K10 Is very happy to learn	1	1	1	3	1.00
K11 Able to accept criticism and correction from others in a friendly manner	0	1	1	2	0.67
K12 Develop goals and study plans for each subject	1	1	1	3	1.00
K13 Protect the rights of others	1	1	1	3	1.00
K14 Abide by laws and regulations and do not break the law or commit any crime	1	1	1	3	1.00
K15 When you see others vandalizing public property, step forward to stop them.	1	1	0	2	0.67
K16 Takes the initiative to take on family work	1	1	1	3	1.00
K17 Always face difficulties head on	1	0	1	2	0.67
K18 Likes to join various student clubs	0	1	1	2	0.67
K19 Science and technology competition plays an important role in enhancing college students' scientific and technological	1	1	1	3	1.00

Evaluation items	Expert 1	Expert 2	Expert 3	Total	IOC
innovation capabilities					
K20 There is a relationship between college students' practical and innovative abilities and personal employment	0	1	1	2	0.67
K21 Have good work and rest habits	1	1	1	3	1.00
K22 Always pay attention to the hygiene around you and love sports	1	1	1	3	1.00
K23 Has a good attitude and is full of hope for future life	1	0	1	2	0.67
Total					0.89

Appendix E

Traditional teaching design cases

<table>
<tr><td colspan="2">Teaching content</td><td colspan="2">2.6 Superposition theorem</td></tr>
<tr><td>Course category</td><td>New lecture</td><td>Class schedule</td><td>3 lessons</td></tr>
<tr><td colspan="4">1 Teaching analysis
1.1 Selection of teaching materials
"Electrical Engineering" is a basic professional course. Through the study of this course, students can master the basic methods and basic theorems of analyzing circuits, which is the basis for learning subsequent professional courses. As the overall quality of the students continues to decline, their academic foundation and learning ability are getting worse and worse, their understanding is weak, and they do not like pure theoretical learning, so they chose a textbook with strong operational performance.
1.2 Teaching purposes
Grasp the content of the superposition theorem and the method of analyzing circuits using the superposition theorem.
1.3 Important and difficult points in teaching
Key points: First, the content of the superposition theorem, and second, the method of analyzing circuits using the superposition theorem.
Difficulty: How to deal with the power supply without using it and draw the equivalent circuit diagram.</td></tr>
<tr><td colspan="4">2 Teaching Strategies
Based on the above teaching analysis, the teaching method centered on teachers, teaching materials, and classrooms is implemented to achieve the teaching purpose of solving key points and overcoming difficulties. Receive teaching strategies for pre-class preview, classroom teaching, and post-class application. Self-study before class. Since students now love playing with mobile phones, self-study before class uses the online teaching platform of Tongyun Class to release online resources such as animations and PPT courseware on superposition theorem in advance for students to study on their own. In classroom teaching, teachers explain and demonstrate practical operations. All classroom teaching comments and analysis, circuit simulation, and cloud class line-limited self-tests and other teaching strategies</td></tr>
</table>

increase practical operation exercises. After-class application, based on the psychological characteristics of students who love the Internet, the after-class application requires students to use the Internet to find examples of the application of the superposition theorem in life and analyze them.

3 Teaching process

Pre-class , classroom teaching and after-class application. The focus is on the in-class teaching part. In-class teaching is divided into course introduction, comment analysis, practical exploration, summary, circuit simulation and time limit. There are 6 parts to the self-test.

3.1 Pre-class preparation

Students are required to self-study the superposition theorem part of the PPT courseware, animations and teaching materials published by the teacher in the Tongyun class, argue and draw the equivalent circuit diagram when the power supply acts alone in the circuit diagram given by the teacher, and upload it to the Tongyun class class, the teacher Evaluations. Through the preliminaries , the students have a preliminary familiarity with the difficult teaching method of dealing with non-functional power supplies.

3.2 Classroom teaching

The first link is scene introduction. Electronic product speakers, which are relatively unfamiliar to everyone, are used as scene introduction. Questions are asked to make students think and lead to the idea of superposition theorem. The second step is critique and analysis, which presents the equivalent circuit diagrams drawn by several groups of students before class, and critiques and analyzes them. Through this teaching link, not only did the students become more familiar with the teaching difficulties, but it also tested the effectiveness of the students' self-study before class. In order to emphasize the difficulty of teaching, the teacher wrote on the blackboard how to deal with the problem without using the power supply. Finalize the unified test circuit diagram. The third link is experimental exploration. Students build a circuit on a breadboard based on the determined unified circuit diagram, test the data, and complete the form. Through practical hands-on operations, students can gain a deep understanding of teaching difficulties. The fourth link is the summary. The teacher raises two questions based on the test data in the practical inquiry link to

guide students to think. By allowing students to practice operations, analyze data and summarize the content of the superposition theorem, they can deepen their grasp and understanding of this teaching focus. To further reinforce the key points, the teacher writes on the blackboard. The fifth teaching link is circuit simulation. Switching to another typical circuit, students use simulation software to simulate and measure the data under three conditions. Then let the students analyze the obtained data and summarize the applicable scope of the superposition theorem. In order to test the students' grasp of the knowledge of this lesson, a time-limited self-test session was designed in the cloud class. The teacher opened the time-limited self-test questions and gave the students 5 minutes to complete, and then gave the students 2 minutes to debate. Then the teacher checks the answers and solves the problems raised during the self-assessment, and finally summarizes the class.

3.3 After-class application

Students are required to use the Internet to search for application examples of the superposition theorem and analyze them, and then upload them to the cloud class for peer review. Through this teaching link, students can combine the theoretical knowledge learned in the classroom with real life and stimulate their interest in learning.

4Teaching effect

Teachers give full play to their leading role. Teachers can convey information from easy to difficult and from shallow to deep, which is conducive to students' acceptance and effectively solves the major and difficult problems of teaching. Use information technology to conduct diversified assessment of students. Use the experience value in the cloud class to complete the process assessment, accounting for 20%; use practical exploration and circuit simulation to mainly assess practical skills, accounting for 60%; time-limited self-test, mainly assess theoretical knowledge, accounting for 20%.

Appendix F

Cooperative learning method teaching design case

<table>
<tr><td colspan="2">Teaching content</td><td colspan="2">2.6 Superposition theorem</td></tr>
<tr><td>Course category</td><td>New lecture</td><td>Class schedule</td><td>3 lessons</td></tr>
<tr><td colspan="4">1 Teaching analysis
1.1 Selection of teaching materials
"Electrical Engineering" is a basic professional course. Through the study of this course, students can master the basic methods and basic theorems of analyzing circuits, which is the basis for learning subsequent professional courses. As the overall quality of the students continues to decline, their academic foundation and learning ability are getting worse and worse, their understanding is weak, and they do not like pure theoretical learning, so they chose a textbook with strong operational performance.
1.2 Teaching purposes
Grasp the content of the superposition theorem and the method of analyzing circuits using the superposition theorem.
1.3 Important and difficult points in teaching
Key points: First, the content of the superposition theorem, and second, the method of analyzing circuits using the superposition theorem.
Difficulty: How to deal with the power supply without using it and draw the equivalent circuit diagram.</td></tr>
<tr><td colspan="4">2 Teaching Strategies
Based on the above teaching analysis, the student-centered teaching method is implemented to achieve the teaching purpose of solving key points and overcoming difficulties. Receive teaching strategies for pre-class preview , classroom teaching, and post-class application. Self-study before class. Since students now love playing with mobile phones, the pre-class preview uses the Tongyun class online teaching platform to release online resources such as animations and PPT courseware on superposition theorem in advance for students to study on their own. Classroom teaching uses Cooperative learning method method, and increases practical practice through teaching strategies such as group discussion, comment analysis, practical inquiry, circuit simulation, and cloud class limited self-test. After-class application,</td></tr>
</table>

based on the psychological characteristics of students who love the Internet, the after-class application requires students to use the Internet to find examples of the application of the superposition theorem in life and analyze them.

3 Teaching process

The teaching process is divided into three parts: pre-class preview , classroom cooperative learning and after-class application. The focus is on the classroom teaching part. Classroom cooperative learning is divided into situation introduction , clear tasks, cooperative exploration, communication and feedback, inductive evaluation , circuit There are 7 links including simulation and time-limited self-test.

3.1 Preview before class

Students are required to self-study the superposition theorem part of the PPT courseware, animations and teaching materials released by the teacher in the Tongyun class. Then, in groups of 4-5 people, they debate and draw the equations when the power supply acts alone on the circuit diagram given by the teacher. Effective circuit diagram, upload it to the Tongyun class, and the teacher will Evaluation it. Through the self-study session, students have a preliminary familiarity with the teaching difficulty of handling non-functional power supplies.

3.2 Classroom cooperative learning

The first is the scene introduction in the teaching process . The electronic product speakers that everyone is familiar with are used as the scene introduction. Questions are asked to make students think, elicit the idea of superposition theorem, and stimulate students' interest. The second step is to clarify the tasks in the teaching process . According to the circuit diagram, the division of labor among each group member is clarified, which is divided into four tasks: preparation of experimental equipment, actual circuit construction, data recording and data calculation . The third is the cooperative exploration in the teaching process . Students build circuits on the breadboard based on the determined unified circuit diagram, test the data, and complete the form. Through practical hands-on operations, students can gain a deep understanding of teaching difficulties. The fourth is the communication feedback in the teaching session . In this session, the main groups find problems during discussions and exchanges, find solutions to the problems, and explore the specific content of the superposition theorem. The fifth is the inductive evaluation of the teaching link . The teacher raises questions based on the test data of the practical

inquiry link to guide students to think. By allowing students to practice operations, analyze data and summarize the content of the superposition theorem, they can deepen their grasp and understanding of this teaching focus. To further reinforce the key points, the teacher writes on the blackboard. The sixth part is the circuit simulation in the teaching session . Switch to another typical circuit, and students use simulation software to simulate it and measure the data under three conditions. Then let the students analyze the obtained data and summarize the applicable scope of the superposition theorem. The seventh is the time -limited self-test in the teaching session . In order to test the students' grasp of the knowledge in this lesson, a time-limited self-test session is designed in the cloud class. The teacher starts the time-limited self-test questions and gives the students 5 minutes to complete, and then gives the students 2 minutes to work in small groups. argue. Then the teacher checks the answers and solves the problems raised during the self-assessment, and finally summarizes the class.

3.3 After-class application

Students are required to work in groups of 4-5 people to use the Internet to search for application examples of superposition theorem and analyze them, then upload the cloud class lessons, and the groups will Evaluation each other's scores. Through this teaching link, students can combine the theoretical knowledge learned in the classroom with real life and stimulate their interest in learning.

4Teaching effect

Use the cooperative learning method to allow students to explore in practice, design the classroom according to the basic process of " questioning - self-study - cooperation - communication - expansion " , and carry out teaching in two lines: teachers and students. Teachers pay attention to " leading " , boldly " let go " . Be proficient in the classroom teaching model of cooperative learning , completely change the previous phenomenon of simple teacher explanation, and enhance the efficiency of classroom teaching. Use information technology to conduct diversified assessment of students. Use the experience value in the cloud class to complete the process assessment, accounting for 20%; use practical exploration and circuit simulation to mainly assess practical skills, accounting for 60%; time-limited self-assessment, mainly assess theoretical knowledge, accounting for 20%.

Appendix G

Traditional teaching method teaching design case expert evaluation form

Evaluation items	Expert 1	Expert 2	Expert 3	Total	IOC
Reasonable selection of teaching materials	1	1	1	3	1.00
Meet syllabus requirements	1	1	0	2	0.67
Learning objectives are clear	1	1	1	3	1.00
Learning content is consistent with goals	1	1	1	3	1.00
Learning content is correct	1	0	1	2	0.67
Key points and difficulties are clear	1	1	1	3	1.00
Reasonable lesson design	1	1	1	3	1.00
Reasonably arrange classroom activities	1	1	1	3	1.00
Have reasonable testing and evaluation methods	1	1	1	3	1.00
Reasonable arrangements after class	1	0	1	2	0.67
Total					0.90

Appendix H

Cooperative learning method teaching design case expert evaluation form

Evaluation items	Expert 1	Expert 2	Expert 3	Total	IOC
Reasonable selection of teaching materials	1	1	1	3	1.00
Meet syllabus requirements	1	1	1	3	1.00
Learning objectives are clear	1	1	1	3	1.00
Learning content is consistent with goals	1	0	1	2	0.67
Learning content is correct	1	1	1	3	1.00
Key points and difficulties are clear	1	1	1	3	1.00
Reasonable lesson design	1	1	0	2	0.67
Reasonably arrange classroom activities	1	1	1	3	1.00
Have reasonable testing and evaluation methods	1	1	1	3	1.00
Reasonable arrangements after class	1	1	1	3	1.00
Total					0.93

Appendix I

Pre-test—Students' learning ability questionnaire statistics table for control group

Name	Student ID	T 1	T 2	T 3	T 4	T5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	T 16	T 17	T 18	T 19	T 20
A01	223021010101	2	2	2	3	3	4	3	3	2	2	2	3	2	3	3	4	3	3	3	4
A02	223021010102	3	3	4	2	2	3	2	3	4	3	3	4	3	1	3	2	2	2	3	2
A03	223021010103	3	4	3	3	4	4	2	2	2	4	2	2	4	3	2	2	3	3	3	4
A04	223021010104	3	4	4	5	4	4	2	4	1	3	3	1	3	3	2	3	3	1	2	2
A05	223021010105	3	3	3	3	3	3	3	3	3	4	4	3	2	2	3	3	4	2	4	3
A06	223021010106	2	3	4	3	2	2	2	3	3	2	2	3	3	4	4	1	2	2	2	3
A07	223021010107	3	3	3	4	3	2	2	1	4	4	3	4	3	2	3	2	1	3	3	3
A08	223021010108	3	2	1	3	2	1	3	2	4	2	2	3	2	3	4	3	4	2	3	2
A09	223021010109	3	4	5	2	3	2	2	1	1	4	3	3	4	3	1	3	3	3	2	3
A10	223021010110	4	3	3	3	2	2	3	3	2	4	4	2	3	4	3	3	3	2	1	2
A11	223021010111	2	2	3	3	3	3	1	2	3	4	4	4	3	5	3	4	2	4	2	2
A12	223021010112	3	3	4	4	2	4	2	4	4	2	3	4	3	2	3	4	3	3	3	4
A13	223021010113	4	4	4	2	2	4	3	3	3	3	4	3	2	3	2	3	4	1	4	3
A14	223021010114	3	3	2	3	4	3	2	2	2	1	3	2	3	3	5	2	1	3	3	4
A15	223021010115	4	1	4	2	1	2	4	4	4	3	2	3	4	2	3	2	3	2	2	1

Name	Student ID	T 1	T 2	T 3	T 4	T5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	T 16	T 17	T 18	T 19	T 20
A16	223021010116	3	3	2	5	3	4	3	2	3	2	3	4	2	3	4	3	1	3	3	2
A17	223021010117	3	3	3	1	3	4	3	2	3	3	4	3	4	4	3	3	2	4	3	4
A18	223021010118	3	3	1	2	5	3	2	5	4	3	3	3	2	3	4	2	3	3	1	3
A19	223021010119	4	4	3	3	4	3	2	4	4	3	2	2	4	2	3	1	3	2	2	2
A20	223021010120	5	3	4	2	3	4	3	3	3	1	3	1	3	3	3	3	4	2	2	2
A21	223021010121	3	4	2	3	3	2	3	3	3	2	3	4	2	2	4	2	2	3	3	1
A22	223021010122	2	3	3	2	3	4	4	3	3	4	2	2	3	3	3	1	3	2	2	3
A23	223021010123	3	3	3	3	3	3	2	2	2	2	3	3	2	2	2	3	2	4	3	1
A24	223021010124	4	2	1	4	4	4	3	3	1	4	4	2	3	3	2	2	3	3	4	4
A25	223021010125	3	3	3	4	1	3	3	4	3	3	2	3	2	1	3	3	4	1	3	3
A26	223021010126	4	2	4	2	3	2	4	3	2	4	2	3	3	4	4	2	1	2	2	2
A27	223021010127	2	3	3	3	4	4	2	4	4	3	3	4	2	3	3	2	2	2	4	3
A28	223021010128	3	4	2	2	2	3	2	3	3	3	2	4	3	5	3	3	4	2	3	3
A29	223021010129	2	3	4	2	3	3	2	2	3	4	3	3	3	3	2	4	3	4	2	2
A30	223021010130	4	2	3	3	3	2	3	3	4	3	3	2	2	3	4	3	3	3	3	4

Appendix J

Pre-test—Students' learning ability questionnaire statistics table for experimental group

Name	Student ID	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
B01	223021010201	3	5	3	4	3	3	2	3	2	2	3	3	4	3	4	2	4	4	3	2
B02	223021010202	3	3	4	3	3	4	1	4	2	3	3	2	3	3	3	3	3	2	2	2
B03	223021010203	2	3	5	3	5	4	2	4	2	3	3	2	3	3	3	3	3	2	3	3
B04	223021010204	2	3	4	5	2	3	3	3	1	3	3	3	4	3	3	3	4	3	2	2
B05	223021010205	4	4	3	3	3	3	3	3	3	4	4	3	2	3	3	3	2	3	4	3
B06	223021010206	2	3	3	3	2	2	4	2	3	1	2	3	2	4	3	2	3	2	2	3
B07	223021010207	4	2	3	4	3	2	2	1	4	4	4	4	2	4	3	2	1	2	2	2
B08	223021010208	3	4	2	2	2	1	1	2	4	2	2	3	4	3	3	3	5	2	2	2
B09	223021010209	3	2	5	2	3	2	1	2	1	4	2	3	4	3	2	4	1	1	2	2
B10	223021010210	5	3	2	5	2	2	5	3	2	5	4	3	4	3	3	3	3	1	1	2
B11	223021010211	2	3	3	3	2	5	1	3	3	2	4	4	3	5	3	3	2	2	2	3
B12	223021010212	3	2	5	3	4	4	1	4	5	2	4	4	3	3	4	4	3	4	2	4
B13	223021010213	5	3	4	2	2	5	2	3	3	4	4	3	3	3	4	4	4	2	4	3
B14	223021010214	2	4	2	4	2	3	3	3	4	2	3	3	2	3	3	3	4	4	1	3
B15	223021010215	4	2	3	2	3	3	3	4	4	2	2	3	3	2	3	3	3	2	3	1

Name	Student ID	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
B16	223021010216	3	3	2	5	3	4	3	4	3	2	3	3	2	3	3	3	3	2	3	2
B17	223021010217	3	3	3	1	5	4	4	2	3	3	5	3	3	4	4	1	2	3	2	4
B18	223021010218	2	2	2	2	3	4	2	5	2	2	3	2	2	1	4	2	2	3	1	3
B19	223021010219	4	3	3	3	2	3	1	4	5	4	3	2	4	2	4	3	3	3	2	3
B20	223021010220	5	5	2	2	4	2	4	4	3	1	3	2	4	4	3	1	3	2	2	2
B21	223021010221	3	2	2	4	2	2	3	2	3	3	3	1	3	4	3	2	3	3	3	2
B22	223021010222	3	3	4	2	3	5	3	2	4	4	2	2	3	3	4	1	1	2	4	4
B23	223021010223	2	3	2	3	3	3	2	2	2	1	3	2	2	2	2	3	3	2	3	3
B24	223021010224	4	2	2	5	4	3	2	3	1	4	3	2	3	1	2	3	3	3	4	4
B25	223021010225	3	4	3	4	2	3	4	4	2	3	3	3	2	4	3	4	4	3	3	3
B26	223021010226	2	2	3	2	3	2	4	3	2	4	3	3	3	2	2	3	4	3	3	2
B27	223021010227	2	3	2	3	4	2	2	2	3	4	3	4	2	3	3	2	2	3	4	3
B28	223021010228	3	2	3	2	2	4	3	2	3	3	1	4	2	5	2	2	5	2	3	4
B29	223021010229	4	4	5	2	3	5	1	3	4	2	1	4	3	3	2	4	2	4	2	2
B30	223021010230	4	3	2	4	4	3	3	2	3	5	2	3	3	3	3	4	2	2	2	3

Appendix K

PosT-test—Students' learning ability questionnaire statistics table for control group

Name	Student ID	T1	T 2	T 3	T 4	T5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	T 16	T 17	T 18	T 19	T 20
A01	223021010101	3	3	2	4	3	4	3	3	2	3	2	3	3	4	3	4	4	3	3	3
A02	223021010102	3	3	3	2	2	2	4	2	4	2	2	4	3	2	3	2	2	4	2	2
A03	223021010103	2	2	3	3	4	3	2	3	2	4	2	2	2	3	3	3	2	3	3	4
A04	223021010104	3	3	4	4	4	3	2	4	4	3	3	2	3	3	2	4	3	2	2	3
A05	223021010105	2	4	3	3	3	3	3	3	3	4	4	3	2	2	3	3	4	3	4	2
A06	223021010106	3	3	4	3	2	1	2	2	3	2	2	3	3	4	4	4	3	2	2	3
A07	223021010107	1	2	4	1	3	4	2	3	1	4	2	2	3	3	3	2	3	3	4	4
A08	223021010108	4	3	3	3	2	3	3	2	4	2	2	2	2	3	4	3	3	3	3	2
A09	223021010109	3	4	2	4	3	2	2	2	1	4	3	3	4	2	2	3	3	3	2	3
A10	223021010110	3	3	3	3	2	2	3	3	2	3	3	2	3	4	3	2	2	2	3	3
A11	223021010111	3	3	2	3	3	3	3	2	3	4	4	4	3	4	3	2	2	1	2	2
A12	223021010112	4	4	4	4	2	5	2	2	4	2	3	5	2	3	2	3	2	3	1	2
A13	223021010113	4	3	3	2	2	3	3	3	3	3	4	3	2	3	4	5	4	2	2	3
A14	223021010114	2	3	2	1	4	3	3	2	2	1	3	2	3	2	2	2	2	4	3	4
A15	223021010115	2	2	3	2	3	2	4	3	4	3	2	3	2	2	3	4	2	2	3	3

Name	Student ID	T1	T 2	T 3	T 4	T5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	T 16	T 17	T 18	T 19	T 20
A16	223021010116	3	3	3	3	3	4	3	2	3	2	4	4	3	4	4	3	2	3	4	2
A17	223021010117	2	2	3	3	3	2	3	3	3	2	4	3	3	3	2	2	3	3	3	2
A18	223021010118	2	3	2	2	5	3	2	4	4	3	3	4	2	3	2	2	3	1	2	3
A19	223021010119	3	4	3	4	4	2	2	1	4	3	2	2	4	2	4	1	3	2	2	2
A20	223021010120	2	2	5	3	3	4	4	3	3	2	3	2	2	3	3	2	4	3	3	4
A21	223021010121	3	3	2	3	3	2	3	3	2	3	2	4	2	4	3	2	2	3	3	1
A22	223021010122	5	3	3	2	3	4	1	3	3	4	2	2	3	2	2	3	2	2	2	3
A23	223021010123	3	2	2	3	3	3	2	2	2	2	3	3	2	5	4	3	4	4	2	2
A24	223021010124	4	3	2	4	4	4	4	3	2	4	3	2	2	2	2	2	3	2	4	3
A25	223021010125	3	3	3	2	3	3	3	4	3	3	2	3	2	2	3	3	2	2	3	3
A26	223021010126	4	2	2	2	3	2	1	3	2	4	2	3	3	4	4	3	3	3	3	2
A27	223021010127	3	3	3	3	4	4	2	3	4	3	3	4	3	3	3	4	3	2	4	2
A28	223021010128	3	2	3	2	2	3	3	3	2	4	3	4	3	4	3	3	2	2	2	4
A29	223021010129	4	5	4	3	3	2	2	2	3	2	3	2	3	2	2	2	2	4	3	2
A30	223021010130	3	3	2	3	3	3	3	4	3	3	3	2	4	3	3	3	3	3	3	3

Appendix L

PosT-test—Students' learning ability questionnaire statistics table for experimental group

Name	Student ID	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
B01	223021010201	5	4	5	4	5	3	4	5	4	4	4	4	4	4	5	5	4	5	4	4
B02	223021010202	5	5	5	4	3	4	5	4	5	4	3	5	5	5	5	4	5	5	5	4
B03	223021010203	5	5	4	5	5	5	5	5	5	5	5	4	4	5	4	4	5	4	4	2
B04	223021010204	4	5	4	5	5	5	5	5	4	5	2	4	5	4	5	2	5	3	5	3
B05	223021010205	5	4	4	5	4	5	4	5	4	2	5	3	3	4	5	4	4	5	5	5
B06	223021010206	5	5	4	3	5	4	3	3	3	5	5	3	5	5	3	3	3	3	3	3
B07	223021010207	4	5	5	2	4	4	5	5	4	3	4	5	5	3	4	5	3	5	2	5
B08	223021010208	5	4	5	4	4	5	5	5	5	5	4	5	2	5	5	3	4	4	3	3
B09	223021010209	4	4	5	5	2	5	5	4	5	4	5	4	5	5	4	4	3	5	5	4
B10	223021010210	5	3	5	4	4	3	5	4	4	4	4	4	4	4	3	4	5	4	5	2
B11	223021010211	5	4	4	5	5	4	4	5	4	4	3	5	4	3	3	5	5	4	4	5
B12	223021010212	5	4	3	5	5	5	4	5	2	4	4	5	4	5	5	4	3	5	4	5
B13	223021010213	4	4	4	4	3	5	5	4	5	3	5	2	5	5	3	3	5	5	5	5
B14	223021010214	4	5	5	5	4	5	3	5	5	4	5	4	5	4	5	4	2	3	5	4
B15	223021010215	5	2	5	5	4	4	5	4	4	5	4	5	5	4	4	5	4	5	3	5

Name	Student ID	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
B16	223021010216	5	5	4	3	4	5	5	4	5	5	4	4	3	5	4	5	5	5	5	4
B17	223021010217	4	5	5	3	4	5	4	4	5	4	4	5	4	5	5	5	5	4	3	3
B18	223021010218	3	5	4	4	5	5	5	5	5	4	5	5	5	5	5	4	4	3	4	5
B19	223021010219	5	5	5	5	4	4	2	3	4	5	3	3	4	3	5	4	3	4	5	3
B20	223021010220	5	5	2	5	3	4	5	2	5	5	3	5	5	4	4	4	5	5	3	4
B21	223021010221	4	4	3	4	4	4	5	4	5	4	3	4	4	5	5	3	4	4	3	5
B22	223021010222	4	5	4	5	4	5	5	4	4	5	4	4	4	4	5	5	4	4	5	3
B23	223021010223	5	5	4	3	4	4	4	3	4	5	4	3	4	4	4	5	5	3	3	5
B24	223021010224	4	4	5	5	4	5	4	4	4	4	5	5	5	5	5	4	3	5	3	5
B25	223021010225	5	5	5	5	4	3	5	4	5	4	5	4	5	4	3	4	3	3	4	4
B26	223021010226	4	4	5	5	5	5	5	5	5	4	4	3	3	3	5	5	5	5	5	5
B27	223021010227	5	3	3	4	4	5	5	4	4	5	3	2	4	2	3	5	5	3	5	4
B28	223021010228	2	5	4	5	3	5	4	5	5	4	5	5	4	5	5	5	5	5	4	5
B29	223021010229	5	5	4	4	3	3	3	3	3	4	5	5	5	4	4	5	5	3	4	4
B30	223021010230	4	5	5	5	5	4	4	5	5	4	4	5	4	5	4	5	3	5	5	4

Appendix M

Pre-test and posT-test - Total score table for measurement of students'learning ability in the control group

Name	Student ID	Reading ability (T1-T4) total score		Comprehension ability (T5-T9) total score		Memory (T10-T13) total score		Concentration (T14-T17) total score		Creativity (T18-T20) total score	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
A01	223021010101	9	12	15	15	9	11	13	15	10	9
A02	223021010102	12	11	14	14	13	11	8	9	7	8
A03	223021010103	13	10	14	14	12	10	10	11	10	10
A04	223021010104	16	14	15	17	10	11	11	12	5	7
A05	223021010105	12	12	15	15	13	13	12	12	9	9
A06	223021010106	12	13	12	10	10	10	11	15	7	7
A07	223021010107	13	8	12	13	14	11	8	11	9	11
A08	223021010108	9	13	12	14	9	8	14	13	7	8
A09	223021010109	14	13	9	10	14	14	10	10	8	8
A10	223021010110	13	12	12	12	13	11	13	11	5	8
A11	223021010111	10	11	12	14	15	15	14	11	8	5
A12	223021010112	14	16	16	15	12	12	12	10	10	6
A13	223021010113	14	12	15	14	12	12	12	16	8	7
A14	223021010114	11	8	13	14	9	9	11	8	10	11
A15	223021010115	11	9	15	16	12	10	10	11	5	8
A16	223021010116	13	12	15	15	11	13	11	13	8	9
A17	223021010117	10	10	15	14	14	12	12	10	11	8
A18	223021010118	9	9	19	18	11	12	12	10	7	6

Name	Student ID	Reading ability (T1-T4) total score		Comprehension ability (T5-T9) total score		Memory (T10-T13) total score		Concentration (T14-T17) total score		Creativity (T18-T20) total score	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
A19	223021010119	14	14	17	13	11	11	9	10	6	6
A20	223021010120	14	12	16	17	8	9	13	12	6	10
A21	223021010121	12	11	14	13	11	11	10	11	7	7
A22	223021010122	10	13	17	14	11	11	10	9	7	7
A23	223021010123	12	10	12	12	10	10	9	16	8	8
A24	223021010124	11	13	15	17	13	11	10	9	11	9
A25	223021010125	13	11	14	16	10	10	11	10	7	8
A26	223021010126	12	10	14	11	12	12	11	14	6	8
A27	223021010127	11	12	18	17	12	13	10	13	9	8
A28	223021010128	11	10	13	13	12	14	15	12	8	8
A29	223021010129	11	16	13	12	13	10	12	8	8	9
A30	223021010130	12	11	15	16	10	12	13	12	10	9

Appendix N

Pre-test and posT-test - Total score table for measurement of students'learning ability in the experimental group

Name	Student ID	Reading ability (T1-T4) total score		Comprehension ability (T5-T9) total score		Memory (T10-T13) total score		Concentration (T14-T17) total score		Creativity (T18-T20) total score	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
B01	223021010201	15	18	13	21	12	16	13	18	9	13
B02	223021010202	13	19	14	19	11	17	12	19	6	14
B03	223021010203	13	19	17	20	11	18	12	18	8	10
B04	223021010204	14	18	12	24	13	16	13	16	7	11
B05	223021010205	14	18	15	22	13	13	11	17	10	15
B06	223021010206	11	17	13	18	8	16	12	14	7	9
B07	223021010207	13	16	12	22	14	17	10	15	6	12
B08	223021010208	11	18	10	24	11	16	14	17	6	10
B09	223021010209	12	18	9	21	13	18	10	16	5	14
B10	223021010210	15	17	14	21	16	16	12	16	4	11
B11	223021010211	11	18	14	22	13	16	13	16	7	13
B12	223021010212	13	17	18	21	13	17	14	17	10	14
B13	223021010213	14	16	15	22	14	15	15	16	9	15
B14	223021010214	12	19	15	22	10	18	13	15	8	12
B15	223021010215	11	17	17	21	10	19	11	17	6	13
B16	223021010216	13	17	17	23	10	16	12	19	5	14
B17	223021010217	10	17	18	23	14	17	11	20	9	10
B18	223021010218	8	16	16	25	9	19	9	18	7	12

Name	Student ID	Reading ability (T1-T4) total score		Comprehension ability (T5-T9) total score		Memory (T10-T13) total score		Concentration (T14-T17) total score		Creativity (T18-T20) total score	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
B19	223021010219	13	20	15	17	13	15	12	15	8	12
B20	223021010220	14	17	17	19	10	18	11	17	6	12
B21	223021010221	11	15	12	18	10	15	12	17	8	12
B22	223021010222	12	18	17	24	11	16	9	19	10	12
B23	223021010223	10	17	12	22	8	15	10	18	8	11
B24	223021010224	13	18	13	21	12	19	9	17	11	13
B25	223021010225	14	20	15	21	11	18	15	14	9	11
B26	223021010226	9	18	14	20	13	14	11	18	8	15
B27	223021010227	10	15	13	22	13	14	10	15	10	12
B28	223021010228	10	16	14	21	10	16	14	20	9	14
B29	223021010229	15	18	16	20	10	15	11	18	8	11
B30	223021010230	13	19	15	23	13	17	12	17	7	14

Appendix O

Pre-test—Students' core competencies questionnaire statistics table for control group

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K 10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
A01	223021010101	3	3	2	3	2	3	4	3	3	2	3	4	3	2	2	3	3	4	3	2	3	2	3
A02	223021010102	2	4	2	2	2	3	2	3	2	2	2	2	3	3	3	3	3	2	3	2	2	3	2
A03	223021010103	3	2	4	3	3	2	1	2	2	3	3	2	2	2	3	4	2	2	2	3	2	3	2
A04	223021010104	3	2	3	3	4	2	2	4	3	4	3	3	3	2	4	2	3	3	1	3	3	1	3
A05	223021010105	2	3	3	1	3	1	3	2	3	5	1	3	2	2	4	2	2	2	3	3	3	4	3
A06	223021010106	2	3	2	2	1	4	3	2	2	2	2	2	1	3	2	2	3	3	3	2	2	2	4
A07	223021010107	3	4	3	5	2	4	2	4	1	5	4	4	4	4	1	3	4	4	3	4	2	3	2
A08	223021010108	4	3	1	2	3	3	2	1	4	3	2	3	2	4	1	5	3	3	3	3	1	3	1
A09	223021010109	3	2	3	4	3	2	3	1	2	3	2	2	3	3	2	3	3	3	2	2	1	1	2
A10	223021010110	2	4	3	3	1	3	3	2	3	2	4	2	3	3	2	4	2	2	2	4	1	2	3
A11	223021010111	1	3	2	4	2	2	4	2	1	2	1	3	2	2	5	2	1	2	1	2	4	4	2
A12	223021010112	1	4	3	2	2	2	1	3	3	1	2	2	3	4	2	2	2	2	3	2	2	2	4
A13	223021010113	2	3	2	3	3	1	4	3	2	2	3	2	2	3	2	3	3	1	3	3	5	2	2
A14	223021010114	2	4	3	2	3	2	1	2	2	2	3	3	3	4	3	1	3	1	2	2	2	1	2
A15	223021010115	3	4	4	3	4	3	1	1	3	3	4	4	3	3	3	1	3	3	3	2	3	1	3

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K 10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
A16	223021010116	3	2	4	2	4	2	2	1	2	2	2	1	2	4	2	2	2	2	3	1	3	3	3
A17	223021010117	2	4	4	2	3	3	2	2	3	2	2	4	3	2	2	3	2	2	2	3	4	2	3
A18	223021010118	3	4	2	2	3	2	2	3	4	3	4	2	2	3	4	3	3	4	2	3	2	3	2
A19	223021010119	4	3	3	3	2	3	3	4	2	2	1	3	3	4	2	2	3	3	1	2	4	3	4
A20	223021010120	2	3	3	4	1	2	3	3	4	1	2	2	2	3	3	2	2	2	2	2	3	2	2
A21	223021010121	2	2	3	4	2	1	2	3	3	2	3	2	3	4	2	3	4	2	4	4	2	3	4
A22	223021010122	3	1	1	5	2	2	4	2	4	3	3	4	2	2	3	2	3	3	3	2	3	1	2
A23	223021010123	3	1	3	2	3	3	2	2	2	4	2	3	2	5	3	4	2	2	3	3	3	2	2
A24	223021010124	1	3	2	1	4	4	3	2	3	4	2	1	2	4	2	3	3	2	5	3	2	2	2
A25	223021010125	2	3	2	2	2	2	3	4	4	3	3	5	1	3	4	3	3	3	1	2	4	3	3
A26	223021010126	3	2	4	2	3	2	2	1	3	3	2	1	2	3	2	3	3	2	2	1	2	3	3
A27	223021010127	2	3	2	3	2	2	2	2	2	2	1	2	2	4	3	2	3	2	2	1	3	2	1
A28	223021010128	2	3	1	3	3	3	2	2	1	1	3	3	3	3	3	2	2	3	3	2	3	1	1
A29	223021010129	1	2	3	2	2	2	3	3	2	2	4	2	3	4	2	4	2	2	1	4	2	1	2
A30	223021010130	2	1	2	2	2	3	3	3	2	3	3	3	2	3	2	2	4	2	2	3	3	4	3

Appendix P

Pre-test—Students' core competencies questionnaire statistics table for experimental group

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K 10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
B01	223021010201	4	2	3	2	2	3	2	2	1	2	2	1	3	4	4	3	3	3	3	4	3	4	2
B02	223021010202	2	4	2	2	3	2	2	3	2	3	3	3	3	3	2	1	1	2	2	2	2	2	3
B03	223021010203	2	3	3	2	3	2	3	2	4	3	3	2	4	4	3	3	2	1	4	3	2	3	2
B04	223021010204	3	2	2	1	3	2	2	2	3	4	2	2	3	2	4	2	3	5	1	3	1	2	3
B05	223021010205	3	3	3	2	2	1	3	2	3	5	4	3	2	4	4	5	2	2	2	2	3	4	3
B06	223021010206	3	3	2	2	1	4	3	2	2	2	2	2	1	3	2	2	3	1	2	1	2	2	2
B07	223021010207	3	1	3	2	2	3	2	1	3	4	4	4	2	4	1	3	4	3	3	3	1	3	2
B08	223021010208	1	3	1	2	2	3	1	1	4	3	2	3	2	4	5	1	3	2	1	3	1	1	1
B09	223021010209	3	2	3	3	2	3	3	2	2	2	2	2	3	3	2	3	3	3	2	2	2	1	2
B10	223021010210	3	4	3	1	4	2	3	2	3	2	1	2	1	3	3	5	1	4	1	4	2	2	3
B11	223021010211	3	2	3	2	2	2	2	2	3	2	3	3	2	4	1	2	5	1	5	2	3	3	2
B12	223021010212	1	4	2	2	2	2	1	3	3	1	2	2	1	5	2	2	2	2	3	2	2	2	3
B13	223021010213	2	1	2	4	3	1	3	1	2	5	3	1	3	3	3	3	3	3	1	3	3	5	2
B14	223021010214	2	3	1	2	2	2	1	2	4	2	2	3	4	2	3	3	1	1	2	2	2	1	2
B15	223021010215	2	5	4	2	1	1	2	2	3	3	3	2	3	4	3	1	3	3	3	2	3	2	5

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K 10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
B16	223021010216	3	1	3	2	1	2	2	2	1	3	4	3	3	4	5	2	4	3	4	1	5	3	3
B17	223021010217	2	4	3	2	3	2	1	2	3	4	2	3	1	4	2	2	2	1	2	3	3	2	3
B18	223021010218	3	2	2	3	1	2	2	3	4	3	4	2	2	3	3	3	3	4	2	1	2	3	2
B19	223021010219	3	3	4	3	2	2	3	1	2	2	3	2	3	2	2	2	4	3	3	1	2	3	4
B20	223021010220	2	3	3	2	1	2	3	2	2	2	1	1	2	3	3	1	2	1	2	2	3	1	4
B21	223021010221	5	1	3	2	2	3	1	3	3	2	3	2	3	2	4	3	2	2	1	4	2	3	1
B22	223021010222	3	1	2	1	2	2	2	2	4	3	1	4	3	4	3	3	1	3	2	3	4	2	2
B23	223021010223	3	3	2	2	2	3	2	2	1	4	2	3	2	3	3	4	2	2	3	1	3	4	2
B24	223021010224	1	3	2	4	1	3	3	1	3	2	2	1	2	4	2	1	3	1	4	3	2	2	2
B25	223021010225	3	4	1	2	2	2	3	2	3	3	3	5	4	3	3	3	1	3	1	2	1	2	3
B26	223021010226	3	3	4	2	3	2	3	2	3	3	4	1	2	3	2	4	4	3	3	1	2	3	2
B27	223021010227	2	2	2	1	2	2	1	2	2	2	2	1	2	4	1	2	3	2	2	4	3	2	1
B28	223021010228	3	3	1	2	1	2	1	3	1	5	3	3	1	4	3	2	2	3	3	2	2	3	4
B29	223021010229	1	3	3	1	2	2	3	2	4	1	4	3	3	4	4	3	2	2	3	3	2	3	1
B30	223021010230	3	3	4	3	2	1	2	3	2	3	1	3	4	3	2	1	3	2	2	3	4	2	3

Appendix Q

PosT-test—Students' core competencies questionnaire statistics table for control group

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
A01	223021010101	3	3	4	4	2	3	3	3	4	4	3	1	4	4	4	3	4	4	3	4	3	3	2
A02	223021010102	3	4	2	4	2	4	3	1	2	2	5	3	2	3	3	4	3	2	4	3	1	2	4
A03	223021010103	2	2	2	2	3	2	2	2	4	3	3	1	4	4	3	3	3	3	4	4	4	3	2
A04	223021010104	3	2	4	1	4	4	3	4	3	3	2	2	3	3	4	2	3	4	1	3	3	2	3
A05	223021010105	2	1	3	3	4	1	3	2	4	1	4	3	2	4	4	5	2	2	2	3	4	3	3
A06	223021010106	2	3	2	2	1	5	3	2	2	2	2	2	1	4	2	3	3	5	2	1	2	2	2
A07	223021010107	3	4	4	2	2	4	3	1	3	4	1	4	2	2	3	3	4	2	4	4	3	3	2
A08	223021010108	4	3	1	1	2	4	2	1	1	3	2	3	2	3	5	1	2	3	4	3	1	3	1
A09	223021010109	3	2	3	1	3	2	3	4	2	2	3	4	3	3	2	3	3	4	2	2	2	1	4
A10	223021010110	2	4	1	3	5	1	3	2	2	1	1	2	3	3	3	3	4	4	1	4	3	2	3
A11	223021010111	1	4	3	3	4	2	4	2	3	2	3	3	2	4	1	2	5	3	5	3	3	4	2
A12	223021010112	1	4	2	2	2	3	3	4	3	1	3	2	2	3	2	2	2	1	4	3	4	2	3
A13	223021010113	2	1	2	5	1	1	1	4	2	5	3	1	3	3	3	2	4	3	1	1	3	2	3
A14	223021010114	4	1	2	2	3	2	1	2	4	2	2	3	4	3	3	3	1	1	2	2	2	4	4
A15	223021010115	2	5	4	1	3	1	2	4	4	4	3	3	4	3	3	3	2	3	3	3	3	1	2

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
A16	223021010116	3	1	4	2	4	2	4	2	1	3	2	4	3	4	3	2	4	3	3	1	4	4	3
A17	223021010117	2	4	3	3	4	1	3	2	3	4	2	3	1	4	2	3	2	1	1	1	3	3	4
A18	223021010118	3	2	3	3	2	4	2	4	3	3	5	4	1	3	3	3	4	3	2	3	2	3	3
A19	223021010119	3	3	4	1	1	4	3	1	3	3	3	2	3	2	4	2	4	5	4	3	2	3	3
A20	223021010120	2	3	3	2	3	2	3	3	2	2	4	1	2	4	3	1	2	1	2	2	2	1	2
A21	223021010121	3	1	3	2	2	1	1	4	2	2	3	2	2	3	4	3	3	2	4	4	2	3	2
A22	223021010122	3	1	4	4	3	4	2	3	4	3	1	4	2	2	3	3	3	1	2	1	4	3	3
A23	223021010123	2	2	2	2	1	3	3	2	2	3	2	3	2	4	3	1	2	3	1	3	4	1	2
A24	223021010124	4	3	2	1	2	1	3	1	3	2	2	1	2	3	2	5	3	3	4	3	2	2	2
A25	223021010125	3	4	1	2	2	3	3	1	2	3	1	5	4	3	3	3	3	3	4	3	3	3	3
A26	223021010126	2	2	4	2	1	2	4	2	3	1	4	1	3	3	2	3	3	1	3	2	3	3	2
A27	223021010127	2	2	2	3	2	4	2	3	2	2	1	4	4	4	3	2	1	2	2	4	3	2	1
A28	223021010128	3	2	1	3	3	3	2	3	1	5	2	4	1	3	3	2	2	3	3	2	2	3	4
A29	223021010129	1	3	3	2	3	2	3	4	4	4	4	3	3	2	4	3	2	1	3	4	4	3	1
A30	223021010130	3	4	2	3	4	1	4	4	2	3	4	2	4	4	2	4	3	4	4	3	3	4	4

Appendix R

PosT-test—Students' core competencies questionnaire statistics table for experimental group

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K 10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
B01	223021010201	4	4	4	4	4	4	5	3	4	4	5	5	3	4	4	5	4	4	4	4	4	3	4
B02	223021010202	4	4	5	5	4	5	5	3	5	5	5	5	5	4	4	5	4	3	4	5	4	5	5
B03	223021010203	3	5	4	5	4	5	2	5	5	5	5	3	4	4	4	4	4	5	4	5	4	5	4
B04	223021010204	4	5	5	5	5	4	5	5	5	5	4	3	5	4	5	5	3	3	3	5	5	4	5
B05	223021010205	5	4	5	3	5	5	5	3	5	4	3	4	5	4	5	5	2	4	5	4	4	5	4
B06	223021010206	4	3	4	5	3	4	4	5	4	5	5	5	5	3	3	5	3	4	5	5	5	4	5
B07	223021010207	5	5	3	5	5	5	5	5	4	4	5	4	4	5	3	3	3	4	4	4	4	5	4
B08	223021010208	3	4	4	4	5	3	4	4	4	5	4	4	4	4	4	3	5	4	5	5	5	4	4
B09	223021010209	5	4	1	3	4	5	4	5	3	5	4	4	4	5	3	5	5	4	4	3	5	4	4
B10	223021010210	5	3	5	3	5	4	4	4	3	3	4	4	4	5	4	3	5	4	4	4	3	4	4
B11	223021010211	4	3	4	5	5	5	4	5	5	4	5	4	3	4	4	5	4	5	4	4	3	4	3
B12	223021010212	4	5	5	5	4	4	4	5	3	5	4	5	3	5	4	4	3	4	3	4	5	3	3
B13	223021010213	3	5	4	4	5	5	4	5	5	5	3	5	4	4	4	4	4	4	2	3	4	3	2
B14	223021010214	3	5	5	4	3	5	5	4	3	3	3	5	5	5	5	4	4	5	5	5	5	5	5
B15	223021010215	4	4	4	4	5	4	5	4	3	2	5	5	4	4	3	4	3	4	2	4	5	5	5

Name	Student ID	K1	K2	K3	K4	K5	K6	K7	K8	K9	K 10	K 11	K 12	K 13	K 14	K 15	K 16	K 17	K 18	K 19	K 20	K 21	K 22	K 23
B16	223021010216	4	4	5	5	3	4	5	3	3	3	5	3	5	3	5	4	4	3	5	5	5	5	5
B17	223021010217	5	3	5	4	5	1	5	4	4	3	4	5	5	5	5	5	3	4	5	4	3	5	4
B18	223021010218	3	5	4	5	4	3	4	4	4	4	3	5	4	5	4	4	4	4	4	4	3	4	4
B19	223021010219	2	5	4	4	4	4	5	4	5	4	5	5	4	4	4	5	5	3	5	4	5	5	4
B20	223021010220	5	4	3	4	4	5	4	5	5	5	5	5	4	4	4	4	4	3	4	3	3	4	3
B21	223021010221	4	3	2	5	4	4	3	5	5	4	5	5	5	4	4	5	5	5	5	4	3	4	5
B22	223021010222	4	3	3	5	5	5	3	5	5	4	4	3	3	4	4	4	5	5	4	5	4	4	5
B23	223021010223	3	4	5	5	5	5	3	4	4	4	4	4	3	5	4	5	4	4	4	5	5	5	4
B24	223021010224	5	5	5	4	4	5	5	5	4	5	4	3	4	3	4	4	5	5	4	4	5	3	5
B25	223021010225	4	5	4	3	3	3	4	4	4	5	5	4	5	3	3	5	5	4	3	5	5	3	4
B26	223021010226	4	4	4	4	3	4	5	5	3	3	3	4	4	4	2	4	5	3	5	3	4	5	4
B27	223021010227	3	5	5	5	5	5	3	4	5	5	3	5	5	3	4	5	4	3	5	3	5	4	4
B28	223021010228	3	4	4	5	5	4	4	5	5	4	2	5	4	5	4	4	4	5	5	5	4	3	4
B29	223021010229	5	4	4	4	5	4	5	5	5	3	2	5	5	3	5	4	5	4	4	5	4	4	4
B30	223021010230	4	4	4	5	4	4	5	3	3	5	5	3	4	5	4	4	4	3	4	5	5	5	3

Appendix S

Pre-test and posT-test - Total score table of the core competencies measurement content of students in the control group

Name	Student ID	Total score of humanistic foundation (K1-K3)		Total score of scientific spirit (K4-K8)		Total score of learn to learn (K9-K12)		Total score of responsibility (K13-K17)		Total score of practical innovation (K18-K20)		Total score of healthy life (K21-K23)	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
A01	223021010101	8	10	12	15	12	12	13	19	9	11	8	8
A02	223021010102	8	9	9	14	8	12	15	15	7	9	7	7
A03	223021010103	9	6	9	11	10	11	13	17	7	11	7	9
A04	223021010104	8	9	11	16	13	10	14	15	7	8	7	8
A05	223021010105	8	6	8	13	12	12	12	17	5	7	10	10
A06	223021010106	7	7	10	13	8	8	11	13	5	8	8	6
A07	223021010107	10	11	13	12	14	12	16	14	13	10	7	8
A08	223021010108	8	8	10	10	12	9	15	13	9	10	5	5
A09	223021010109	8	8	12	13	9	11	14	14	7	8	4	7
A10	223021010110	9	7	10	14	11	6	14	16	7	9	6	8
A11	223021010111	6	8	12	15	7	11	12	14	5	11	10	9
A12	223021010112	8	7	7	14	8	9	13	11	7	8	8	9
A13	223021010113	7	5	11	12	9	11	13	15	7	5	9	8
A14	223021010114	9	7	8	10	10	11	14	14	5	5	5	10
A15	223021010115	10	11	11	11	14	14	13	15	8	9	7	6
A16	223021010116	9	8	10	14	7	10	12	16	6	7	9	11
A17	223021010117	10	9	10	13	11	12	12	12	7	3	9	10

Name	Student ID	Total score of humanistic foundation (K1-K3)		Total score of scientific spirit (K4-K8)		Total score of learn to learn (K9-K12)		Total score of responsibility (K13-K17)		Total score of practical innovation (K18-K20)		Total score of healthy life (K21-K23)	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
A18	223021010118	9	8	9	15	13	15	15	14	9	8	7	8
A19	223021010119	10	10	11	10	8	11	14	15	6	12	11	8
A20	223021010120	8	8	10	13	9	9	12	12	6	5	7	5
A21	223021010121	7	7	9	10	10	9	16	15	10	10	9	7
A22	223021010122	5	8	13	16	14	12	11	13	8	4	6	10
A23	223021010123	7	6	10	11	11	10	16	12	8	7	7	7
A24	223021010124	6	9	12	8	10	8	14	15	10	10	6	6
A25	223021010125	7	8	9	11	15	11	14	16	6	10	10	9
A26	223021010126	9	8	9	11	9	9	13	15	5	6	8	8
A27	223021010127	7	6	9	14	7	9	14	14	5	8	6	6
A28	223021010128	6	6	11	14	8	12	13	11	8	8	5	9
A29	223021010129	6	7	9	14	10	15	15	14	7	8	5	8
A30	223021010130	5	9	10	16	11	11	13	17	7	11	10	11

Appendix T

Pre-test and posT-test - Total score table of the core competencies measurement content of students in the experimental group

Name	Student ID	Total score of humanistic foundation (K1-K3)		Total score of scientific spirit (K4-K8)		Total score of learn to learn (K9-K12)		Total score of responsibility (K13-K17)		Total score of practical innovation (K18-K20)		Total score of healthy life (K21-K23)	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
B01	223021010201	9	12	11	20	6	18	17	20	10	12	9	11
B02	223021010202	8	13	12	22	11	20	10	22	6	12	7	14
B03	223021010203	8	12	12	21	12	18	16	20	8	14	7	13
B04	223021010204	7	14	11	24	11	17	14	22	9	11	6	14
B05	223021010205	9	14	10	21	15	16	17	21	6	14	10	13
B06	223021010206	8	11	12	21	8	19	11	19	4	13	6	14
B07	223021010207	7	13	10	25	15	17	14	18	9	12	6	13
B08	223021010208	5	11	9	20	12	17	15	20	6	14	3	13
B09	223021010209	8	10	13	21	8	16	14	22	7	11	5	13
B10	223021010210	10	13	12	20	8	14	13	21	9	12	7	11
B11	223021010211	8	11	10	24	11	18	14	20	8	13	8	10
B12	223021010212	7	14	10	22	8	17	12	19	7	11	7	11
B13	223021010213	5	12	12	23	11	18	15	20	7	9	10	9
B14	223021010214	6	13	9	21	11	14	13	23	5	15	5	15
B15	223021010215	11	12	9	22	11	15	14	18	8	10	10	15
B16	223021010216	7	13	9	20	11	14	18	21	8	13	11	15
B17	223021010217	9	13	10	19	12	16	11	23	6	13	8	12

Name	Student ID	Total score of humanistic foundation (K1-K3)		Total score of scientific spirit (K4-K8)		Total score of learn to learn (K9-K12)		Total score of responsibility (K13-K17)		Total score of practical innovation (K18-K20)		Total score of healthy life (K21-K23)	
		pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
B18	223021010218	7	12	11	20	13	16	14	21	7	12	7	11
B19	223021010219	10	11	11	21	9	19	13	22	7	12	9	14
B20	223021010220	8	12	10	22	6	20	11	20	5	10	8	10
B21	223021010221	9	9	11	21	10	19	14	23	7	14	6	12
B22	223021010222	6	10	9	21	12	16	14	20	8	14	8	13
B23	223021010223	8	12	11	22	10	16	14	21	6	13	9	14
B24	223021010224	6	15	12	23	8	16	12	20	8	13	6	13
B25	223021010225	8	13	11	17	14	17	14	21	6	12	6	12
B26	223021010226	10	12	12	21	11	13	15	19	7	11	7	13
B27	223021010227	6	13	8	22	7	18	12	21	8	11	6	13
B28	223021010228	7	11	9	23	12	16	12	21	8	15	9	11
B29	223021010229	7	13	10	23	12	15	16	22	8	13	6	12
B30	223021010230	30	12	11	21	9	16	13	21	7	12	9	13

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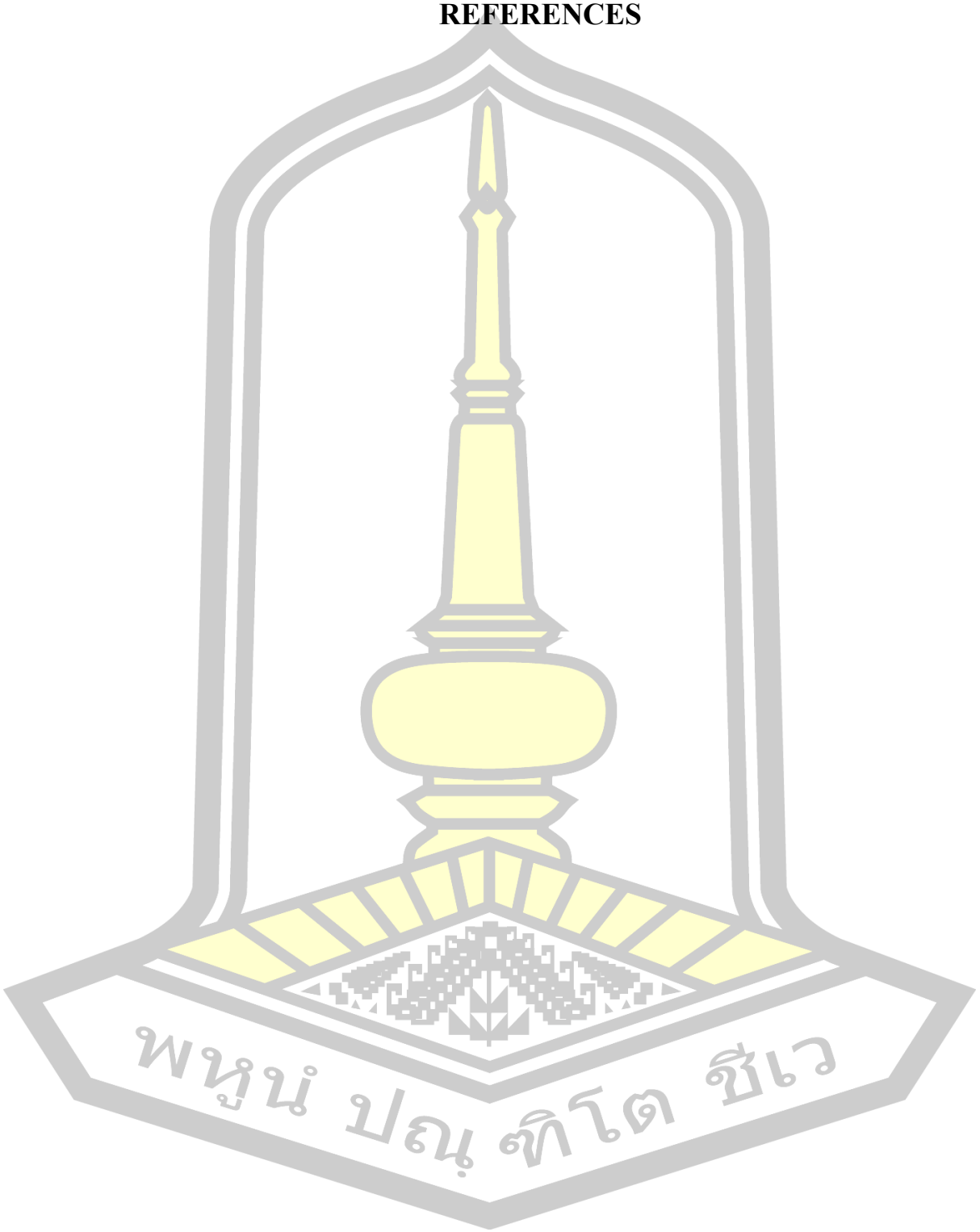

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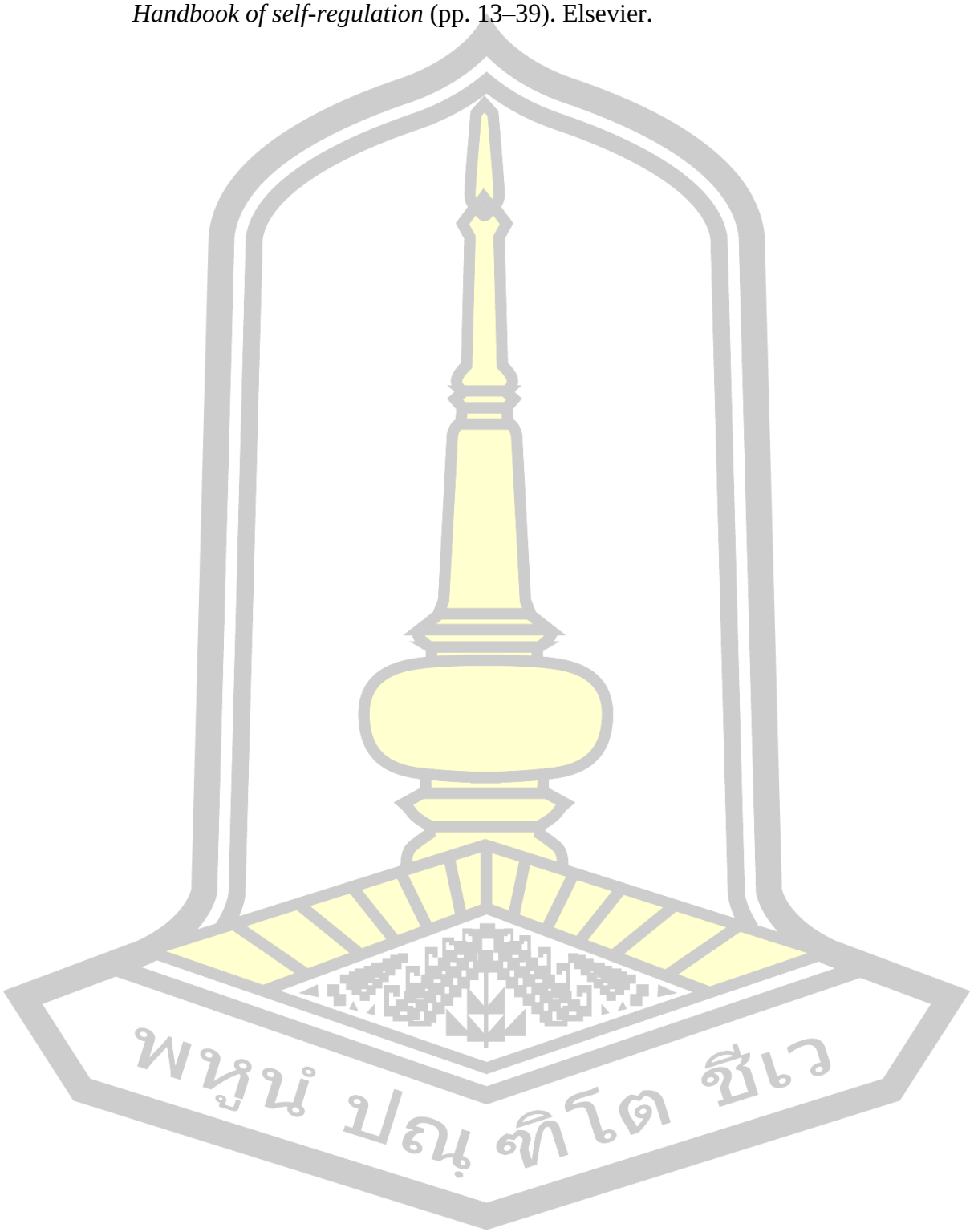

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