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ARTICLE

Research on the Generation Path of Heuristic Teaching Language Based on Positive Psychology Theory

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ABSTRACT

As the essence of traditional Chinese educational thought, heuristic teaching has gradually enriched and developed its ideas through the continuous efforts of educational researchers of the past dynasties. In front-line teaching, heuristic teaching, as a teaching principle that can help teachers and students to interact and learn, undoubtedly plays an important role in students' acquisition of knowledge and scientific thinking activities. But teachers' understanding of heuristic teaching is not the same. In actual teaching, there are obvious gaps in language ability among different teachers. This research aims to enrich the heuristic teaching theory based on the perspective of psychology, and provide a certain theoretical basis for teacher training. Through the research and analysis of the generation path of the heuristic teaching language, this paper helps more teachers realize the advantages of the heuristic teaching language, improve their own heuristic teaching language level, and provide reference for the scientific teaching evaluation standard. We apply the heuristic instruction language approach proposed in this study and apply it to real classrooms. In the application, it can be clearly found that the students' thinking and participation have been strengthened, and the teaching effect has been significantly improved compared with the past, which indicates that the heuristic teaching language generation path in this study has certain practical application value.

KEYWORDS

Heuristic language of instruction; positive psychology; biology class; application path

1 Introduction

1.1 Research Background

As a teaching method that can help teachers and students to interact and learn, heuristic teaching undoubtedly plays an important role in students' acquisition of knowledge and scientific thinking activities [1,2]. So far, heuristic teaching has been a common teaching method in classroom teaching of various subjects. In the heuristic teaching, "enlightenment" is the means, and "comprehending" is the purpose. The "enlightenment" of teachers relies more on language expression, and the "comprehending" of students relies more on understanding and internalization of language. In the actual teaching process, we will always find such a situation: the same question is explained by different teachers, and some teachers will patiently explain it from beginning to end, but in the end students still cannot understand it. Some teachers leave a few rhetorical questions and leave the students to think for themselves, but the

students finally come to a realization. This educational phenomenon has researchers thinking. The former type of teachers may seem patient and responsible, but gain little. The latter type of teachers, seemingly effortless, can really inspire students, which is the inspiration of the language of instruction. The influence of language on students exists at the psychological level, and students' learning is a psychological process. Because of this, this paper chooses to study the constituent elements of heuristic teaching language on the basis of psychological principles. This paper aims to study the generation path of heuristic teaching language according to the relevant elements, and improve the existing heuristic teaching methods.

In practical teaching, most teachers believe that heuristic teaching is equivalent to triggering students to think through classroom questions, and the number of questions has become the main criterion for teachers to judge whether the principle of heuristic teaching has been applied. Such a view is not entirely correct, because the essence of heuristic teaching should be that the teacher's language is appropriate and timely, rather than simple and vulgar classroom questions. In the process of teachers' heuristic teaching, few teachers will notice which words are inspiring to students and which are invalid. Inefficient or invalid heuristic language, not only can not inspire students, but even make students lose interest in learning this part of the content [3]. The purpose of heuristic teaching language is: through the language of teachers, it can guide students to think independently and form a process of internalization of knowledge. The heuristic teaching language should consider both the timing and the method, otherwise it will not be able to exert its best effect [4]. However, due to the heavy teaching tasks, most teachers in the classroom often ignore the use of heuristic teaching language in order to save time. Appropriate heuristic language often achieves twice the result with half the effort, can guide students to achieve good learning effect, but can save teaching time.

Based on this situation, we have reviewed a large number of literatures and materials on heuristic teaching, and found that most of the research is only based on the level of teaching methods and teaching principles, and there are few researches directly on the subject of heuristic teaching language. The literature on the path of language generation based on psychology is even less. This research takes this as the starting point and innovation point. First, it analyzes the generation path of heuristic teaching language from the psychological level, trying to find the teaching language heuristic method that can affect students' autonomous thinking. Specifically, the research idea of this paper is shown in Fig. 1.

1.2 Research Purpose

This research takes college biology classroom teaching as the research object, and is based on constructivist psychology theory and cognitivist psychology theory. The constituent elements and structural model of the teaching language, to find the inspirational elements of the teaching language that can affect the students' autonomous thinking, and then through the observation of the actual classroom and the interviews with the front-line teachers, to explore the generation path of the heuristic teaching language. In order to enrich the theory of heuristic teaching, and can provide practical examples for the training of teachers.

1.3 Research Significance

Throughout the psychological theory, the research on heuristic teaching has never stopped. This provides a rich theoretical basis for the research of this paper, but the theories are diverse and cover many aspects. Therefore, this paper analyzes and studies the theory from the perspective of teachers' teaching language, and explores the components and elements of teachers' heuristic teaching language structural model. And combine this with biology classroom practice. From the perspective of psychology, enrich the heuristic teaching theory and provide a certain theoretical basis for teacher training.

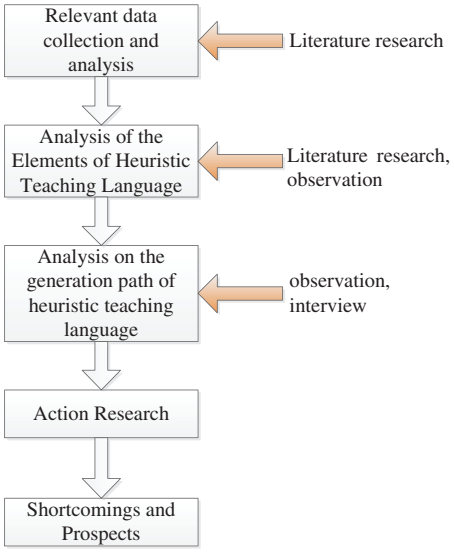

Figure 1: Research ideas of heuristic teaching language based on psychological theory

Under the environment of the core literacy of biology, the change of the way of thinking of students is advocated, and the teaching language of teachers should also be changed accordingly. Therefore, the research can reflect that teachers' heuristic teaching language has an important influence on the development of students' core literacy. Provide teachers with the language generation path and application method of heuristic teaching, in order to help more teachers realize the advantages of heuristic teaching language. It is expected to help teachers improve their own heuristic teaching language level, and at the same time provide reference for the scientific evaluation of teachers.

1.4 Research Method

This article mainly involves the combination of theory and practice and the basic methods of qualitative research, mainly including literature research method, observation method, interview method and so on.

In the initial stage of the research, through the collection and analysis of a large number of documents, the basic theories and development trends related to the research are mastered, and a solid foundation is laid for the follow-up research. This is also the most time-consuming part of the research. Literature research plays an important role in this paper, it not only exists in the part of research review, but also in the theoretical analysis stage of this paper. Only through the study of literature can we summarize the relevant theories of psychology and provide important reference and theoretical basis for the exploration of elements and paths and the practice stage.

The biggest feature of the observation method is that it is convenient and can be used almost at any time, and can be applied to the study of all explicit behaviors. The language of instruction is the most abundant explicit behavior of teachers in the classroom. In this study, the observation method is applied to the analysis of the lessons, which belongs to the practice stage of the study. The first observation was used to analyze the constituent elements of the heuristic teaching language combined with psychological theory, and the research team members selected 60 high-quality lessons for observation. The second observation was used to explore the generation path and application method of teachers' heuristic teaching language. Eight classroom videos of college biology teachers were selected, and the researchers and three other experts jointly observed and discussed. Of course, due to the related content of psychology, the observation method cannot be completely independent, and it needs to be used in combination with other methods.

In this study, the interview method is also applied to the exploration and analysis stage of the heuristic teaching language generation path. After the researcher observes the lesson examples, the teacher conducts unstructured interviews. Through the interview, we can deeply discuss and analyze the generation path of heuristic teaching language and the problems that need attention when applying.

2 Related Works

2.1 Related Concepts

This research should first clarify the connotation and essence of positive psychology, teaching language and heuristic teaching language, and their understanding directly affects the subsequent theoretical and practical research. Therefore, this part defines these three concepts as follows.

2.1.1 Positive Psychology

Western countries have been studying psychology for a long time. Among them, Terman's research on "genius and happiness" opened the door to the research of positive psychology [5]. In 1954, Maslow first used the concept of "towards positive psychology", but this concept was only proposed, but not studied in depth. In 1997, Seligman was elected president of the American Psychological Association. At this point, positive psychology was officially born. In 1999, Seligman first offered a course in psychology at a university, which was a great encouragement to researchers in positive psychology. In 2000, Seligman and Csikszentmihalyi jointly published "Positive psychology: an introduction", which introduced how positive psychology came into being, the main research contents and future prospects of positive psychology. As a result, positive psychology has appeared in the public's field of vision with a new concept [6]. In 2002, the official publication of the Handbook of Positive Psychology edited by Snyder and Lopez heralded the independence of the positive psychology movement [7]. Since then, related courses with positive psychology as the main content have spread in various western countries and achieved very good results.

Positive psychology was first applied to corporate sectors such as McKinsey & Company. Since then, positive psychology has been applied to the education field in western countries such as the United States, the United Kingdom, and Australia in the form of courses, and has been widely promoted in the field of education. With the gradual entry of positive psychology into the public eye, the research on related theories of positive psychology has gradually penetrated into different disciplines such as education and management, making the theory of positive psychology continue to innovate and develop. After 2006, many western countries began to gradually add postgraduate programs specializing in positive psychology. Positive psychology is in line with the strong desire of people in most countries to realize their own values and to pursue their own happiness, and to achieve great success.

2.1.2 Language of Instruction

Language is the main medium for transmitting information in daily life, and the interaction between teachers and students in the classroom also relies on language. Teaching language is a kind of language, different from everyday language, it has the characteristics of professional, normative, scientific and educational. The language of instruction is the language of the teaching profession, and it is the general term for all the languages used by teachers in the process of educating people [8]. It can be seen that the language of instruction is a skill that teachers must master, which cannot only play the function of organizing classroom teaching, but also have educational significance for students [9]. Teaching language can carry teaching information, and it is an indispensable tool for teachers and students to transmit knowledge, ideas and emotions in the classroom [10,11]. At present, the main teaching system in our country is the class teaching system, so the language of teachers still occupies a large amount of space and a major position in the classroom. The skill of teaching language has also become an essential basic skill for teachers. In the theory of pedagogy, the language of instruction includes two forms of

expression: the language of voice teaching and the language of silent teaching. The language of instruction mentioned in this study mostly refers to the language of instruction with sound.

2.1.3 Heuristic Language of Instruction

In the existing research, there are many researches on heuristic teaching, and many researches on teaching language. But there is no relatively authoritative definition for the concept of heuristic teaching language. Therefore, this paper discusses this concept by combining heuristic and teaching language. Inspiration focuses on the gradual guidance and guidance of teachers, emphasizing that contradictions and confusions in students' thinking are caused by way of questioning, so as to promote students to think and solve problems. The language of instruction is the language used by teachers to transmit teaching information to students in order to improve and develop students' understanding of knowledge for specific teaching objectives and specific content in a teaching situation. Obviously, no matter what kind of classroom and what kind of teaching method is used, teachers will definitely use the language of instruction as the main tool. But heuristic teaching language not only reflects the dissemination function of this tool, but also its inspiring function.

Teachers' inspiration for students is often based on language. This language can cause internal conflicts in students' thinking and enter a state of unbalanced thinking through questions or other methods, thereby actively producing thinking activities. Therefore, when defining the heuristic teaching language, it is necessary to retain the essence of heuristic, but also reflect the educational and professional nature of the teaching language.

2.2 Review of Research at Home and Abroad

2.2.1 Research on Heuristic Teaching

From the perspective of basic theory, to study a theory, we must first clarify its connotation, essence and category. In the book "Encyclopedia of China", the meaning of heuristic teaching is summarized as: "In teaching work, teachers guide students to actively, actively and consciously master various specific teaching methods based on the objective laws of the learning process general name" [12]. Until now, there are still differences on the meaning of heuristic teaching, and different scholars have different views. But there is a broadly similar understanding of its nature. In recent years of research, many scholars have analyzed the nature of heuristic teaching, and believe that the essence of heuristic lies in "resolving doubts", that is, on the basis of students' existing experience, to establish a conflict between old and new knowledge and experience. The process of conflict resolution under the guidance of teachers [13]. At the same time, domestic scholars also have many different views on its category attributes. Whether heuristic teaching is a guiding ideology, a teaching principle, or a teaching method is the main content of the debate among scholars. At present, more scholars tend to classify heuristic teaching as a teaching principle or teaching guiding ideology [14]. From the perspective of strategies and methods, the author studies the premise and heuristic method of realizing heuristic teaching in the literature [15], and proposes heuristic methods such as revealing contradictions, interrogation, and questioning. The inspiration methods include metaphor inspiration, story inspiration, visual demonstration inspiration, facial expression inspiration, questioning inspiration, analogy inspiration, graphic inspiration, click inspiration [16]. Many scholars have different expositions on the method of heuristic teaching, but at the root, they all emphasize the methods of guidance, questioning, and comparison. From a practical perspective, experimental research and reforms on heuristic teaching are being carried out in many places across the country. Among them, the more prominent ones are: the reform experiment of "heuristic comprehensive teaching" advocated by Taiyuan Normal University, and the reform experiment of heuristic teaching by Capital Normal University [17]. These reforms all emphasize that teachers should play the main role of students in the teaching process, pay attention to the cultivation of students' autonomous ability, and provide a demonstration role for the practice of heuristic teaching.

Foreign research on heuristic teaching mainly focuses on its understanding, methods and models. The foreign understanding of heuristic teaching began with the "midwifery technique" proposed by Socrates, also known as "talking method". It advocates that teachers pretend to be nothing in teaching, and start asking students questions from simple truths. Students fully express their opinions, teachers ask again, and back and forth constantly make students fall into the dilemma of self-contradictions, promote their positive thinking, and then continue to approach and correct answers through the guidance of teachers [18]. After continuous development, foreign educators have deepened their understanding of heuristic teaching. German educator Herbart proposed a four-stage teaching method of "clear-association-system-method" [19], which enriched the heuristic teaching theory.

Dewey, an American educator, proposed a five-step teaching method: suggestions, problem, hypothesis, reasoning, and testing [20]. The hint and question links are mainly realized through inspiration [21]. In modern research, foreign scholars have made a lot of discussions on heuristic teaching methods and related cognitive models. The famous Swiss psychologist Piaget proposed the knowledge acquisition model. He transferred the biological evolution model to the cognitive process of psychology [22], and proposed that the acquisition of knowledge has gone through the process of "balance-de-balance-re-balance", thus proposing the epistemology of generation. American educator Bruner proposed the discovery learning method. Since the 1950s, discovery learning has had a great impact on science teaching. Bruner's discovery learning emphasizes the student's learning process and believes that students should be like scientists, able to actively think and explore. In the teaching process, students are active inquirers, and the role of teachers is to form a situation in which students can explore independently, rather than providing ready-made knowledge [23,24]. In Bruner's discovery learning theory, it is reflected that students acquire knowledge in person, and teachers act as facilitators and situation creators to inspire students how to think. This greatly enriches the heuristic teaching theory. Ausubel's meaningful learning theory emphasizes meaningful receptive learning and proposes expository teaching. Explanation here does not imply a statement or narration of knowledge by the teacher, but proposes that the teacher should conduct the exposition in two stages: the first stage provides the advance organizer, and the second stage presents the learning material [25].

To sum up, with the influence of different social cultures, there are differences in the development process and concepts of heuristic teaching between China and the West. But in general, there are some similar teaching ideas worthy of our reference. On the basis of analyzing and synthesizing existing theories, we need to continuously enrich, develop and deepen heuristic teaching so that it can adapt to the pace of social and educational development.

2.2.2 Research on Language of Instruction

Most of the classification research of Chinese scholars on the teaching language is based on the three dimensions of teaching link, language expression, and information dissemination direction. From the dimension of teaching links, most domestic scholars agree with the research in the literature [26], and divide the teaching language into: opening language, introduction language, question language, lecture language and conclusion language. Since then, based on the new curriculum background, some scholars have further improved the existing research, and divided the teaching language into introduction, questioning, analysis, conclusion and emergency. According to the dimension of language expression, Chinese scholars divide the teaching language into two types: educational language and teaching language [27]. From the perspective of the direction of information dissemination, some people divide the teaching language into two types: one-way expressive language and two-way communication language. Later, after continuous enrichment and improvement, multi-directional communication language was added on the basis of the first two categories [28]. Today, the research on the classification of teaching language has not ended. It can be recognized by many scholars and often mentioned is that the teaching language is divided into two categories: audio teaching language and silent teaching language according

to whether it is vocalized [29]. Beginning in the late 1990s, many scholars' attention to language of instruction began to shift to its effectiveness. Most domestic scholars believe that an effective language of instruction should have several characteristics: normative, scientific, educational, and enlightening. Literature [30] believes that inspiring students' thinking should be the destination of teachers' spoken language.

In addition, Shen et al. interpreted the effectiveness of teaching language from the perspective of effective classroom, and proposes that teaching language should have the characteristics of guidance, inspiration, time waiting, and transformation [31]. It can be seen that the inspiration of the teaching language plays an important role in its effectiveness. So far, there have been many research perspectives on the language of instruction in China, and some studies have turned their perspectives to the evaluation criteria of the language of instruction. Foreign scholars' research on language of instruction is more inclined to analyze classroom discourse, which has produced a variety of discourse analysis theories. Classroom Discourse Analysis is extremely difficult. This is because the classroom is a complex environment. Therefore, discourse research is not only "discourse-centered research", but more "problem-oriented research". At present, more and more language and discourse researchers tend to use "discourse studies" instead of traditional "discourse analysis" to position their research [32–34]. The American educational scholar Flanders proposed the "Classroom Discourse Interactive Analysis System", which became the authoritative representative of the positivist discourse analysis orientation. Subsequently, after continuous development and improvement, the theory of Kazston and Mehan emerged, namely the "(initiation-response-feedback, IRF) sequence". Later, Mehan described the IRF sequence as an IRE model, namely "teacher initiative", "student response", "teacher evaluation" [35]. The emergence of IRF classroom discourse structure reveals the unconscious discourse patterns formed by teachers and students in classroom interaction. The discovery of IRF structure has surprised researchers and teachers alike. Although the IRF framework theory is controversial at this stage, it has undoubtedly become an effective tool for educators to describe and analyze classroom interactions.

At present, it seems that there are still problems in the study of language for teachers, whether abroad or at home. Although the shortcomings of the original theory can be recognized, they cannot be perfectly solved in the recent stage. First, most of the discussions are to analyze the teaching language from the perspective of speech, and lack of analyzing the teaching language from the information dissemination mechanism. Second, most studies focus on theoretical elaboration, but rarely involve empirical analysis. In particular, there is very little research on how to improve and cultivate language as the basic behavior of teachers' teaching. Third, even though there are many kinds of analytical tools, they can achieve a level of refinement, but to a certain extent, the relationship between the discourses of students and teachers is separated. The teaching language should be changeable and random. The analysis is performed in a detailed mode. So far, research needs to jump out of the circle and look at the language of instruction from the perspective of teaching itself.

3 Analysis and Model Construction of Elements of Heuristic Teaching Language Based on Psychology

This section will explore and analyze the constituent elements of heuristic teaching language and establish a structural model based on the relevant theories of psychology. Through the observation of a large number of real classrooms, the members of the research group concluded that the heuristic teaching language should be mainly generated by the two main subjects of teachers and students. Therefore, the constituent elements of heuristic teaching language are analyzed from the two aspects of teacher's "initiation" and students' "fat". Then through the combination of classroom observation and psychological theory, each element is analyzed in detail, and the constituent elements of the heuristic teaching language are finally determined. Then through the construction of the model, the relationship between the elements of the heuristic teaching language is analyzed and obtained.

In the study of heuristic teaching language, the starting point should first focus on "inspiration". The researchers and members of the research group in this paper collected 60 videos of college biology teaching, mainly from the National Educational Resources Public Service Platform and the Biology Excellent Course Competition. Through the observation of a large number of classrooms, and based on the relevant psychology theories, the researcher makes a rational analysis of the basic elements of the teachers' heuristic teaching language in the classroom.

3.1 Elements of Teachers' "Enlightenment"

The teachers' "Enlightenment" is the premise and necessary condition of the heuristic teaching language, and "Kai" has the meaning of opening and opening. Through the observation of the actual classroom and the analysis of relevant psychological theories, this study finally determines that the teacher's "initiation" consists of three elements: setting up circumstance, setting up doubts, and inducing. These three elements are all from the teacher's point of view.

Setting up circumstance means that teachers create a suitable situation through language, so that students can enter into the situation and prepare for learning psychologically. Aristotle said: Most of human thinking activities come from curiosity about things. In the same way, in teaching activities, students can keep up with the pace of teachers, not relying entirely on students' willpower, but need teachers to arouse students' curiosity about knowledge content and desire to learn. Therefore, mobilizing the curiosity of students has become a pre-requisite link in the process of teachers' "setting up circumstance". The setting up circumstance includes two ways. One is that teachers guide students into the learning state through problem situations. Second, teachers provide advance organizers. The beginning of the teacher's heuristic teaching must be accompanied by the creation of a certain situation. The creation of this situation can be carried out in the form of dialogue or the presentation of other teaching aids. Regardless of the form, the involvement of teachers in the language of instruction is required. If the teacher's teaching can guide the students to immerse themselves in the specific situation at the beginning stage, it can achieve a multiplier effect in the process of attracting the students' attention. This can be done by presenting meaningful learning materials or incorporating things that interest students.

The concept of advance organizer was first put forward by American educational psychologist Ausubel. The first organizer refers to the guiding material that appears before the learning material and has a great relationship with the learning material, and is a kind of inspiring material. This material can be the language of the teacher, the situation created by the teacher, etc. Advance organizers provide templates for heuristic teaching. Ausubel divides students' learning into four types: mechanical learning, discovery learning, receptive learning, and meaningful learning. He believes that the learning process is the process of organization and reorganization of the cognitive structure, and pays attention to the role of the learner's original cognitive structure, the internal connection of the learning materials themselves, and the active process of the students.

Setting doubts means that teachers use scientific, concise, and clear language to set up questions, and by raising questions, they stimulate students' cognitive conflicts and cause confusion and contradictions within them. Scientific thinking does not happen out of thin air, but arises from difficult fork in the road, from the choice between the two. Only when students enter into a dilemma or doubt, will they stop and think carefully, and through this process, they can leave a more profound impression. The steps of questioning should include: 1. The teacher guides the students into the dilemma of contradiction through the question. 2. The design of the problem should begin with the student's zone of proximal development. When teachers can effectively guide students into thinking processes such as comparison, analysis, and analogy, students will truly participate in the classroom teaching process. What happens here is the collision of language and thinking. Teachers guide students into contradictions through language, triggering students' thinking activities, and students output their thinking process through the language of feedback, so that teachers

can adjust the problem in time according to their responses. Such a process is also in line with Vygotsky's theory of mental functioning [36]. Vygotsky's theory of advanced psychological functions emphasizes that human psychological functions need to occur and develop in social activities. In the teaching process, the mutual activity of teaching and learning is an important way for the occurrence and development of learners' psychological functions. Therefore, language, as a tool for problem and thinking representation, has become an indispensable part of the heuristic teaching generation process.

Therefore, teachers' questioning through language plays an important role in inspiring students' thinking. At the same time, teachers should also pay attention to students' language in this process, and make timely adjustments to questions based on students' sufficient speaking time.

Based on the theory of the zone of proximal development proposed by Vygotz in 1932, he defined the zone of proximal development as the gap between the actual level of development and the potential level of development. The former is determined by the learner's ability to solve problems independently, while the latter refers to the learner's ability to solve problems under the guidance of an adult or in cooperation with a more capable peer. The theory of the zone of proximal development has provided great inspiration for the development of pedagogy and psychology. Vygotsky firmly believes that the development of learners must be within their zone of proximal development, and that adults or peers with higher abilities play a crucial role in the development of learners. On the one hand, he emphasized the importance of the social and cultural environment, and on the other hand, he also paid attention to the important influence of the learning situation on the individual. Therefore, cooperative activities in learning situations are particularly important. Cooperative activities here can be paired by adults and learners, or by pairs of learners and learners. In order to verify which of the two activities is more effective, Rogoff et al. conducted a psychological experiment [37]. The experimental results show that: when adults and learners are paired, learners are more inclined to use complex strategies, and can design action sequences in a planned way, and adults' instructional language is more abundant. When learners are paired with learners, although cooperative tasks can be completed, verbal instruction is simpler, focusing more on the immediate task and ignoring long-term goals. Vygotsky also found that learner-learner cooperation can be effective when there is adult-directed participation. Summarizing the relevant viewpoints, it can be analyzed that teachers can play the following roles in the various cooperative activities of learners: designers of educational programs, role models, moderators of activities, consultants or interlocutors, and evaluators.

The hidden meaning in the induction refers to the "inspiration" of the students, that is, the occurrence and development of thinking. The development of students' thinking, the construction and understanding of knowledge requires teachers to induce them through language. Therefore, the evoked signified is for teachers to promote students' understanding of knowledge and guide students to construct meaningfully through language. Induction is a gradual process, not overnight. Teachers are not simply imparting knowledge, but should be guided by the language of instruction to promote students to turn passive acceptance into active construction. First, teachers guide students to construct actively through effective teaching language. Second, teachers provide scaffolding for teaching. For education, the most important part of students' learning process is the development of knowledge, concepts, skills, etc. Students can internalize knowledge, concepts, and skills, and require the participation of teachers or peers, forming a social activity environment in the classroom. When teachers transmit concepts, knowledge and skills, they need language as an intermediary. Therefore, through the analysis of the theory, it can be clarified that there is a close connection between student learning, teacher teaching, and language transmission. The teaching concept in the constructivist psychology theory proposes that teaching is the process of helping students to construct actively. The traditional teaching theory always regards teaching as a process in which teachers impart knowledge and students receive knowledge, and is a bilateral activity in which teachers and students participate together. This view only sees the teaching relationship between teachers and students in the teaching process, but ignores that students should be the main body of learning, and there

should be social interaction between peers in the teaching process. Therefore, teachers need to realize that teaching should belong to a process of social interaction and communication. At the same time, teaching should also be a process of teacher-student cooperation. Teachers should guide students' thinking to occur and develop through continuous and changeable questions, and induce their active construction of knowledge. With the continuous in-depth study of Vygotsky's theory of the zone of proximal development, a variety of teaching modes have been derived. Among the many teaching modes, the scaffolding teaching proposed by Bruner has become a typical representative [38]. Here, as a form of metaphor, "scaffolding" figuratively illustrates the role that teachers should play in teaching activities—the scaffolding provider. What needs to be paid attention to is that teachers should not present or pass the scaffolding directly to students, but should present them in the form of hints, support, guidance, help, and questions. The role of the scaffolding is to help the student move smoothly through the zone of proximal development. In the process of eliciting students, the students' thinking changes from one level to another. During this transition, it is very likely that there will be a stagnation of thinking. At this time, teachers should provide scaffolding for students to help students get through the stagnation of thinking.

3.2 The Components of Students' "Comprehending"

Through the teacher's "enlightenment", it corresponds to the students' psychological tendency and internal thinking changes. Teaching activity is a two-way interactive process. If the teacher's "enlightenment" is a necessary condition, then the students' "comprehending" is the result of the activity. All "enlightenment" is for "comprehending". In this study, the observation of the actual classroom and the analysis of the students' learning process based on psychological theories have been carried out, and the components of students' "comprehending" include: orientation, contradiction, and induction.

Mind orientation refers to a psychological tendency, which is a state of mental preparation of learners before learning. The generation of students' learning attitude is not spontaneous, and teachers need to guide students to develop their learning attitude through guidance and inspiration, that is, through effective stimuli. The learner's mental orientation is the starting point of his spontaneous and active learning, and it is also a necessary condition for him to reach the state of "comprehending'. Through the observation of students in a large number of classrooms, it is found that students can enter a specific learning state by stimulating their interest or curiosity in learning through the guidance of teachers. In Ausubel's view, there is a great difference between mechanical learning and meaningful learning. From the perspective of psychological mechanism, the psychological mechanism of mechanical learning should be association, which promotes learners' recognition of concepts and knowledge through stimulation and reinforcement. The psychological mechanism of meaningful learning is assimilation, and its production conditions should satisfy three points: the learning materials must have logical meaning; the learner must have the intention of meaningful learning; the learner's cognitive structure must have the original ability to assimilate new knowledge appropriate concept. From a teaching point of view, the mind orientation refers to a psychological tendency, inspired by teachers, that when learners face a specific problem situation, they can actively establish a certain relationship between the new material and the original cognitive structure a propensity for a substantive connection. The learning materials and the learner's original appropriate concept determine the degree of achievement of the learner's aspiration. Therefore, the learner's intention has become a necessary condition for the generation of inspirational teaching. From this, it is not difficult to conclude that students' desire to learn should be regarded as a constituent element of students' "comprehending".

Contradiction refers to the state in which there is a certain gap or opposition between the existing cognitive schema in the learner's thinking and the new knowledge structure. This is the best time for teachers to guide students to form a state of "anger". Through a large number of classroom observations, it is found that the internal contradictions of the students have reached the level of knowing that they do

not know, but they are unable to speak, which is when confusion arises. The presentation of new information in the classroom, the gradual change of cognition, the contrast between similar concepts, and the strong conflict can all be the reasons for the internal contradictions in students' thinking.

Processing means that the internalization process of students' new cognitive schema is a dynamic process from balance-unbalance-balance, in which the thinking goes through a process of assimilation and adaptation. This process can be regarded as a process of processing knowledge and information in students' minds. The relationship between knowledge and thinking is understood as follows: thinking is based on old knowledge, new thinking is formed through the process of processing, and thinking should be presented logically. Therefore, the processing of knowledge should also have a logical sequence. Teachers induce students to process knowledge through step-by-step questions. Processing is the dynamic process of learners' assimilation-adaptation-balance.

To sum up, students are in the process of learning from an unbalanced state to a balanced state of construction. The unbalanced state of students is actually a contradiction within their thoughts, and the occurrence of contradictions drives students to construct new knowledge. The most important thing in the construction process is the inner processing of students' minds, which is the only way to construct knowledge. So far, this study has identified the constituent elements of a heuristic instruction language. We further need to consider what connections there are among the elements and what kind of structure the constituent elements should have.

3.3 Model Construction of the Elements of Heuristic Teaching Language

Through the analysis of the constituent elements in this section, this study finds that there is an inherent relationship between the elements. The teaching process should be a two-way interactive process, and the behavior of teachers and students should be highly matched. Therefore, as the most basic elements in the heuristic teaching language, there is an inevitable connection between the teacher's "enlightenment" and the student's "comprehending". Therefore, this study proposes a structural model of the elements of heuristic teaching language, and its specific model is shown in Fig. 2.

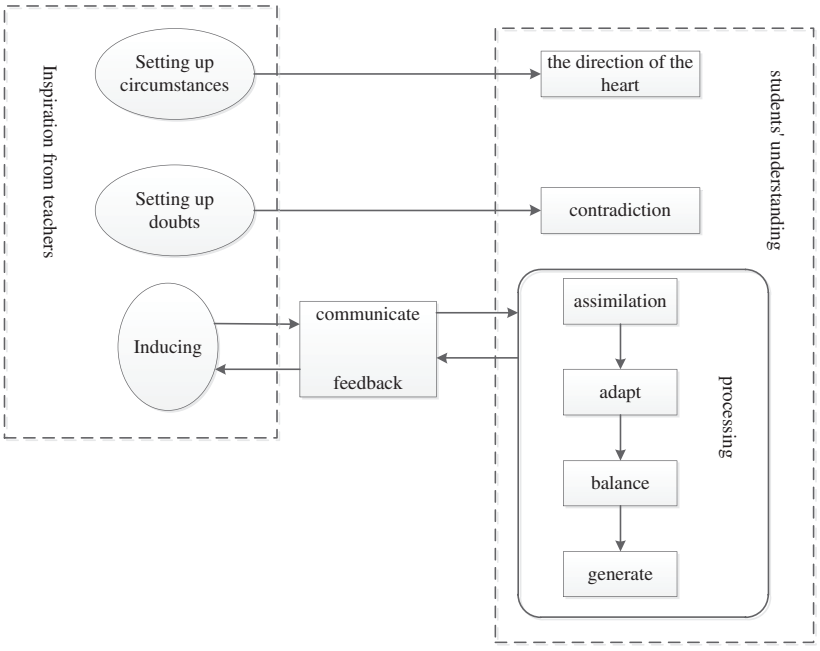

Figure 2: A structural model of the elements of heuristic teaching language

The first-level dimension of the elements of heuristic teaching is composed of teachers' "enlightenment" and students' "comprehending", because heuristics should be a two-way interaction process between teachers and students, and neither is indispensable. The teacher's "enlightenment" includes three elements: setting up circumstance, questioning, and inducing; the student's "comprehending" includes three elements: mind orientation, contradiction, and processing. There is a corresponding relationship between the elements, which is determined by the characteristics of the inspiration. Horizontally, there is a one-to-one correspondence between the elements of teachers' "enlightenment" and the elements of students' "comprehending".

Teachers can stimulate students' motivation to learn by setting up circumstance; help students to generate internal conflicts by questioning; promote students to process new knowledge by inducing them, and students' processing is a step-by-step process, which includes process of assimilation and adaptation. In this process, students will produce corresponding responses as feedback. Teachers should continuously form continuous questions to guide students based on students' feedback, and form two-way communication and feedback.

From a vertical point of view, there is a certain order among the three elements of setting up circumstance, questioning, and inducing by teachers. The process of teacher initiation should start with the creation of the situation, followed by problems and forming a continuous chain of problems. That is to say, the sequence of teacher's "enlightenment" should be setting up circumstance-questioning-inducing. After the teaching purpose is achieved, if new teaching problems can continue to be generated, the process can be repeated to carry out a new round of enlightening teaching. In the same way, the process of students "comprehending" also corresponds to this order.

4 Analysis on the Generation Path of Heuristic Teaching Language

Based on the analysis of the elements of the heuristic teaching language in the previous article, this study uses the research methods of observation and interview to analyze its generation path and the application strategy of the path in actual teaching. In this research stage, four first-line high school biology teachers were selected to record and observe their classrooms. At the same time, three experts were invited to observe the video lessons together. Through repeated observation, the teachers' classroom heuristic teaching language behavior was recorded and analyzed. The implementation process of heuristic teaching in teaching, discuss and analyze the advantages and disadvantages of teachers' heuristic teaching language in classroom teaching together with experts. Afterwards, in-depth interviews were conducted with the teaching teachers. Through the interviews, we could trace the mental journey of using heuristic teaching language in the classroom. After the experts' comments and analysis and interviews with teachers, the generation path of the heuristic teaching language is summarized, and the application method of the heuristic teaching language path is explored.

4.1 Information Collection and Analysis

We selected four high school biology teachers in Nanjing, Jiangsu province, who came from two different schools. They are recorded as Teacher A, Teacher B, Teacher C, and Teacher D respectively (to protect their privacy, their names are withheld). Among them, Teachers A and B have won the title of outstanding teachers in Nanjing city and won awards in Nanjing teaching competition. Teachers C and D are newly recruited young teachers. The author selects two new lectures from each teacher for recording, a total of 8 video lectures. For comparative analysis, take the form of the same class and heterogeneous. The basic information of teachers and teaching content are shown in Table 1.

Table 1: Heuristic instruction language classroom observation teacher information sheet

Teacher number	Teaching age (year)	Course content	
A	8	Sugars and fats in cells	Protein is the main undertaker of life activities
B	10	Structure and function of cell membranes	Principles and applications of photosynthesis
C	1	Sugars and fats in cells	Protein is the main undertaker of life activities
D	2	Structure and function of cell membranes	Principles and applications of photosynthesis

The analysis of each class is divided into two stages: the first stage is preliminary observation, which mainly observes the application of the heuristic teaching language of teachers; comparative analysis of courses. The three experts are: Expert A—City teaching and researcher, Expert B—College curriculum and teaching theory teacher, Expert C—Senior first-line biology teacher, and the principal of a high school in Nanjing.

During the observation and discussion, the experts put forward specific opinions and suggestions for the 8 lessons respectively. After summarizing and comparing, this paper finds that there are obvious differences in the opinions of novice teachers and excellent teachers, and thus lists their deficiencies.

First, focus on formal questions and ignore in-depth communication. Many questions in the heuristic teaching of novice teachers only stop at students making fill-in-the-blank answers, and the questions are frequent and in a single form. The question is only superficial, or even a simple yes or no answer. The classroom lacks activities that can lead to long-term communication with students, and lacks inspiring and substantive questions that lead to students' active participation.

Second, pay more attention to the inspiration of external behavior and ignore the inspiration of inner thinking. The novice teachers in the teaching video attach great importance to the inspiration of students' external behavior, including prompting students to observe and discuss. But in essence, students only participate in behavior, and the part that is really worth thinking about is provided by teachers or teaching materials. Students are not involved in the whole thinking process, and many students do not even know what the purpose of teaching is at this time.

Third, emphasize the teaching process and ignore the self-construction. The observation also found that novice teachers can consciously inspire when they teach the teaching content, but the inspiration only becomes a process in the teaching process. After being inspired, teachers cannot know whether students have reconstructed knowledge in the cognitive structure. Teachers only inspire for the sake of enlightenment. In other words, teachers can understand the importance of the heuristic instruction language, but cannot pay attention to whether the heuristic instruction language is effective.

Fourth, pay more attention to the learning of knowledge and ignore the improvement of metacognitive skills. The inspiration of novice teachers mostly stays at the knowledge level, and few teachers can inspire students' cognition of cognition, or even cognition of learning emotion. In this way, it is difficult to strengthen students to learn and not forget the content of knowledge, and students have not established a sense of self-monitoring in the learning process.

4.2 Analysis on the Generation Path and Teaching Method of Heuristic Teaching Language

A path is the entire process from a starting state to a goal state. Studying the constituent elements of heuristic teaching language can explain its inner essence and clarify its complex process, and provide a feasible theoretical basis for the analysis of the generation path. In the heuristic teaching activities, the teacher's "enlightenment" and the students' "comprehending" are two processes that map to each other. Whether the inspiration is effective or not depends first on whether the learner begins to have the intention to learn, and then whether there can be contradictions in the students' thinking to guide them into the process of internalization-adaptation-balance. Therefore, effective enlightenment has several characteristics: first, it can stimulate students' learning motivation through specific situations; second, it can guide students to generate internal conflicts by asking questions; third, it can induce students to carry out meaningful processing and construction; The level of inspiration can be to promote students' self-monitoring and cognition. This paper constructs a heuristic teaching language generation path, as shown in Fig. 3. The occurrence of the path includes four links: stimulate the learner's intention-promote association-help meaning construction-guide self-monitoring. Next, the four links and their specific implementation methods will be further explained.

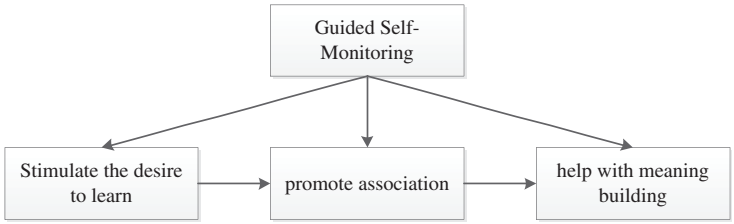

Figure 3: The generating path of heuristic teaching language

(1) Stimulate the desire to learn

Mind orientation, as a psychological tendency, has undoubtedly become a prerequisite for learners to start the learning process. Based on the analysis of the theory in the previous part of this study, it is not difficult to see that in addition to generating curiosity, it is actually a phenomenon of imbalance in the learner's cognitive thinking. And this unbalanced phenomenon can start from two points: the first one starts from the learner's dissatisfaction with the existing knowledge and finds that the material in the existing cognitive structure has been difficult to use to solve the new problem situation; the second one can start from learning A certain cognitive conflict arises in the cognitive structure, and the conflict causes an imbalance between the original knowledge and the new material.

Teachers should understand students' current development level when preparing for class, so that they can create problem situations based on students' level. The creation of problem situations can be carried out from the following two aspects: First, the context of life. Teachers create contexts that are relevant to students based on their existing life experiences. Doing so can start from the current level of students, lay the groundwork for the potential level in the future, and can stimulate students' intrinsic motivation from life-like situations and form a learning orientation. Second, there is the context of prior knowledge. Teachers can provide information related to students' current level, and inspire students to comment or refute the content proposed by teachers through analogy or synthesis, thus triggering the follow-up question-and-answer process.

The following points should be paid attention to for the created situation: First, the language has sufficient guidance. Since it is heuristic teaching, the inspiration and guidance of the problem situation is necessary. The problem situation can not only guide students to develop their learning intentions, but also

guide students to focus on the goal of the lesson. Second, pay attention to the timing of problem creation. From the perspective of classroom process, the creation of problem situations is usually suitable for the beginning of a class or the beginning of a teaching content, which is more conducive to attracting students' attention. But sometimes it can also be placed in teaching. When students' thinking is blocked, teachers can create a problem situation to transition students' thinking to a favorable direction. Third, the questions created are enough to trigger thinking, rather than simple one-sided questions and answers.

(2) Promote association

Based on the analysis of the theory, this study designed the second link of the heuristic instruction language path to promote association. To promote association is actually to stimulate students to produce internal contradictions through teachers' questions to students. After stimulating the learner's mental orientation, the learner has begun to have an unbalanced state in the internal cognitive structure, but the unbalanced state is initially established at this time, and it is difficult for students to have deep thinking in their thinking. Promoting association is to find a direction for the unbalanced state of learners, and follow this direction to carry out the next step of meaning construction. Teachers should inspire students and build scaffolding after fully understanding, which is effective heuristic teaching. In addition, the problem transformation in this process should not be rigid and detached from each other, and should be smoothly transitioned to the next zone of proximal development through continuous questioning in a natural teaching situation. And this process is the process of associating old and new experiences together. So, how should teachers promote students' association? The first is to guide students in effective migration.

The second is to set the question of continuity to deepen the association.

(3) Help with meaningful construction

Meaningful construction is to further process the schema, and teachers need to help students make the concepts and cognitions that have just been established in their minds continue to take root, that is, to promote their in-depth understanding of new materials. Students' understanding of knowledge is actually an individual adopting two methods of "assimilation" and "adaptation". The former is a process of incorporating new concepts into the original schema, while the latter is a process of modifying the schema to achieve a balance on the basis of the former or when the former encounters obstacles. The process of assimilation begins in the stage of promoting association and continues to the process of building a new knowledge system. Adaptation requires teachers to promote students' analysis and thinking, induction and synthesis of knowledge concepts. In the stage of mechanism exploration, this research has shown that the process of learners from imbalance to balance, and then to dissatisfaction with the existing balance and then generating a new imbalance is a dynamic and changing process. Therefore, teachers' help for learners to construct new meaningful constructions does not only stay at one stage, but needs to be progressive through a series of related inspirations. Teachers need to help students to make sense in two ways. One is to promote the integration of students' knowledge. In order to help students integrate what they have just thought about, teachers can appropriately refine students' answers. Teachers' refinement can help students pay attention to the process of answering and the key content in the answer, abandon misconceptions, and transform concepts. But the language that helps students to refine should also be enlightening. The second is the rational use of heuristic prompts. Heuristic prompts have the characteristics of heuristic, procedural, hierarchical and suggestive. It is used to trigger cognitive conflict and stimulate students' thinking. Heuristic prompts should be flexible, layered, and deepened step by step, so that students' thinking is not only in the process of development, but also allows students with different thinking levels to receive the teacher's inspiration. Heuristic hints should be more subtle, euphemistic indirect hints can motivate students, and the more students think, the better they know.

(4) Guided self-monitoring

The guided self-monitoring session was inspired by interviews with teachers. The so-called "give a man a fish is worse than teach a man to fish", teachers should not only focus on the knowledge level, but also on the strategy and method level of inspiration for students. For teaching, the scientific thinking of students is an important aspect of the core literacy, and the cultivation of the way of thinking lies in the inspiration of teachers to the way of thinking and methods of students. Teachers should inspire students to use the general research methods of biology to learn, and use reflective concepts to promote students' monitoring of cognitive processes, which is the weak link in current teaching. The learner's self-monitoring should run through the whole learning activity. There are three paths teachers can take to guide students in self-monitoring. First, the guidance of students' self-monitoring should be reflected in the whole process of teaching. Teachers' inspiration to students should not only be limited to the knowledge level, but should also inspire students how to learn. When students learn knowledge, if teachers can clearly guide their knowledge acquisition methods and knowledge acquisition process, students' learning effect will be better, and it will be easier to transfer such methods and processes to other aspects. In the heuristic teaching language, the prompts for students' metacognition should be conducive to regulating and monitoring individual cognitive activities, and should be able to indirectly promote students' cognitive process and achieve the teaching goal of ability development. The cultivation of students' scientific thinking cannot be completed independently, which requires more inspiration from teachers. The development of students' thinking should be included in the teaching language of teachers in all aspects, especially the inspiration for their metacognitive monitoring ability. Therefore, the process of guiding self-monitoring should also be reflected in each stage. Second, the effective use of metacognitive cues. Teachers can guide students to gradually form metacognitive strategies with their own style through heuristic teaching language. This is more helpful for students to independently monitor and adjust their cognitive processes without the help and guidance of teachers when the teacher is not around. In this way, students can not only pay attention to the scientific inquiry process, but also guide students to infer the principle from the process and the learning method of inferring the result from the phenomenon. The third is to inspire students to apply knowledge with examples close to life. A major feature of biology is that it is closely related to life. The mastery of knowledge and skills is ultimately to be able to be applied in life. There are perceptual and rational aspects in the learners' thinking, and the rational aspect mainly includes concepts, laws and theories. It is the purpose of teaching that learners can apply these concepts, laws and theories to solve practical problems, and it is also an important sign to test learning outcomes. Only when students reach the application level can they truly turn knowledge into a part of their own thinking. Teachers can not only guide students to connect with the reality of life, but also inspire students to combine new methods and new technologies.

4.3 Experimental Results and Analysis

Our questionnaire has a total of 15 sub-questions, all of which use a 5-point scale, with the highest score being 5 and the lowest being 1. A score of 1 means no compliance at all. A score of 2 indicates a majority of nonconformities. A score of 3 means fair or uncertain. A score of 4 indicates a majority agreement. A score of 5 means complete compliance. Each 5 sub-topics is a dimension and is arranged in random order. The specific topic distribution is shown in Table 2.

Table 2: Topic distribution

Item	Topic number
Learning attitude	1 4 8 10 12
Learning ability	3 5 7 11 15
Learning experience	2 6 9 13 14

The subjects of this survey are students from 4 classes of a high school in Nanjing. A total of 225 questionnaires were distributed, and 220 valid questionnaires were recovered. Using Excel and SPSS 28.0 data analysis software, the information of the recovered questionnaires was entered and counted, and the score distribution, average score, standard deviation and difference analysis of the recovered questionnaire data were carried out. Reliability can reflect the stability and consistency of the results of the scale data. The larger the Cronbach Alpha coefficient, the greater the reliability of the scale. For the analysis of the reliability of the scale, we used SPSS 28.0 software to analyze the post-test data of the four experimental classes, and the results are shown in Table 3.

Table 3: Statistics reliability

Reliability analysis	
Cronbach alpha	Number of items
0.988	15

For the reliability analysis of the measurement table data after this study, the larger the α, the greater the reliability of the proof scale. Taking the Cronbach's coefficient α greater than 0.85 to indicate that the reliability of the questionnaire is very high, the results show that α is 0.988 greater than 0.85, indicating that the data reliability of the questionnaire returned by the post-measurement form is very high.

It can be seen from Fig. 4 that most of the 5 questions in question 1, 4, 8, 10 and 12 have a score of 3 or above. It can be seen that after adopting the heuristic teaching method, students' learning enthusiasm has improved a lot. It can be seen from Fig. 5 that most of the five questions that examine the temperature of learning ability (they express their meaning and self-directed learning ability) scored 3 points or above. Focus on the learning process. It can be seen from Fig. 6 that most of the students scored 3 points or more on the five questions in the dimension of learning experience (the meanings of the questions are all good experience). Except for the 6th question, less than 10% of the students scored less than 3 points in the remaining 4 questions. In the sixth question, less than 20% of the students chose to score below 3 points. It can be seen that after the implementation of heuristic teaching, students have a good sense of learning experience.

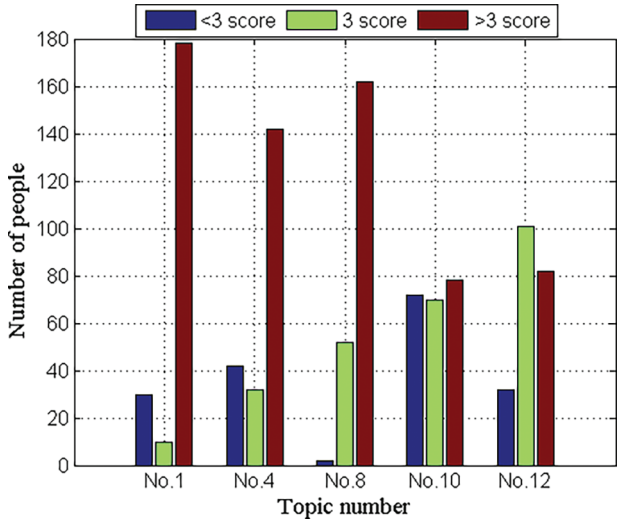

Figure 4: Distribution of learning attitude scores measured for the second times

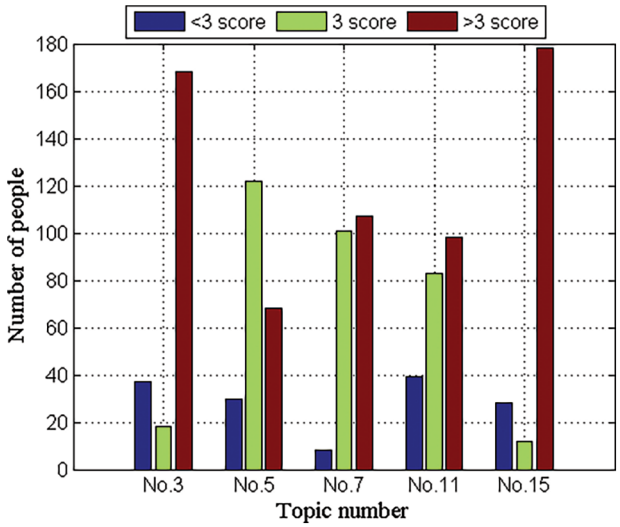

Figure 5: Score distribution of the second measured learning ability scale

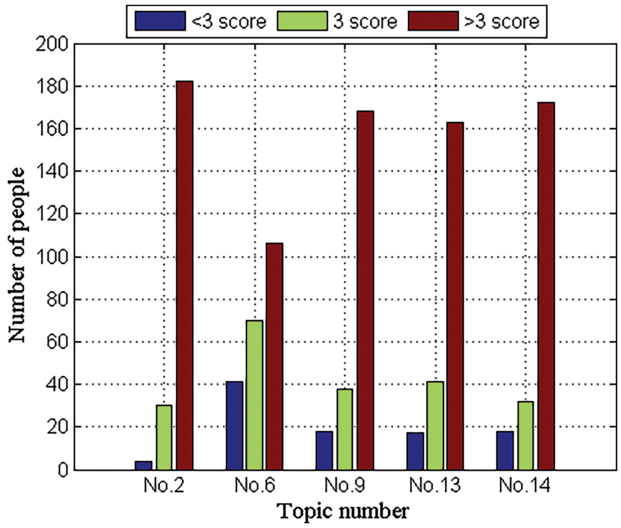

Figure 6: Score distribution of the second measured learning experience scale

5 Conclusions

High school students have low enthusiasm for biological learning, poor learning ability, and self-learning ability needs to be improved. At the same time, teachers' teaching methods are relatively simple, their teaching enthusiasm is poor, and their teaching evaluation methods are relatively simple. When teachers understand positive psychology, they can improve their own emotions and infect students with positive emotions to enhance their sense of positive learning experience. Based on relevant psychological theories, this study discusses and analyzes the elements of teachers' heuristic teaching language, and initially proposes the path of heuristic teaching language, hoping to enrich the theory of heuristic teaching and provide some help for novice teachers. The research of this paper found that the research on the heuristic teaching language based on positive psychology not only helps to improve the effectiveness of high school biology classroom teaching, but also can cultivate students' fund character to play their own advantages and cultivate their ability to obtain happiness. The shortcoming of this paper is that the

research starts from the teacher's main body to study the teacher's heuristic teaching language, but rarely involves the student's learning process. In the next step of research, we will turn our attention to the combination of teachers' teaching and students' learning.

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