

# Research on Teaching Strategies to Realize Mathematical Understanding in University Mathematics Classes

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## Abstract

Mathematical understanding is one of the hot topics in the research of mathematics education in recent years. Many articles and Monographs on mathematics understanding have been found in the search keyword "Mathematics understanding" on CNKI. However, most of the research content is based on primary and secondary school mathematics, ignoring university mathematics. University mathematics as an important part of mathematics education has been lack of relevant research. Therefore, in view of the current research gaps, the author uses the literature research method. Firstly, to study the cognitive process and characteristics of college students and the characteristics of college mathematics. Secondly, the author puts forward four teaching strategies to realize mathematical understanding in college mathematics class by comparing the mathematical understanding in senior high school. It lays a foundation for the further study of mathematical understanding in university mathematics.

## Keywords

Understanding, Mathematical Understanding, University Mathematics, Teaching Strategies

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## 1. Introduction

What is understanding? Understanding is a process in which people objectively understand the world, grasp the objective laws and interpret the objective things. Mathematical understanding is called mathematical understanding. Mathematical understanding was an internal network representing mathematical concepts and facts [1]. Mathematical understanding was a process in which mathematical knowledge enters in the individual cognitive structure and forms an internal network with the old knowledge in the original cognitive structure [2]. Mathematical understanding was also a dynamic process, which was the construction of cognitive structure and the construction of knowledge meaning [3]. It had two modes: instrumental understanding and relational understanding [4], and there were five progressive levels [5]. In the study of

mathematics knowledge, understanding was the key to knowledge transfer, which can improve the effect of memory and reduce the burden of memory of learners [6]. Mathematical understanding can improve the ability of solving practical problems [7]. In 1989, the National Council of Mathematics Teachers clearly put forward that the focus of mathematics curriculum should be "mathematical concepts and understanding". Mathematics education researchers and teaching designers should regard mathematical understanding as the primary focus of mathematics research [8]. Mathematics understanding has always been one of the hot directions in the research of mathematics education, but most of the research fields are concentrated in primary and secondary schools, and there is rare research on College mathematics. Therefore, through the literature research method and the author's teaching experience, this paper intends to study the mathematics understanding in the

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university mathematics classroom and explore the corresponding teaching strategies.

## 2. Cognitive Process and Characteristics of University Students

Cognitive process is the direct cognition of the objective world under the stimulation of the outside world. The cognitive process refers to the process in which the human brain reflected the nature of objective objects and the relations among them through feeling, intuition, memory, thinking and imagination in psychology [9]. According to cognitive development theory of Piaget, university students were in the stage of formal operation, just like adults, and can think in an abstract way. Abstract thinking and operational ability have reached the peak. University is like a small society. After students pass the university entrance examination and enter the university, they have strong curiosity about the university and lack in-depth analysis and research on things. Cognitive of university student style had changed from external authority to internal rationality [10]. For example, in middle school, students thought the teacher should tell them what is right, but in university man have their own ideas, along with the development of their bodies and mind, their independent consciousness distinct enhancement and the information obtained externally will be screened, and the correct part will be selected and absorbed according to their own cognition. In other words, university student will process the information they receive from the outside, absorb what they think is useful and make use of it.

## 3. Characteristics of University Mathematics

In recent years, more and more majors in universities offer mathematics courses, not only those related to mathematics. Some traditional humanities, such as philosophy and history, also regard the opening of mathematics course as one of the important contents of their teaching reform. More and more people realize that mathematics is not only a useful tool, but also a systematic, rigorous and widely used way of thinking [11, 12].

The characteristics of university mathematics were mainly reflected in the differences between university mathematics and high school mathematics. There were both connections and differences between university mathematics and high school mathematics [13]. The knowledge structure of university mathematics curriculum is not closely related to that of high school mathematics curriculum, and the

subordinate relationship is not strong. As a result, the original cognitive structure of university student cannot be effectively used in university mathematics classes, which affects the transfer and application of old and new knowledge for university student. High school mathematics is a hodgepodge of all kinds, including algebra, calculus, geometry and other knowledge. By the time you get to university math isn't such a mess. Mathematics has its own second-level discipline, there are clear boundaries between different disciplines and deeper, more and more professional knowledge. Therefore, it is necessary for university student to rebuild their cognitive structure, knowledge network system and mathematical thinking. This is the characteristic of university mathematics, more professional, deeper and more detailed. For university student, how to rebuild the mathematical knowledge network system? What teachers do can help students rebuild in their teaching? This is one of the rare areas which been studied. The author believes that the mathematics teaching strategies for university student are completely different from those for middle school students. University student are better at accepting and cognitive abilities than middle school students, so if teachers use the intuitive teaching, the inspired teaching and other teaching methods may not play a very good role. Therefore, we should help students rebuild the knowledge network system through effective teaching methods according to the characteristics and significance of mathematical understanding.

## 4. Teaching Strategies for Mathematical Understanding

The cognitive characteristics of university student and the characteristics of university mathematics have been introduced above. What are the specific teaching strategies? Through what kind of method can realize student's mathematics understanding? The author puts forward the following four teaching strategies according to the cognitive process and characteristics of university student and the characteristics of university mathematics.

### 4.1. Teaching of Mathematics Cognitive

Mathematical cognition referred to students' most basic knowledge and understanding of mathematics [14]. In order to promote understanding of mathematics of student in university mathematics classes, it is necessary to start from students' existing mathematical knowledge system and mathematical cognitive system. Teachers should make clear what kind of current mathematical knowledge system students have, to what extent students' mathematical level has reached, and what mathematical knowledge students have mastered. Only in this way can teachers effectively supplement and

improve students' existing mathematical knowledge. For the knowledge which students easy to fuzzy, the error-prone knowledge and key points to emphasize, and the corresponding supporting training to improve the ability of students. Teachers can understand these aspects of students through examination, after-class conversation or questionnaire survey, and choose appropriate teaching language according to cognitive level of students. In a word, mathematics cognitive teaching should be carried out first, which is the fundamental and foundation to promote mathematical understanding of students and the premise to implement other teaching strategies.

#### 4.2. Metacognitive Teaching

Metacognition was first proposed by Flavell in the 1970s. Metacognition was the cognition and monitoring of oneself thinking and learning activities and the core of it was the cognition of cognition [15]. Metacognitive teaching refers to the application of metacognition in the teaching process with the purpose of making students form self-consciousness, which includes three strategies: planning strategy, monitoring strategy and adjustment strategy. In the structure of human intelligence, metacognition is in a dominant position and plays an overall control role on other development factors, so it is very important to cultivate metacognition ability of students. In the university mathematics study in every week or each class, the teachers should guide the students to make the semester plan, what they must study, what the student should prepare in advance, how much and how deep they need to, must have the explicit request. In this way, students will have the whole learning content structure imprinted in their minds, and they will have corresponding plans according to the requirements of teachers. If there is a difference between the actual situation and the plan, such as the learning content does not keep up with the content of the plan, then students should adjust the plan in time to make the plan correspond to the actual situation. At the same time, metacognitive teaching also puts forward higher requirements for university teacher, who must master a variety of teaching skills to deal with unexpected situations which often occur in class. In a well-prepared teaching plan, various constraints should also be taken into account, such as teaching environment, student psychology, etc. [16].

#### 4.3. Mathematics Reflection Teaching

Innovation and reflection are the driving force for students to improve their understanding of mathematics. Learning without thinking about innovation and thinking without learning are both perilous. University mathematics is not like that in high school, university mathematics teaching time is tight, the task is heavy, the intensity is high. The fell in

university is very free, no teacher like high school teacher that always staring at the students. Therefore, if university student wanted to improve their mathematical level, mathematical ability and mathematical understanding, they can only rely on their own unremitting efforts and reflection. According to this, reflection teaching emerged at the right moment. Students should reflect on what they do not understand in class after class, reflect on the key content of the explanation of teachers, and seek help from classmates or teachers if they do not understand. Teachers should also teach students how to reflect. University students have the ability of independent thinking and judgment, so understanding of mathematics of students will also generate their own understanding and opinions. The teacher should ask the students at the beginning of each lesson: how much have you remembered from the last lesson? What is your own understanding of a concept? Through such questions to promote the reflection of students, the implementation of reflection teaching, there will be unexpected results through accumulate over a long period.

#### 4.4. Mathematics Culture Teaching

Compared with other subject math classes are boring compared with other subjects, so are university math classes. Therefore, it is necessary to find ways to improve the interest of students in learning. How to improve? The author thinks that it is an important teaching strategy to integrate mathematics culture into mathematics teaching to improve understanding ability and interest in mathematics of students. The practice has proved that the mathematics culture teaching strategy has the very important function for the student to understand the mathematics knowledge, enhances the mathematics ability. Mathematics culture includes mathematics history, mathematics celebrity, mathematics fun, local culture and so on. Teachers can apply these contents to mathematics teaching in class. For example, the integration of the History of Mathematics into the teaching of Mathematics was also called HPM (History and Pedagogy of Mathematics) [17]. By integrating the history of mathematics with the classroom teaching of mathematics, teachers can not only stimulate the interest of students in learning mathematics, but also enable them to learn more knowledge, combine history with teaching, and strive to improve mathematical understanding ability of students. In university math class is boring, university student aren't interest in learning and get bored easily, if the teachers can use some methods, such as introducing some stories of the mathematical celebrity, sharing something interesting of math, so that teachers can not only focus the attention of students, but also improve the ability of mathematical understanding. Thus, mathematics culture teaching strategy is a very practical teaching strategy.

## 5. Conclusions and Prospects

Through the analysis and research on the cognitive characteristics of college students and the characteristics of college mathematics, it can be concluded that it is feasible to apply mathematical understanding to college mathematics classroom, but the premise is to master certain teaching strategies or teaching methods. Only when teachers use these teaching strategies in mathematics class, students understand the corresponding learning strategies, stimulate interest of student in learning, and let students truly understand college mathematics, can we improve students' mathematical understanding ability and form a good mathematical literacy.

According to my own experience and understanding, the author puts forward four teaching strategies: mathematics cognition teaching, metacognition teaching, mathematics reflection teaching and mathematics culture teaching. These four teaching strategies have not been verified by practice, which is the inadequacy of this study. The force of a person is finite. Hope readers understand and correct. The relationship between mathematical understanding and university mathematics is a new research field. There are not many research results and conclusions in this field, such as teaching evaluation, learning strategies and empirical research, which are still blank. These blank areas can be used as the direction of researchers in future research.

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