

# Exploration and Practice of Teaching Reform in Numerical Analysis Course

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**Abstract:** With the continuous development of science and technology, the teaching content and methods of numerical analysis courses also need to be constantly updated and improved to meet the needs of the times and the development of students. This paper explores the main aspects of teaching reform in numerical analysis, including optimizing teaching content, innovating teaching methods, enhancing teachers' teaching abilities and reforming assessment methods. The aim is to improve students' comprehensive quality and ability level, improve teaching quality and effectiveness, and promote the development and application of numerical analysis courses.

**Keywords:** Numerical analysis; Teaching reform; Teaching quality; Assessment method

## 1. Introduction

The origin of numerical analysis can be traced back to ancient times, when people began to use simple numerical calculation methods to solve various problems. Classical numerical analysis mainly refers to the study of numerical calculation methods by mathematicians during the period from the late 19th century to the early 20th century. For example, Gauss et al. proposed an iterative method for solving linear equations; Taylor and Peano et al. studied methods for approximating functions using polynomials[1]. The main purpose of classical numerical analysis is to solve various practical problems encountered at that time, such as astronomy, physics, engineering, etc. The resolution of these problems laid a solid foundation for the subsequent development of numerical analysis[2].

Modern numerical analysis mainly studies how to use computers to efficiently perform numerical calculations, including solving linear equations, optimization problems, interpolation and approximation, integration and differentiation, etc. During this period, many important numerical calculation software was developed, such as FORTRAN, C, MATLAB, etc[3]. The application of these software enables people to perform numerical calculations more conveniently, while also promoting the development of numerical analysis. The application range of numerical analysis is becoming increasingly widespread, and it has become an indispensable part of scientific research, engineering design, data analysis, and other fields[4]. With the continuous development of technologies such as artificial intelligence and machine learning, numerical analysis will also become more intelligent[5].

The in-depth learning of numerical analysis is of great help to the learning and research of fields such as mathematics and computer science. This paper explores and practices the teaching reform of numerical analysis from the perspectives of teaching content, teaching methods, teachers' teaching abilities and assessment methods, as shown in Figure 1.

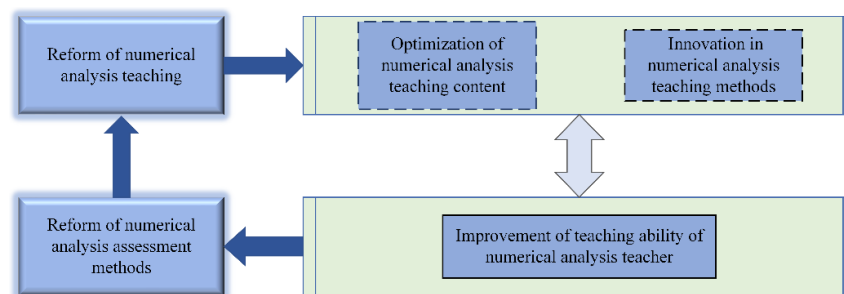


Figure 1 Structural diagram of numerical analysis teaching reform

## 2. Optimization of Numerical Analysis Teaching Content

Optimizing teaching content is the core of the reform of numerical analysis teaching content. In order to better adapt to the needs of the times, we need to optimize and update the existing teaching content.

In the teaching process of numerical analysis, teachers should pay attention to updating teaching content to meet the needs of modern technological development. In order to enable students to better handle large-scale data in real life, modern computing technologies such as big data processing, cloud computing, and artificial intelligence can be integrated into teaching content. Teachers can design some experimental plans and steps, such as using numerical methods to solve the roots of functions, solving integrals, and solving differential equations. Students can apply their knowledge to practical operations, implement these experimental plans and steps, understand the practical application and implementation process of numerical analysis methods, and deepen their understanding and mastery of numerical analysis methods.

Numerical analysis is a highly applied discipline aimed at solving mathematical problems in practical situations. Therefore, attention should be paid to cultivating students' ability to solve practical problems. In practical teaching, teachers can use mathematical modeling to guide students to use numerical analysis methods to solve practical problems based on practical problems.

### 3. Innovation In Numerical Analysis Teaching Methods

In order to improve teaching effectiveness and cultivate students' innovative and practical abilities, the innovation of numerical analysis teaching methods is particularly important. This section summarizes innovative teaching methods for numerical analysis, which mainly include the following aspects, as shown in Table 1.

Table 1 Teaching method

Types of teaching methods	Mode and content
Discussion mode teaching	Discussion mode teaching is a student-centered teaching method that guides students to actively participate in classroom activities and enables them to better understand the design and implementation of numerical algorithms.
Case teaching	Case teaching is a method of teaching theoretical knowledge by analyzing practical problems as the background, which enhances students' interest in learning and their ability to solve practical problems.
Experiment teaching	Experimental teaching verifies the correctness and feasibility of numerical algorithms through experimental operations, improves students' practical abilities, and enables them to better grasp the application of algorithms.
Flipped classroom	Flipped classroom is a teaching method that inverts the learning process inside and outside the classroom, such as pre class preview and post class review, to help students better grasp the course content and improve their independent learning and innovation abilities.

### 4. Improvement of Teaching Ability of Numerical Analysis Teachers

With the increasingly widespread application of numerical analysis in scientific research and engineering practice, teachers need to constantly update and improve their teaching abilities to improve the teaching quality and effectiveness of numerical analysis courses.

In order to improve their teaching skills, teachers need to continuously learn and master effective teaching methods, including classroom organization, teaching strategies, selection and application of teaching methods, etc. According to different teaching content and objectives, teachers need to pay attention to the development and application of online resources, such as online textbooks, online experimental platforms, etc., to provide students with more abundant learning resources and practical opportunities. Furthermore, teachers need to choose appropriate teaching tools and techniques to improve their teaching efficiency and effectiveness.

Teaching practice is a key link in improving the teaching ability of numerical analysis teachers. By participating in professional training, teachers can continuously update their knowledge and skills, improve their teaching level and practical ability. Based on practical teaching experience, teachers can better understand students' needs and learning characteristics, thereby better guiding students' learning and practice. Teachers need to continuously learn and master the academic dynamics in the field of numerical analysis, understand the latest research trends and directions, and transmit the latest research results in the field of numerical analysis to students.

### 5. Reform of Numerical Analysis Assessment Methods

In the assessment process of numerical analysis, in order to evaluate students' learning effectiveness more comprehensively and accurately, the assessment methods are reformed from the following aspects, as shown in Table 2.

Table 2 Numerical analysis assessment method

Assessment method	Reform content
Theoretical examination	Theoretical assessment is to ensure that students fully understand the basic concepts of numerical analysis. Generally, some application questions are added to the theoretical assessment to better evaluate students' practical application abilities. Comprehensive questions involving multiple knowledge points can be set to assess students' ability to comprehensively apply knowledge.
Practical operation assessment	In practical operation assessment, attention should be paid to the assessment of students' programming abilities, including algorithm implementation, program debugging, etc. In order to better evaluate students' data processing abilities, some questions on data analysis and processing can be added to the practical operation assessment. By setting challenging questions, students' innovation and independent thinking abilities can be stimulated.
Case analysis assessment	Select representative cases, such as solving linear equations or optimization problems, to better evaluate students' ability to analyze and solve problems. In the case analysis assessment, students are allowed to independently collect and analyze data, with the aim of examining their ideas and methods, including problem modeling, algorithm design, etc.
Classroom interactive assessment	In the classroom, encourage students to actively participate in discussions, propose their own opinions and ideas, in order to better evaluate students' thinking and expression abilities. It is necessary to pay attention to the examination of students' thinking styles, including logical reasoning, problem analysis, etc.
Stage test	Stage test can effectively help students discover and solve problems in a timely manner, and improve learning outcomes. Continuously improve the content and difficulty level of stage tests based on students' learning situation and feedback, in order to better meet students' learning needs and improve learning outcomes.

## 6. Conclusion

When discussing the reform of numerical analysis teaching, it is necessary to review traditional teaching methods and textbooks in the past, and consider whether they are still applicable to modern technological society. The traditional teaching method of numerical analysis mainly focuses on theory, emphasizing formula derivation and theoretical proof. However, in practical applications, students often lack understanding of the essence of numerical analysis and necessary computational skills. This paper optimizes the teaching content from the perspectives of modern computing technology, students' practical operation ability, and students' problem-solving skills. By adopting methods such as discussion mode teaching, case teaching, experimental teaching, comparative teaching, and reverse classroom teaching, the quality and effectiveness of teaching can be effectively improved. Teachers enhance their teaching abilities through the cultivation of teaching technology, practical skills, and scientific research abilities, in order to better meet the learning needs of students. The numerical analysis assessment has been reformed from theoretical assessment, practical operation assessment, case analysis assessment, classroom interaction assessment, and stage testing, with the aim of comprehensively and accurately evaluating students' learning effectiveness. The reform of numerical analysis teaching needs to continuously summarize experience, improve and improve in order to cultivate more high-quality talents that meet the needs of modern technology society.

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