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Teaching of Calculation methods Course Based on a Simple to Complex Perspective

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Abstract: Starting from simple knowledge in teaching,the transformation of complex methods in computational methods into combinations of simple methods is explained,which helps to improve teaching effectiveness.This paper analyzes the application of the principle of moving from simple to complex in the teaching of computational methods through specific cases based on the perspective of moving from simple to complex,and introduces the embodiment of the property of transforming complex problems into combinations of simple problems in computational methods based on specific knowledge points.The paper will play an active role in the teaching of computational methods course.

Keywords: Calculation methods course;Teaching;Simple to complex

1. Introduction

Calculation methods is a discipline that studies the approximate solutions of various mathematical problems and implements them numerically using computers.As one of the public basic course for undergraduate engineering students,its contents include interpolation and fitting,numerical solution of nonlinear equations,numerical calculus,numerical solution of systems of linear algebraic equations,matrix eigenvalue problems,numerical solution of ordinary differential equations and error analysis[1,2].With the increasingly important role of computers in the field of scientific research and the widespread use of calculation methods,the course has received more and more attention[3,4].However,because of its relative abstractness and complexity,this course is also a subject that undergraduate students generally find difficult[1,3].In the teaching process of calculation methods,if we can follow the principle of moving from simple to complex,and can turn complex theories into a combination of simple knowledge instead of starting directly from complex,it will not only help students understand better,but also help them develop interest in learning,and it will be beneficial to improve their analytical and creative abilities.

2. Teaching characteristics of calculation methods

Calculation methods,like other mathematical disciplines,has a high degree of abstraction and rigorous science,students will encounter a lot of difficulties in learning this course.It can be said that a textbook on calculation methods without any illustrations does not affect the correctness and comprehensiveness of its content.It is just that such a textbook is very abstract and obscure for most undergraduates.These characteristics determine that the calculation methods lecture process should pay attention to avoid making students directly face the relatively complex abstract concepts and methods,and choose the lecture method from simple to complex.

On the other hand,calculation methods is a science about approximate calculations,it needs to follow clear steps to meet the needs of computer programming convenience,which increases the complexity of the theory,especially when solving simple problems often seems cumbersome.For example,when explaining Lagrangian linear interpolation,students have a clear feeling of the tediousness of the interpolation method.In order to meet the high accuracy and efficiency of approximate computation,the theory related to calculation methods also develops in the direction of relatively more complexity,which also brings difficulties for beginners to master the theory of calculation methods.

3. Teaching calculation methods course based on a simple-to-complex perspective

3.1 The principle from simple to complex

The basic teaching of mathematics starts from natural numbers,from points,lines and segments,which are the simplest concepts. The overall content of the calculation methods course is large,but the number of hours of instruction is limited.In this case,teachers need to grasp the content of the whole course from a macro perspective.The teaching process of the calculation methods course follows the principle from simple to complex,which helps to develop students'interest in learning and better grasp the course content.

Some specific cases are illustrated.When introducing interpolation,linear interpolation is introduced first,then over to quadratic polynomial interpolation and cubic polynomial interpolation.Linear interpolation can be combined with students'linear equations in junior high school,which is easy to understand,and easy to understand the limitations of linear interpolation in terms of accuracy,so as

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to go over to the explanation of quadratic and cubic interpolation,and thus derive the Lagrange interpolation and Newton interpolation formula,and introduce the method and theory in the calculation methods need to facilitate computer programming to achieve this feature.The bisection method is relatively simple because it can be understood intuitively through graphs,and learning the bisection method first can give students a clear understanding of the connotation of the numerical solution of nonlinear equations.When introducing the bisection method,in addition to visual images,a guessing game can be used to introduce the bisection method to students,allowing them to think about it in a game.The program first selects a random integer between 1 and 100,and then the player guesses the number by entering it.The question is then asked,"Based on what strategy can the selected random integer be guessed relatively quickly?"Through the guessing game and thinking about the above questions,students can better understand the meaning of the bisection method and increase their enthusiasm for learning the calculation methods.

3.2 Complex methods and combinations of simple methods

Calculation methods often deal with the approximation of complex problems by transforming complex things into combinations of relatively simple things and then proposing solution strategies.In the teaching of calculation methods,the transformation of complex problems and methods into combinations of relatively simple methods is more helpful to students'acceptance and understanding,and is also helpful to the improvement of their creative and analytical abilities.

The following are some concrete examples in the teaching process.When undergraduate students are first exposed to the theory of numerical solution of differential equations,they often have difficulties in understanding it because it is different from the mathematical knowledge they have studied before.In fact,the numerical solution of differential equations can be considered as a typical case of transforming something complex into a combination of simple things.In the numerical solution of differential equations,the value domain is decomposed into a series of subintervals by defining the step size,and then the derivatives of each order at the nodes of each subinterval can be calculated.Based on various numerical algorithms for differential equations,the complex differential equations can be transformed into a series of algebraic equations to obtain the numerical solution of differential equations.In this process,the relatively complex differential equation is transformed into a combination of a series of algebraic equations.The numerical solution of differential equations is explained from this perspective,which is more helpful for the student to understand based on his previous knowledge in algebraic equations and is helpful for mastering the numerical solution of differential equations.When explaining the theory of interpolation,after talking about linear interpolation,quadratic interpolation and cubic interpolation,the students are given a chance to understand the Runger phenomenon in higher interpolation by using motion pictures,etc.,so as to ask the question:How to construct a high-precision interpolation form in multi-point interpolation problems?Transforming complex things into combinations of simple things is reflected here by decomposing the value domain into various subintervals,and transforming the problem of interpolating complex curves on the value domain into a combination of simple low interpolation curves on each subinterval,thus solving the problem with guaranteed accuracy.The influence of the way of combining simple things on the method can also be further explored here.Considering the consistency of the derivatives at the connection point of the low order interpolation curves for each subinterval leads to the introduction of Hermit interpolation and spline interpolation,and the presentation of this case also allows students to further think about the impact of different ways of combining simple things on the treatment of complex things.

4. Conclusions

Calculation methods course is abstract and complex,which makes it difficult for students to understand.Based on the principle of teaching from simple to complex,and good grasp of the theory of calculation methods to transform complex problems into simple problem combinations,it will be helpful for students to understand and master the course,and develop interest in learning.From the perspective of simple to complex,this paper analyzes the application of the principle from simple to complex in the teaching process of computational methods through specific cases,and analyzes the embodiment of the characteristic of transforming complex problems into simple problems combination in computational methods based on specific knowledge points.The paper will play an active role in the teaching of calculation methods course.

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