
On the Effective Connection between College Mathematics and High School Mathematics Teaching

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Date of publication (dd/mm/yyyy): 20/07/2019

Abstract – Mathematics teaching is an important part of the whole education system from high school to university and even to higher level learning. It plays a key role in forming a complete mathematics knowledge system for students by connecting closely and effectively mathematics teaching at all stages. The connection between college mathematics and high school mathematics teaching has always been a common concern of the educational circles ^[1]. This paper compares the teaching of college mathematics with that of high school mathematics, hoping that mathematics teachers can understand the connection between high school mathematics and college mathematics, adjust teaching contents effectively and appropriately, change teaching methods and arrange teaching better. The suggestions put forward can help freshmen adapt to the teaching methods and thinking modes of college mathematics better and faster.

Keywords – University Mathematics Teaching, High School Mathematics Teaching, Effective Link.

I. INTRODUCTION

With the expansion of college enrollment and the deepening of basic education curriculum reform, higher education has transformed from elite education to popular education, and high schools have also promoted new curriculum standards ^[2]. At present, there are serious repetitions and disjoints in the teaching content, teaching methods and learning methods of college mathematics and high school mathematics in our country, which bring some troubles to teaching. Many students who have just entered the university entrance exam have not got much difference in math scores, but their final scores of the basic course of college mathematics are significantly different. Students who do not understand the course get scores of nearly units. This also reflects the shortcomings of students who have just transited from high school to university in self-control, logical reasoning and flexible application. Therefore, how to realize the effective connection between college mathematics and high school mathematics is the key part of mathematics education research at present.

II. ANALYSIS OF CONNECTION PROBLEMS AND CAUSES

A. Education has different Goals

Senior high school mathematics focuses on exam-oriented education to improve students' performance, often neglecting the exertion of students' personality, so that students can learn the basic knowledge of algebraic geometry, probability statistics and calculus, and form basic skills ^[3]. College mathematics teaching requires students to develop in an all-round way and pay attention to students' personality growth as the goal. Teachers should not only teach students knowledge, but also enlighten and cultivate students' mathematical literacy and ability, so that students can understand and learn college mathematics from all aspects and multiple perspectives in order to truly cultivate students' mathematical thinking ability for other disciplines. Such a change in teaching objectives makes it difficult for students to adapt to the study of college mathematics.

B. Different Teaching Contents

The main research objects of high school mathematics textbooks are constant mathematics, such as function derivative, probability statistics, analytic geometry of solid geometry, etc. The concepts are simple and intuitive, and easy to be accepted by students. On the contrary, there are more extensive and abstract quantitative spatial relationships in university mathematics. The conceptual nature has not been easily understood by most students. Its theory is more profound and its vertical and horizontal links are more closely. It belongs to variable mathematics, which has a great change in teaching content.

After the new curriculum reform in senior high school, probability theory and mathematical statistics, geometry on the sphere, symmetry and group, euler formula and so on have been added as optional modules in senior high school mathematics. But at the same time, a lot of classical contents of high school mathematics have been deleted, such as the image and properties of inverse trigonometric function, trigonometric function and differential product, product and difference formula, etc. The derivation and integral operation of trigonometric or anti-trigonometric functions are often involved in university mathematics. It is difficult for students to find the zero basis skillfully, which results in some important knowledge not appearing in university, and makes it very difficult for students to learn mathematics [4]. High school liberal arts mathematics has deleted permutation and combination, binomial theorem, mathematical induction and so on, resulting in the knowledge continuity of the disconnection, making the teaching of college mathematics in the economic category has been greatly affected.

C. Different Teaching Methods

In high school, teachers give detailed lectures to students in mathematics learning classes and instruct them to practice after class. Students generally have a good grasp of mathematical knowledge points and examples. Meanwhile, high school also advocates encouraging and caring for students. Students are the main body of the classroom and teachers are the leading ones. Through teachers and students to explore, mathematical modeling and other knowledge systems, to obtain direct experience and practical ability, personally experience the close relationship between mathematics and life. However, compared with university mathematics, its class hours are less, but the content is several times higher than that of senior high school, and its depth is also improved. In addition, the visualization of knowledge language leads to poor understanding of theory. In the University classroom, teachers and students mainly give lectures, there is little interaction between teachers and students, and the emphasis is not uniform, so the teaching methods like catching up with the schedule are scattered and unsystematic. Therefore, students' interest and effect in college mathematics learning are more or less affected [5].

For example, students have seen inflection points at the extreme points of functions in high school, which are not mentioned in textbooks and books. Only a few teachers have mentioned that the zero points of derivative images are called inflection points except the minimum and maximum points. Students who have heard this will automatically analogize extremes and zeros, feeling that the inflection point is not a point but a number. However, after going to university, the inflection point is studied again in calculus of basic course. Although the definition has clearly given the point of changing convexity on the continuous curve, such a concise concept will not be emphasized carefully by university teachers, while students still continue the inertia of understanding inflection point in high school, and think it is abscissa coordinate. Even those who study college math very fast can hardly escape the inertia of thinking and still do wrong questions.

D. Learning Difference

Mathematics learning in senior high school is easy to understand but difficult to do problems, and students rely heavily on math teachers. Even if they do not preview or preview before class, they will master the lessons carefully, and practice so-called "routine questions" more often, and they will get good scores. For college freshmen, the goal of entering university has been achieved for many years. Suddenly, they feel that they have no direction to work hard. The loss of learning motivation makes them unable to arrange their spare time. Once the way of high school learning has completely not adapted to the changes of university mathematics learning, so relying on their own way of learning is just a high school students did not contact, resulting in a significant decline in performance.

Under the pressure of college entrance examination, senior high school students are accustomed to attaching importance to form rather than content, results rather than process in the process of mathematics learning and problem solving. The study of university mathematics mainly lies in training students' strict logical abstract thinking ability, paying attention to the analysis process of knowledge, and enlightening and cultivating students' mathematical literacy and ability. The speed of university teachers' explanations and the increase of mathematics learning content from direct to abstract make it difficult for some students to adapt to the way of university lectures [6]. They can't understand only by memorizing symbols. They are busy in class, confused after class and can't make progress for a while.

III. THE COUNTERMEASURE OF THE PROBLEM AND PROPOSAL

A. Connect the Old Knowledge with the new and Optimize the Teaching Content

The teaching content of new college mathematics knowledge should be in line with the old high school knowledge, and students' overall understanding of mathematics knowledge should be established. It should be known that the basic knowledge of high school is necessary preparation for the knowledge and thinking training of college mathematics, so that students can obtain the knowledge that has a general guiding role in their future study. Such as, teachers can help students understand and use the $\varepsilon - \delta$ language of defining limit accurately in college mathematics by refining the common methods of changing variables, scaling to prove inequalities, and dislocation subtraction of summation of sequence [7]. For another example, in the teaching of calculus of one variable function and multivariate function from simple to complex, general to special, we explain the limit of one variable function, the properties and applications of continuity, differentiability, integrability, and then extend to the application of multiple limit, continuity, partial derivative existence, differentiability, integrability and multiple integration of multivariate function. By comparing the recursive relation of continuous, differentiable and differentiable functions of binary functions with that of univariate functions, students will understand that the chapters of university mathematics curriculum are interrelated as a whole through the overall knowledge framework.

B. Mathematics and Life Contact, the Teaching Way Synchronization

University mathematics is consistent with the high school math teaching methods as far as possible the content of the university mathematics every class is a lot of, a course system of large, but the best, and high school teaching way synchronous: teaching focuses on understand the difficulties in dealing with appropriate explanation as clear

as possible, have the blackboard writing in multimedia aided by calculus proof process, purpose is to complete the mathematics knowledge representation of intuitive to facilitate students to understand; According to the actual teaching situation and students' adaptability, we should try to improve the teaching speed step by step, so that students can gradually adapt to the pace of college teachers' explanation on the basis of certain theories^[8]. For instance, teachers can draw lessons from the method of binomial theorem in senior high school. The second important limit in university calculus can also be explained by living examples of bank deposits.

The annual interest rate is set as I , then after one year, the principal and profit are $a + ai = a(1 + i)$

And the principal and interest of the first month is $a + a(i/12) = a(1 + (i/12))^1$.

The principal and interest of the second month are $a(1 + (i/12)) + a(1 + (i/12))(i/12) = a(1 + (i/12))^2$.

And so on to the twelfth month: $a(1 + (i/12))^{12}$.

The analogy is that the daily principal and interest are $a(1 + (i/12))^{365}$.

Take the limit of the principal and interest per minute per second: $a \lim_{n \rightarrow \infty} (1 + (i/n))^n$.

And that leads to this limit expression: $\lim_{n \rightarrow \infty} (1 + i/n)^n = e$.

Such familiar examples are reproduced in different knowledge, which can be easily understood by students.

C. Teacher's Teaching Suggestions

In order to eliminate the discomfort caused by students' sudden exposure to dull and difficult mathematical knowledge after a whole summer vacation, teachers can first explain to students the similarities and differences of academic management mode of college mathematics and high school mathematics, teacher's lecture mode and student's learning mode in the introduction course of college mathematics.

At the beginning of the new semester, a sub-module test of mathematical knowledge will help teachers to get a general understanding of the students' existing learning levels, so that they can have a careful design of teaching process, determine the key points and difficulties of teaching, and teach students in accordance with their aptitude. In order to promote students' understanding of new knowledge, teachers should abandon the tedious way of reading slides and deduce the necessary exercises by blackboard.

Some new students feel that college mathematics has little to do with their major and they only study for one semester, which may not be used in the future. Teachers should be patient in enlightening students and point out the importance of learning university mathematics. That is, university mathematics is not only meaningful for students' logical thinking training, but also has a lot of supporting functions for the follow-up courses. Besides, various learning methods and thinking perspectives will accompany us all our lives when we study university mathematics. When encountering new problems, we can use our previous experience to quickly summarize the solutions to new problems^[9].

D. Students' Learning Suggestions

Asking for some learning methods and experiences of college mathematics from the elders can keep good learning habits of high school mathematics. For example, each course can prepare some reference books, preview before class, although in college, but also to adhere to the habit of taking notes in high school, after class according

to notes and textbooks review classroom content and do homework. But in order to change the high school's emphasis on problem-solving skills rather than understanding and proving mathematical concepts and applying ideological methods to solve problems, students have to learn to use their own language to summarize the contents of the classroom.

It is said that before the university, they learn things, and at the University stage, the ability of self-study will continue to work in the future to slowly explore the skills needed for their posts, even lifelong learning. Imagine if you can learn to understand high, deep and abstract mathematics on your own, or if you can understand it with a little inspiration from your teacher, then is there anything more difficult than this that you won't be afraid of? So students should take the initiative to learn those abstract and difficult concepts and questions after class. They can refer to materials, read books or use multimedia electronic resources to learn more advanced mathematics knowledge. They should abandon the behavior of reciting symbols for exams and develop the habit of independent learning.

IV. CONCLUSION

The connection between college mathematics and high school mathematics teaching is restricted by many factors such as politics, economy, science and technology, culture and so on. At present, many problems need to be further explored and discussed.

College teachers need to fully understand the high school textbooks and the direction of reform, accurately grasp the freshmen's mathematical foundation and learning characteristics, and excessively connect the new and old knowledge of mathematics between universities and high schools, so as to help students adapt to the university's learning as soon as possible, and then improve the efficiency of classroom teaching. High school teachers should change the traditional teaching mode according to the changes of curriculum standards, carry out high-angle high school mathematics teaching, strengthen the infiltration of mathematical thinking and methods, and focus on cultivating students' ability to actively explore learning, so that students are full of expectations for future college mathematics learning.

In addition to the need for high school teachers and university teachers to strengthen communication, unified collaboration, but also must get the support of the education administrative department, in order to truly realize the effective link between high school mathematics and university mathematics earlier.

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