

Analysis of Strategies and Methods for Higher Mathematics Teaching

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Abstract. Mathematical thinking is the soul of mathematics in that it is essential to communicate mathematical knowledge and skills. Mathematics teaching focuses on developing students' rigorous attitude, rational personality, pragmatic spirit, good quality, and high spirit of innovation. This paper, based on teaching practice, proposes several strategies and methods including affective teaching, creation of scenarios, open-ended questions, counterexamples, symbolic-graphic combination and penetration of humanities education, so as to further enhance the classroom effect and quality of teaching.

Introduction

Higher mathematics [1][2] is a core course that plays a vital role in the curricular system of colleges and universities. Higher mathematics teaching aims to impart knowledge, skills and more importantly, mathematical thinking, methods and spirit of scientific rationality.

Classroom teaching is a process of interaction between "teaching" and "learning", teachers and students, students and students, as well as students and textbooks. The primary goal is to help students understand and learn knowledge, so as to develop their abilities. Teaching effectiveness can be judged from to what extent and level students understand the course [3].

In classroom teaching, there are many factors affecting students' understanding of knowledge, and teaching methods are no doubt the most important. Some teachers may teach highlights in plain words using appropriate methods, which guide students to learn easily and happily; while others teach in lively, diversified ways, but fail to help with students' understanding and learning [4]. Therefore, it is a problem worthy of serious reflection and exploration that how mathematics teachers enhance students' understanding and learning of mathematics by appropriate methods. As 21st century is an era of knowledge economy, making thinking ability the core competency of high-quality talents, higher mathematics teachers should take full advantage of the characteristics of the curriculum, guide and inspire students consciously to foster their abilities of logical thinking, dialectical thinking, abstract thinking & generalization, and creative thinking, so as to benefit them for life. And that's why the paper is written.

Status-quo of higher mathematics learning in higher vocational colleges

At present, most students in vocational colleges have shown great interest in practical disciplines but less lasting motivation and enthusiasm for theoretical and abstract mathematics upon their admission, partly because of their unsuccessful experience in high school mathematics learning and lack of foundation and ability for learning consecutive, logic mathematics curriculum [5]. As to teachers, they should put emphasis on teaching methods to enable students to realize the practicability of abstract mathematics, thereby increasing their interest in learning; and to carry out hierarchical teaching more effectively under conventional unified teaching mode, so as to improve students' cognitive ability.

Strategies and methods for higher mathematics teaching

This paper, based on the teaching practice of higher mathematics, proposes the following strategies and methods for teaching activities and processes.

1. Love mathematics. Just as the popular saying goes, “Love whatever job you take up”, the enthusiasm for the work one is doing will determine whether you can do it well or not. Many people succeed in their work because they persist in the job they love. There are numerous examples testifying to this point. As a mathematics teacher, we should work hard to improve our own mastery of mathematics, foster our enthusiasm for mathematics, and enhance our professional ethical standard. Only by respecting work, putting heart and soul into mathematics teaching, and making unremitting efforts with great passion, can we arouse the resonance of the students’ emotion and exert a subtle influence on their thinking, so that the students will fall in love with mathematics, an abstract and rigorous subject.

2. Love every student heartily. Most of the students enter higher vocational colleges at the age of about 19. College students in this age group have very distinct characteristics in common. Although they are eager for recognition and attention from others, they are very sensitive and exclusive. They are vigorous, open-minded and ready to accept new things, and bold in action, but they are mentally immature and have strong emotional changes. They seek independence but they are unsophisticated with little social experience. In addition, they lack the ability to make planning for their life and study.

The differences among individual students are also fully shown in classroom teaching, including the differences in learning abilities, previous school performance, self-awareness, learning style, and family environment in which they are brought up. Teachers should learn about these differences as well as the common characteristics among the students and realize the fact that every student is unique. Since in the students’ mind, the teachers are sacred and deserve reverence, the majority of the students will always follow the teachers’ advice. What the teacher said by accident may greatly encourage the students, in other words, whatever the teachers say or do will attract the students’ attention and exert some influence on them. Therefore, the teachers should try to understand each student and truly take care of them. Only in this way, can they achieve good teaching results.

3. The teachers should be happy and confident. Since the teachers and the students influence each other in their emotions, a happy mood can improve the learning result of the students. If the teacher is in high spirit, they can not only give better play of their teaching skills, but also bring a happy teaching environment for the students. However, if the teacher is in low spirit and looks dull, the students will feel fed up and bored and lose their interest in mathematics class. If the teacher has confidence in the students, the students will be active and make a lot progress. If the teacher always encourages the students, the students will be bold in exploring new things. If the teacher is fair and impartial, the students will behave in a peaceful and democratic way. If the teacher makes entertainment a medium of education, the students will be happy and their study will be full of sunshine.

4. Focus on affective teaching. As Lenin said, “nobody will be in pursuit of truths without emotions. Teachers should firstly care about the students, respect and understand their thoughts and emotions, and manage to produce a harmonious teacher-student relationship through exchange of feelings, thus enhancing their confidence eventually.

In mathematics teaching, teachers should create chances of success for students as much as possible, helping them obtain a sense of joy, accomplishment and self-identity gradually. Steps are as follows: produce various problems at different levels for students during classroom questioning: difficult results for outstanding students and simple ones for average students; give diversified assignments that are required or selected, ask students to complete those according to their mastery of the course and submit at different time points to avoid copying due to immediate submission; set different and individualized evaluation criteria as everyone is unique. Evaluate each student from a unique perspective, try to discover their strengths and have them see their own merits and progress, thus inspiring their confidence.

5. Create teaching scenarios. Situational Teaching Method refers to a method of creating classroom teaching scenarios by means of visual demonstration, role play and multimedia, etc.

Relying on a subtle combination of cognition and emotion, thinking imaginably and abstract thinking, teaching and learning, this method helps to motivate students' enthusiasm, initiative and creativity. Its visual, vivid knowledge representation and rich, deep, concrete practice, will stimulate students' positive affective experience and learning for topics, thus developing their active learning attitude.

"How can it be so clear and cool? For fresh water comes from its source." Mathematics is among the indispensable tools in life, work and learning, and it mainly relies on life for survival and development. Mathematics teachers should base their teaching on reality and try their best to create teaching scenarios with well-known daily phenomena, thus guiding students to think actively, fully motivating their interest and enthusiasm, and fostering and improving their thinking ability to analyze & solve problems.

It is true that traditional mathematics teaching mode tends to make the course more abstract, boring and even difficult to understand. Just as psychologists believe that "wisdom lies on one's fingertips", each of our teachers or students has such profound feelings: we cannot remember what we hear or see but what we do. "Discovery is the best way to learn something, for it results in the deepest understanding and easiest way of mastering the law, nature and linkage." As such discovery is made via students' observation, operation and thinking, teachers imparting new knowledge should fully mobilize their senses for active exploration, provide students with necessary materials of thinking, and convert static formula, theorem and inferences into dynamic exploring objects. During this process, students are required to pay a certain amount of emotions and intelligence, so as to enjoy emotional experience and stimulate their association and creativity.

6. Raise open-ended questions. There are a variety of problems in mathematics teaching, wherein good questions can arouse students' resonance and attract them to think positively, thus achieving maximum teaching results with little effort. "Problem is the heart of mathematics." Therefore, Mathematics teachers should attach great importance to good questions in class. They should, after fully studying the textbooks, design some problems appropriate to students' cognitive and developmental level, so as to stimulate their cognitive drive and get them really involved in learning, thus mastering the knowledge. Flexible, scientific, comprehensive and innovative open-ended questions allow students to think freely, playing an important and positive role in fostering their practical ability and innovative awareness.

Open-ended questions refer to those involving uncertain elements, conclusions and answers that require exploration, conjecture and demonstration. They can be divided into condition-open questions and conclusion-open questions, etc, featuring many answers acquired from divergent solutions and high comprehensiveness. Solvers have to employ various thinking methods including observation, imagination, analysis, synthesis, induction, analogy and deduction to draw lots of conclusions from multiple perspectives, and then sort out and demonstrate them.

7. Use counterexamples skillfully. The correctness of a mathematical proposition must be demonstrated by a series of strict logical reasoning; but its incorrectness simply by a counterexample. It is common in mathematics class that students get confused when trying to understand or prove some mathematical knowledge with positive examples or teachers' positive interpretation. However, simple and intuitive counterexamples may arouse the immense interest of students, enabling them to come to a sudden understanding tactfully.

Just as the mathematician B.R.Gelbaum said, "Mathematics is made up of proof and counterexamples. Its discovery is mainly to offer proof and construct counterexamples... Solving a mathematical problem by counterexamples satisfies people as a good drama." Appropriate construction of vivid, concise, and targeted counterexamples may reflect teachers' wit perfectly and help students to understand mathematics more accurately, clearly and deeply that positive examples cannot do. However, unlike the offer of proof, the elusive counterexamples are not constructed in a clearly logical way. Construction of counterexamples is a positive, creative thinking activity and a process of discovery. Their proper use has imposed higher requirements on teachers in that they have to find student's wrong tendencies and behaviors in classes in a timely manner; make a thorough study of textbooks for lesson preparation, predict common errors as much as possible and

construct suitable counterexample in advance. Therefore, teachers should accumulate relevant experience in daily teaching to avoid students' detours.

9. Focus on and infiltrate humanities education. Humanities education is spiritual rather than intellectual or technical, which solves "spiritual" problems. A knowledgeable but inhumane person will merely be a carrier for storage and dissemination of knowledge. And the value of humanistic knowledge lies in humanistic spirit. Humanities education is irreplaceable, procedural and heart-affirmable. As teaching centering on imparting mathematical knowledge will lead to serious pragmatic tendency, thus adversely affecting students' all-around development, teachers should explore the intrinsic humanistic value of textbooks and infiltrate humanities education in preparation of lessons and in teaching practice based on two principles, i.e. "infiltration consciousness" and "subtle influence". Besides, they should pay attention to the contents and methods of teaching activities, so as to achieve the desired effect obliquely.

10. Arouse emotions to enable students to enhance their self-efficacy. The studies have shown that people with high achievement motivation often attribute their failure to lack of effort. They will never lose heart due to powerlessness and will act positively since they believe in the correlation between efforts and results. By contrast, those with low achievement motivation always attribute their failure to lack of competency, and they tend to lose heart, believing that efforts do not necessarily bring good results. Teachers should reaffirm to students about the positive role of efforts in their achievement and reward or punish them based on their efforts instead of their academic achievements. When students attribute success to their own efforts and abilities and failure to lack of efforts, teachers should give positive reinforcement; when the success is attributed to external factors such as lack of ability and bad luck, they should tell students that success comes from their efforts and failure from insufficient efforts, thus having the students realize the importance of efforts.

Conclusions

As is clearly stated in the Outline of the National Medium-and Long-Term Program for Education Reform and Development promulgated by the State Council, future admission of vocational colleges will be subject to the organization of provinces (municipalities), and some regions may even allow admission without exams (registration) if possible. It has been an important task for all math teachers to actively explore mathematics teaching methods that are in line with mathematics rules and appropriate for vocational college students. Teachers should take full advantage of the characteristics of the course, guide and inspire students to cultivate their abilities of logical thinking, dialectical thinking, abstract thinking & generalization, and creative thinking rigorously that will benefit them for life. Despite more time and efforts for the study of teaching methods, it is still the sacred duty and persistent goal of mathematics teachers to foster students' rigorous attitude, rational personality, pragmatic spirit, good quality, and high spirit of innovation.

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