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Discussion on Teaching Reform of Mathematical Analysis in Local University

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Abstract: Mathematical analysis is one of the important and fundamental courses of the mathematics specialty in universities. In this paper, we consider how to enhance mathematical analysis teaching. Furthermore, these strategies are expected to promote teaching effect by stimulating student's interest in learning.
Keywords: Mathematical Analysis ; Teaching strategies; Assessment.

BACKGROUND

Mathematical analysis is a branch of mathematics that includes the theories of differentiation, integration, measure, limits, infinite series and analytic functions. In our university, mathematical analysis is a basic course of mathematical science specialty, is a required course for the mathematical major students. It is one of the most important compulsory courses in their four years of university study with a credit point value of 15. Mathematical analysis is a three semester course, 3 hours lectures per week. In my university, mathematical analysis course is usually taught in the traditional way. The current teaching approach is teacher-centered. Most of the lecturers still use a 'spoon-feeding' approach. The teacher plays a leading role and transfers information. 'He or she is regarded as the authoritative expert, the main source of knowledge, and the focal point of all activity. After classes, students are asked to hand in their homework once a week. Teachers correct one third to one half of it and make some comments during the tutorial hours. The primary ways students' learn mathematical analysis course is by attending lectures, taking notes, reading textbooks, doing homework and asking questions. Good students have time to read some reference books and do more difficult problems. A lot of students are so busy struggling with their homework that they only look up related content in the textbook when they encounter difficulties with their homework. At the end of each semester, all the students are expected to attend closed-book examinations, which account for 80% of the final mark respectively, the other 20% coming from records of exercises (include homework). The total mark is 100, if a student's final mark is less than 60, he fails the Mathematical analysis course.

In recent years, colleges and universities continue expanding the enrollment. The number of students has constantly increased. Simultaneously, the quality of students generally becomes worse. These bring some problems in higher education and teaching process. Many students have no interest in learning mathematical analysis and thus cannot master it because they think it is abstract and useless. In addition, lecturers complain that students lack the abilities of analyzing and thinking. Teaching/learning activities are important and must be aligned with the course objective to achieve the learning outcomes. When we do not achieve that we expected, changes are necessary. In order to change the current situation of students' learning mathematical analysis, taking appropriate measures and improve the quality of teaching has become an urgent need to solve the problem in the teaching process.

IMPROVEMENT STRATEGIES

Student-centered teaching strategies

Student-centered teaching focuses on the student, in particular, on the cognitive development of the student. The teacher's goal is to help students grasp the development of knowledge as a process rather than a product. The focus of classroom activities and assignments is on the student-centered process of inquiry itself, not on the products of inquiry. Students create their own conceptual or cognitive models. Content, teaching style, and methods are adapted to aid the cognitive and intellectual growth of students. Student-centered teaching combines an understanding of the way that humans process information with other factors that affect learning such as attitudes, values, beliefs, and motivation [1].

Keeping students interested in the courses is paramount. Without interest students incline to surface level learning. With interest they are maybe likely to engage in deep level learning. Some methods, such as presenting interesting problems, asking questions, giving students time to think, and so on, will be used to make students active and interactive in my lectures. For example, the definition of the derivative can be approached in two different ways. One is physical (as a rate of change), the other is geometrical (as a slope of curve). In my lecture, students will be asked to recall the formula of velocity of constant motion. I am sure that students can get the correct answer: $v = \frac{s}{t}$. Then students will be asked to notice the relationship between average velocity and instantaneous velocity in constant motion. Later, students will be requested to calculate the instantaneous velocity of changing motion. In this case, the above formula does not apply directly. Students may think about studying the average velocity of changing motion and see what happens when the elapsed time gets smaller and smaller. They may naturally run into the concept of limit and then the instantaneous velocity of changing motion will be found. This concept of velocity may be extended to find the rate of change of any variable with respect to any other variable. Students can then give more examples and the class can then study the geometrical approach. In the process, students are motivated to acquire knowledge by actively participating in the learning process. Active learning will engage the students' mind in constructing meaningful knowledge of lasting benefit. I believe that students will benefit a great deal from this participation. They will understand the concept of derivative better.

When we talk about some important concepts such as set, functions and limit etc, students will be asked to give their own examples, describe their characteristics and discuss them each other. They must convince each other if they have different opinions. They may have the wrong answers sometimes but once their wrong answer is corrected, the concept will be impressed on them and students will never make the same mistake again. For some important concepts, the traditional lectures will be replaced by workshop seminars, in which students will work in groups to construct the methods rather than the teacher show them how to get the formulae. For example, we could give two statements about a real function $f(x)$ defined on an interval I. One statement would be for $f(x)$ continuous on I, the other for $f(x)$ uniformly continuous. Students would need to judge the relationship of two statements and explain why.

After class, we can establish a discussion area on Net. Students can put their problems of interest on it, can ask for help. Lecturers and tutors can also dispose their opinions. At some fixed time, there will be teachers on the Net to join the discussion and help students, and to get feedback from students. That will be good for both teaching and learning.

Concept mapping

Concept mapping, which is derived from a constructivist approach to teaching and learning, is a technique used for representing knowledge graphically, where the knowledge graphs represent related concepts that are interconnected. Usually, a concept map consists of nodes and links. Nodes represent concepts within a topic, and links represent the relationship between concepts [2]. It is also helpful to explain why the lecturer is focusing on a particular aspect of a topic, so that students can see how particular pieces of information fit into the overall schema. In mathematical analysis, many concepts are closely related. We can use concept mapping to help students to organize their conceptions into a system. For example, the concept of limit is one of the most important topics in mathematics, using the Figure 1, we can clearly show the relationship between limit 、 continuity and integration.

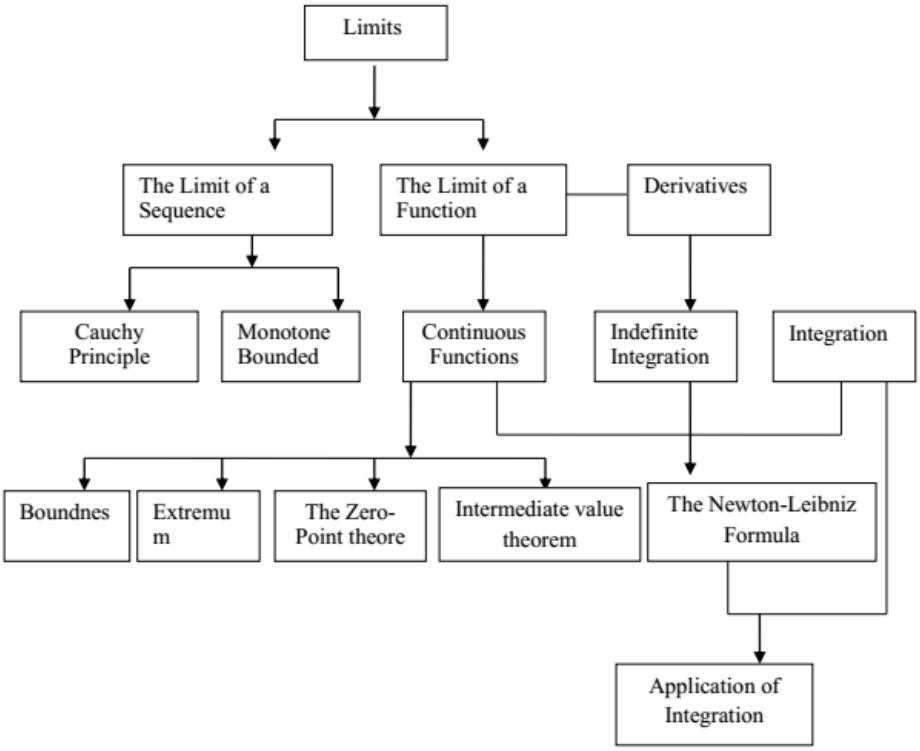

Fig- 1:Concept map of limit

Table 1 Original and new assessment of numerical compare

Original assessment	New assessment
Homework 20%	Homework 10%
	Semi-term examination 20%
	student's ordinary performance 20%
Final examination 80%	Final examination 50%

Adjusting assessment

Assessment is a significant component of teaching and learning. Our principles of assessment will mainly be to stimulate students to work hard and produce deep level learning. The final examination will not rely on memory but on understanding. As you know, the traditional assessment is mainly determined by the final closed-book examination at the end of each semester. In the end few weeks for the examination, some students study very hard and they often successfully pass the examination, but forget most of the knowledge as soon as they have finished the test. This assessment does not evaluate students properly. We should base more assessments on students' learning processes and assess their understanding at frequent intervals throughout the learning processes, meaning the final examination scores should be reduced in importance.

CONCLUSION

There are lots of different approaches to teaching one is not superior to the others in every circumstance. Each of the approaches has its benefits and shortcomings at the same time. Although there exist some possible problems, we believe that those teaching strategies will have positive effects on students' learning.

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