

## Curriculum system of the philosophy of mathematics education for normal students

Yaqiang Yan, Xue Suyue, Junfeng Ma

School of Mathematical Sciences, Soochow University

**Abstract:** *The teachers of mathematics education in China have gradually demonstrated the need for the systematic theory about mathematics education. However, the philosophy of mathematics education is biased towards the academic level, and there are few “readable materials” for direct application in practice. This paper prepares a curriculum system for the philosophy of mathematics education for normal students (the students of teaching universities). The purpose is to stimulate the discussion of the philosophy of mathematics education among the (future) mathematics teachers for practical guidance, to implant the necessary “genetic genes” for the benign development of mathematics education.*

Under the efforts of scholars such as Freudenthal (1973), Ernest (1991), and Yuxin Z (1995), the philosophy of mathematics education (abbr. PME) has become an important field in mathematics education and has played an important role. However, there is still a lack of a practical curriculum system or framework of it. This results in the difficulties for teachers to grasp the methods and frameworks of philosophical analysis that guide their practice. Combining with the teaching experience, we now try to propose a curriculum system of PME for undergraduate students under the line of some recent monographs.

### THE PROPERTIES, BASIC IDEAS AND DESIGN WAYS OF THE CURRICULUM

The curriculum of PME enables students to widely and deeply examine the natures in mathematics education from the perspectives of philosophy, culture and society, including the characters of mathematics education research objects, the internal logic of mathematics educational activities and the motivation of mathematics education curriculum reformation.

The philosophy of mathematics education should aim at the guidance the development of mathematics teachers, adapting to the needs of students as well as the mathematics teachers with none foundation of philosophical knowledge, and making them familiar with the basic viewpoints and methods of mathematics education. The curriculum should guide students' combination of

theory with practice, guide students to observe, discover, independently think and explore the essential problems in mathematics education, along with erecting correct points of view of the definition of mathematics, the reason of mathematics learning and teaching, the way of mathematics teacher development, which enables students to constantly reflect on their work practices, grasp the direction, and form an optimum cycle of basic concepts of mathematics education.

The design of PME should be based primarily on the function of guiding practice. The time is limited to half a year (about 54 hours, may be distributed in 18 weeks), based on the basic principles of philosophy, to train the future mathematics teachers to review the basic knowledge, the evaluation criteria, and the reflection methods of mathematics education from a high point of view.

## **THE CONTENT AND PURPOSES OF THE CURRICULUM**

The curriculum should contain three parts by content.

### **PART I. Philosophical Foundation**

#### **The origin of philosophy, mathematics, and mathematics education**

- The rise and fall of ancient Greek civilization (make know of the basic meaning of philosophy, the origin of geometry, the influence of mathematics, philosophy and education on human civilization, realize Plato's philosophy).
- Mathematical and philosophical achievements from the Middle Ages via Newtonian era to era of analysis mathematics (know the origins of algebra, understand how science, ethics, and arts work together to promote world civilization, understand Descartes' rationalism and his mathematical ideas, realize the mathematical thoughts of the 18th and 19th centuries, know Hume's empiricism, Kant's transcendentalism and Marx's materialism).
- The characteristic of mathematics education in the 20th and 21st centuries (understand the three major branches of mathematics ontologies (logicalism, intuitionism, formalism) , know Dewey's realism, as well as the other very important persons and events in the process of mathematics education reform).

#### **The basic principles of philosophy**

- The general characteristics of philosophy (understand the characteristics of philosophical questions and philosophical thinking, the general content of philosophy, learn to philosophically think about truth, kindness, aesthetics, etc.).

- The philosophy of recognition and value (understand the principles of logical speculation, the recognition course and obstacles, the basic principles of metaphysics, realize the meaning of the cognitive value, moral value and ethical value).

### **Basic philosophy of education**

- Definition, purpose and function of education (understand different definitions of education, different representative views of educational purposes, recognize subjects and objects in education).
- The main schools of educational philosophy and the discussion of the nature and value of education (understand the new educational movement, pragmatism, reformism, elementalism, structuralism and other educational philosophy parties, correctly understand the orientation of utilitarian value and development value).

### **PART II. Philosophical properties in mathematics education**

#### **What is mathematics?**

- Mathematical Model Theory (realize the importance and diversity of mathematics definitions, the dialectical nature of mathematical development, understand mathematical ontology and mathematical epistemology of mathematical model theory, as well as the connection between mathematical model theory and mathematics teaching activities).
- Mathematical Activity Theory (understand the educational meaning of the dynamic concept of mathematics, the "knowledge component" and "conceptual component" of mathematics).
- Mathematical Culture Theory (understand the cultural concept and cultural value of mathematics, the humanistic nature of mathematics education).

#### **Why do we teach mathematics?**

- The goal of mathematics education (understand the mathematics education thoughts by Freudenthal, Polya, M. Klein, G. Klein, learn to think about mathematics from the contrast between "elite education" and "mass education", the goal of education, "three-dimensional goal" of mathematics education).
- The basic nature of mathematics education (understand the basic contradiction of mathematics education, the "age principle" of mathematics education, the theoretical basis of mathematics education curriculum reform, and the necessary integration of humanism and scientism goals in mathematics).

### **How to teach mathematics?**

- Constructivist view of learning and teaching (understand cognitive psychology, understand constructivist learning and teaching concepts, know some specific mathematics learning psychology theories).
- The concept of mathematics learning and teaching from the perspective of society and culture (understand the essence of “situational learning” and understand the role of “learning community” in the classroom).

### **PART III. Development of mathematics teachers**

#### **The rational spirit of mathematics teachers**

- “Calm thinking” of mathematics teachers (understand some basic questions that mathematics teachers should pay attention to, the mathematics teachers’ “slowly thinking”, be able to interpret the examination posts, curriculum standards and teaching materials).
- Aesthetics and self-evaluation of mathematics teachers (understand the main aesthetic standards in educational practice, the content and framework of self-evaluation from the perspective of educational evaluation).

#### **The practice of mathematics teachers**

- The professional knowledge of mathematics teachers (understand the role of “thinking” on the methods, modes and teaching abilities of mathematics teaching, and know the judgments of “good class”, “good teacher”, “good student” and “teaching effect”).
- Case study of the action of book teacher, wise man and master mathematics teacher (showing (at least 10) excellent mathematics teaching cases).

To some mathematics teachers, achievements in solving mathematics exercise simply means good class, good teacher and good student. However, the term “good” refers to truth, kindness and beauty in philosophy. In Yuxin Z’s (2015) opinion, the characteristics of a “good class” are harmonious atmosphere, enough time provided for students to think, interaction in process, full of examples and questions; a good teacher should not only give knowledge to students, but also help them to form wisdom and permeate the analysis of mathematical thinking into the specific teaching; good students have independent thinking and awareness of application, and can actively explore and cooperate in learning. The evaluation of the “teaching effect” may refer to the following items: achieving the teaching goal, students’ activity involved, the knowledge, skills and mathematical ideas increased, the positive emotional experiences.

According to Yuxin Z’s (2015) definition, a book teacher just stays on the level of teaching knowledge; a wise man can help students learn to think through mathematics and give students wisdom; if a teacher can give students an intangible cultural edification, emphasizing the

interpenetration of cultural values and mathematical knowledge content, and can think a little more philosophical thought, then he can be considered a real master mathematics teacher. An excellent mathematics teacher standing on the platform, he is the math! There should be an inner quality in him which derives from reason, wisdom and speculation.

### SUGGESTIONS FOR IMPLEMENTATION

The relationship between theory/ philosophy and classroom practice is very important. As its practical manifestation, the courses accompanied by PME may be: theory of mathematics education, research of mathematics teaching and learning, study of curriculum theory, measurement and assessment in mathematics education. Moreover, it is necessary that corresponding classroom practice be planned such as thematic discussion on educational philosophy, evaluation in modeling mathematics classis, lecturing on international mathematics curriculum.

The program of PME should be completed by teachers and students in cooperation. Teachers should use various forms of open tasks to stimulate students' research potential and use a variety of resources to help students understand the role of philosophical thinking and accumulate experience. For example, the assignments may be reading reports, or oral communicative viewpoints after reading some monographies or listening to someone teaching in mathematics classroom. The students should refer to some reading materials such as: Howard, A. & Samuel, M. (2003); Yuxin Z. (2015); Qinan, H. & Yiming, C. (2019); Shou, L. (2012); Yiming, C. & Qinan, H. & Lixia, Y. (2011); Kunru, W. (2005).

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