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The Research on the Cultivation of Education Master Students Based on Improving the Cultivation Ability of Logical Reasoning Literacy

Zezhong Yang*, Shihua Li, Yixin Wu, Kai Wang

The School of Mathematics and Statistics, Shandong Normal University, Jinan, China

Abstract

Cultivating students' logical reasoning literacy is very important in mathematics teaching. So the middle school mathematics teachers must have high logical reasoning literacy and the ability firstly. The mathematics education master students will be engaged in the work of middle school mathematics teachers in the future, therefore, universities teaching should pay attention to improving their logical reasoning literacy and the cultivation of logical reasoning literacy. In this regard, universities teaching should strengthen education master students' the knowledge, teaching methods and teaching practice of the logical reasoning literacy, so that they can adapt to the cultivation of logical reasoning literacy of middle school students in the future.

Keywords

Logical Reasoning Literacy, Mathematics Education, Master Students

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1. Introduction

Rigorousness is an important feature of mathematics, and logical reasoning literacy is one of the core qualities of mathematics for students. Cultivating students' logical reasoning literacy can enable students to have a clear and coherent thinking process in the process of mathematics learning, and every step is reasonable and well founded, so as to feel the rigor of mathematics discipline [1]. The new high school mathematics curriculum standard requires that secondary school teachers must implement these core qualities in mathematics teaching in middle schools, and the logical reasoning quality is extremely important. And cultivating students' logical reasoning literacy is also one of the goals of mathematics teaching. As mathematics education master students, it is necessary to learn how to cultivate students' logical reasoning literacy during postgraduate education. This article will study the training of mathematics education master students based on the cultivation of logical reasoning literacy.

2. The Interpretation of Basic Concept

Logical reasoning refers to starting from some facts and propositions and launching other proposition according to logic rules. It mainly includes two categories: one is from special to general reasoning, and the form of reasoning mainly has induction and analogy; the other is from general to special reasoning, and the form of reasoning is deductive. Logical reasoning is one of the core qualities of mathematics. Meanwhile it is also an important way to acquire mathematical conclusions and build mathematical systems. It is the basic guarantee of mathematical rigor and the basic thinking quality that people communicate in mathematics activities [2].

Logic reasoning literacy is not only the ability to have logical

* Corresponding author
E-mail address: zhongzee@163.com (Zezhong Yang)

reasoning, but also to master the basic forms and rules of reasoning, to find and raise questions, to explore and express the process of argument, to understand the system of propositions, to express and communicate logically. In other words, having the ability to reason logically does not represent having the literacy of logical reasoning. The literacy of logical reasoning also includes the ability to think logically，grasp the development of things and the relationship between things in more complex situations, form a heavy argument, organized, logical thinking quality and rational spirit, and enhance communication skills. In a word, logical reasoning requires not only logical reasoning, but also a comprehensive grasp of the knowledge and methods of logical reasoning, the related historical culture, and the application of logical reasoning to solve problems [3].

Ability is the comprehensive quality，which is reflected in the completion of a goal or task. It is related to people's practice. The cultivation ability of logical reasoning literacy refers to the ability to cultivate students' logical reasoning ability in teaching practice. Because the teachers' ability is different in completing this teaching activity, the students' logical reasoning literacy is different. In teaching practice, teachers teach students the ability to think from the known to the unknown, to explore new knowledge, and to infer new knowledge logically from existing knowledge by means of various teaching methods and enlarging students' knowledge, so that students can form a rigorous thinking process in mathematics learning [4].

3. The Requirement for Middle School Mathematics Teachers

In order to cultivate students' logical reasoning quality in mathematics teaching, teachers should take teachers as the dominant factor and students as the main body. In order to strengthen the cultivation of students' logical reasoning literacy, teachers are not only required to study hard, strengthen their study, and keep pace with the times, but also have the following conditions and qualities:

3.1. Teachers' Own High Logical Reasoning Literacy

In the process of reasoning and proof, teachers should obey the rules of logic strictly, have a clear and organized logical reasoning process in his mind, correctly apply the concepts and theorems he teaches [5], and make a demonstration. This has a subtle effect on the cultivation of students' logical reasoning ability [6, 7].

Teachers should improve their logical reasoning literacy constantly, keep pace with the times, attach importance to the study of mathematical journals, and expand their knowledge. At the same time, solid basic knowledge is very important to improve their logical reasoning literacy. In addition to the high school mathematics, teachers must not only have the good and fast logic reasoning ability, but also master the knowledge and methods of logic reasoning, such as what is logical reasoning thinking? What basic mathematical knowledge should be learned in logical reasoning? What are the methods of logical reasoning? It requires teachers to learn the historical culture related to logical reasoning and to enrich their cultural literacy, such as the development of logical reasoning in mathematics history. It also requires teachers to be able to use logical reasoning to solve problems. In addition, in the process of teaching knowledge, teachers must not only teach knowledge, but should fully understand the links between the various knowledge points [5], and infiltrate a knowledge point in the free status quo into the network of knowledge structure [2]. It can form an organized structure of logic so that students can grasp the essence of mathematics. Only in this way can teachers improve their abilities of logical reasoning.

3.2. The Teaching Method of Mastering a Variety of Logical Reasoning

In order to cultivate the students' logical reasoning literacy, teachers should not only master the methods of logical reasoning skilfully [8], but also learn how to teach the students their logical reasoning methods. In addition to mastering universal teaching methods of logical reasoning, teachers should also master specialized teaching methods concerning logical reasoning.

The general teaching methods include lecture, demonstration, practice, heuristic and so on. Teachers should teach basic knowledge to students by teaching logical reasoning or demonstrating logical reasoning process. In the process, teachers can help students to construct a logical framework by means of inspiring students, and students should practice consolidation in time to improve the ability of logical reasoning. When teachers adopt universal teaching methods, they also need to consider the characteristics of logical reasoning objects, students' logical thinking level and learning ability. Different students or students of different age groups will encounter different problems in the process of learning logical reasoning. Teachers must have different solutions to different logical reasoning problems [9]. Any teaching that is out of teaching is unnecessary.

On the cultivation of students' logical reasoning literacy, in addition to mastering the above teaching methods, secondary school teachers must also master other methods:

(1) Teachers should cultivate students' imagination. Logical reasoning in mathematics is closely related to imagination,

because logical reasoning requires flexible and developmental logical thinking, and developing students' imagination can greatly promote the logical reasoning of students [7]. To cultivate student's imagination, students should be required to develop a habit of understanding things in multiple angles, and to fully understand the internal and external connections between things so that students' imagination can be expanded and students' logical reasoning qualities can be cultivated.

(2) Teachers should cultivate students' rigorous logical expression skills. The ability to express logical reasoning includes not only written expression, but also language expression. The quality of language ability directly affects the development of imagination, and then influences the development of logical reasoning literacy [10]. Therefore, mathematics language and geometry language are an integral part of students' logical reasoning ability.

(3) Teachers should develop students' ability to draw pictures. Geometry is closely related to logical reasoning. Many hidden known conditions, inference materials and information are contained in the geometry. Whether the knowledge of the pattern is profound or not directly affects the solution of the problem. Therefore, teachers must require students to correctly understand pictures, draw pictures, have spatial concepts, train ideas that combine numbers and shapes [10], and be good at finding the conditions needed for logical reasoning from the graphs, thereby cultivating students' logical reasoning literacy.

3.3. Mastering the Teaching Method of Logical Reasoning Skillfully and Flexibly

For the above teaching method of logical reasoning, teachers should not only grasp firmly, but also apply them flexibly to practical teaching. When applying the above teaching methods, teachers should not only combine teaching practice but also various methods, such as the combination of lecture method, demonstration method, and heuristic method. When the teacher teaches the logical reasoning knowledge of the geometric space, the presentation method can be used to show students the spatial structure of the geometry or geometry. This method can mobilize students' observation and imagination, and make students have a deep impression on this part of the knowledge. The method of enlightenment can also be interspersed with the lectures. The formation of students' logical thinking requires teachers to be locally inspired in a timely manner. This will help students improve their logical thinking skills more quickly.

In addition, teachers need to be flexible in cultivating students' imagination, logical expression ability, and graphing ability. Teachers need to combine different methods for different mathematics objects or different students [11]. It is also possible for students to learn to express themselves, to express their knowledge and to construct the logical framework in their minds, so that the students' logical expression can be exercised.

3.4. Having a Variety of Qualities to Solve Practical Problems

In logic reasoning teaching, there are different practical problems for different mathematics content or different students. Different reasoning objects have different reasoning methods. Different logic thinking will have different reasoning processes, or different students may have different logic thinking levels, so their acceptance of logical reasoning is also different. This requires teachers to have corresponding effective solutions to different problems in the cultivation of logical reasoning literacy.

(1) Teachers must timely grasp the student's thinking, and ideological dynamics in the actual teaching process, pay attention to the student's individual differences, help students establish confidence continuously, point out and correct student's logical errors in the proof of reasoning process. At the same time, helping students to summarize the laws is also an aspect to cultivate students' logical reasoning literacy [6].

(2) Teachers should design different methods of cultivating logical reasoning literacy for different mathematics contents and different students. For example, when teaching partial theorems and rules between plane geometry and three-dimensional geometry, teachers can use analogical reasoning methods. When teaching the square formula of polynomials and the general term formula of the isometric and isometric series, teachers can use the incomplete induction method. For students with different levels of logical thinking, teachers can begin with the most basic logic knowledge. In the process of explanation, common examples in life can be interspersed to facilitate students' understanding. According to the development level of the student's thinking level, teachers can gradually increase the difficulty of logical reasoning. In this process, teachers should pay attention to teaching students in accordance with student's aptitude [12].

(3) Teachers must have a scientific approach to the cultivation of students' logical reasoning literacy. The timely and scientific investigation of teachers is very important for cultivating students' logical reasoning literacy. In this process, problems can be discovered and solved in time, and the rigorous degree of students' logical reasoning can be improved, and students' logical reasoning literacy can be better consummated. Teachers can check students' logical reasoning learning progress by

letting students do exercises in class and use life examples to examine students' logical thinking activities outside class. It also allows students to use the way they say to check the rigor of logic [13].

4. The Cultivation of Education Master Students in Universities

For logical reasoning, the mathematics education master students in universities has studied some courses in university, such as mathematical analysis, advanced algebra, abstract algebra, probability statistics, programming language design, etc. Although these courses are related to logical reasoning, these courses are far from enough to train the reasoning ability of education master students. At present, in the postgraduate period, universities also offer many courses for mathematics education master students. However, most of these courses are designed for the mathematics education master students' professional purpose. They are aimed at cultivating high-quality primary and secondary mathematics teachers who have mastered modern educational theory and have strong educational and teaching practices and research abilities, and neglecting the cultivation of the mathematics literacy of the education master students. Moreover, there is no special course to cultivate the education master students' logical reasoning quality, which leads to the lack of education master students' ability to develop logical reasoning ability.

4.1. Strengthening the Teaching of Logical Knowledge of Education Master Students in Universities

(1) Universities can offer courses in logic. For mathematics education master students, universities can set up basic theoretical courses and professional courses' such as logic research, mathematical logic, introduction to modern inductive logic, etc. Logic studies the formal structure of thinking, the laws of thinking, and some simple logic methods. In general, the basic content of ordinary logic has three aspects: First, the form of thinking includes concepts, judgments and reasoning. The structure of thinking forms mainly refers to the structure of judgments and inferences; Secondly, the basic laws of ordinary logic include the same law, the law of contradiction, and the law of exclusion; Thirdly, it is a simple logical method, such as defining, dividing, searching for the five methods of causality, etc. Logic cannot be replaced by other courses in standardizing students' way of thinking and improving their thinking ability. Learning logic not only enables students to master the core knowledge of logic, but also strengthens the rigor of the student's thinking process (concept-judgment-reasoning) and inspires the formation of students' innovative thinking. Therefore, the lesson of logic in universities will improve the logical reasoning literacy of education master students and play a significant role in improving the ability of the education master students to develop logical reasoning literacy.

(2) Universities can set up logical basis for the history of public courses. The history of logic includes the history of Chinese logic and the history of Western logic. The history of logic is mainly about the history of development of logic, that is, how logic is produced and how it has evolved into what it is now, and in the course of the development of logic, what characters have influenced its development and what masterpieces have been produced? In this regard, universities can regard the history of logic as a common class, so that education master students can have a certain understanding of the development history of logic while students are learning the professional knowledge of logic. Understanding the history of logic not only helps education master students to learn the basic knowledge of logic, but also brings vitality to the boring mechanical logic knowledge, improves education master students' interest in logic, and can deepen the memory of logic knowledge. Besides, learning history of logic also plays an important role in speculating on the direction of future logic development. Therefore, it is necessary for the university to set up a public course on logic history to improve the ability to develop the logical reasoning literacy of education master students.

4.2 Improving Education Master Students' Teaching Skills in Logic Reasoning in Universities

Teaching skills refer to the solid and complex teaching behavior system that teachers use to master the teaching theory knowledge that has been mastered through practice. It includes primary teaching skills and advanced teaching skills. As education master students, teaching skills are the necessary education and teaching skill. It plays a positive role in achieving good teaching effects and realizing teaching innovation. For mathematics education master students, the teaching skills of logical reasoning are indispensable, so universities should improve the teaching skills of logic reasoning of mathematics education master students, and further enable them to form high-level teaching skills.

(1) Universities should guide the designing skills of education master students. Designing skills include the development of teaching plans for writing lesson plans. The teaching of logical reasoning is strict and "meticulous". For every step of logical reasoning, it needs to be clear and "close together", so there is a need for detailed course planning and teaching schedule. The

guidance of universities for education master students should include these aspects: to enable them to clearly understand the basic contents of logical reasoning and the types and relationships between them, to correctly understand the position and role of logical reasoning in the overall mathematics of middle school, to formulate teaching plan of logic reasoning course in middle school mathematics according to the teaching plan and curriculum standard, and to write reasonable and reasonable teaching plans (including electronic teaching plans).

(2) Universities should guide the classroom skills of education master students. Classroom skills are the most basic skills that education master students must possess. It includes the skills of organizing teaching and importing a new lesson, questioning, teaching, writing, summarizing, etc. Teaching logical reasoning in secondary schools requires appropriate examples or situations to import a new lesson to attract students' interests in logical reasoning [14]; Proper and timely questioning in the process of learning logical reasoning will enlighten students' logical thinking and focus on the attention of students. At the end of the course, it is necessary to concisely summarize the contents of logical reasoning, highlight key points, etc [15].

(3) Universities should guide the research skills of education master students' logical reasoning. The research skills of logical reasoning include grasping the basic methods of teaching research, understanding the development of logical reasoning, drawing on scientific research results, and retrieving information on logical reasoning, etc. And these skills can be learned by researching and writing papers on logical reasoning. In this regard, universities should focus on guiding the education master students how to write research papers on logical reasoning. Through this process of writing a thesis, the education master students can not only master the basic methods of teaching research, but also understand the new scientific and technological achievements of logical reasoning in the process of retrieving information, and then update the teaching contents according to the actual situation of the students. At the same time, writing papers can also train the ability of the education master students to independently study logical reasoning literacy.

4.3. Expanding the Way of Teaching Practice and Innovating Cultivating Mode in Universities

In universities, the cultivation of education master students attaches great importance to the practical ability of them. In mathematics, the ability to cultivate logical reasoning literacy is especially emphasized. For this reason, universities have carried out various mathematics teaching practice activities. However, there are some problems in the actual cultivating process. For example, the part of the education master students have low research academic levels, that is, the logic knowledge is not firmly grasped and cannot produce high-level research results. And some education master students are not enthusiastic about improving their mathematics teaching practice. So, they spend less time and energy on logical reasoning and literacy training. The evaluation mechanism of mathematics teaching practice ability is not perfect. The existence of some problems is difficult to guarantee the training of education master students in teaching practice ability.

Therefore, universities should expand teaching practices and innovate modes. In addition to past teaching and practice activities, such as "internships, trial lectures, lectures, teaching assistants, teaching observations, teaching management, teaching and scientific research," etc, universities can also introduce new training models, such as "competition teaching system". The "competition teaching system" is a kind of practice teaching organization form, which introduces the normal classroom teaching competition of primary and middle schools into the training link of the education master's teaching practice, improves the ability, rethinks the teaching and adjusts the teaching elements in the process of educational practice through the actual situation of the industry, and adjusts the teaching elements in the process of educational practice so as to meet the needs of the teacher's professional development [16]. The education master students' logical reasoning literacy cultivating abilities needs to be exercised in the real middle school mathematics class' and finds out the practical problems in the logical reasoning of middle school students, so that the ability of cultivating students' logical reasoning literacy will be improved.

5. Conclusion

All in all, mathematics is a rigorous discipline, and logical reasoning is very important for learning mathematics. As education master students, it is necessary to adapt to the cultivation of logical reasoning literacy for middle school students in the future, and universities should strengthen the guidance of all aspects of education master students. For example, universities should strengthen the teaching of the basic knowledge of logical reasoning, open courses related to logic, guide the teaching skills of the logical reasoning of education master students, expand the teaching practice, and fully cultivate education master students logic reasoning practical teaching ability.

Universities should apply these cultivating measures to education master students' study courses, set up corresponding course activities, mobilize the enthusiasm of education master students, encourage them to take the initiative to participate in teaching practice activities, and constantly improve the ability of education master students to cultivate logical reasoning literacy, so that education master students can adapt to the teaching of mathematics in the future.

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References

[1] Yu J. (2016). How to Cultivate Students' Logical Reasoning Ability in Junior High School Mathematics Teaching. *Secondary School Teaching Reference*, 08 (35), 38-39.

[2] Chen C. (2016). Research on the Improvement of Logical Reasoning Ability of Mathematical Core Literacy. *Friend of Mathematics*, 30 (04), 14-16.

[3] Long Y. (2017). Strategies for Improving Logical Reasoning Quality of Senior High School Students. *Hunan University of Science and Technology*.

[4] Chen Y. M. and Meng W. J. (2000). Investigation and Research on the Current Situation of Graduate Students' Logical Reasoning Ability. *Journal of Beijing University of Aeronautics and Astronautics (Social Science Edition)*, 13 (03), 55-57.

[5] Xia J. H. (2000). On How to Cultivate Students' Logical Reasoning Ability. *Journal of Hulunbeier University*, 08 (01), 105-106+68.

[6] Hou S. Q. (2015). How to Develop Students' Logical Reasoning Ability in Mathematics Teaching. *Intelligence*, 15 (32), 173.

[7] Li J. X. (2008). Research on Developing Students' Ability of Reasoning and Reasoning in High School Mathematics Teaching. *Huazhong Normal University*.

[8] Yang J. F. and Yang J. X. (1962). On Strengthening Logical Reasoning Factors in Middle School Mathematics Teaching. *Mathematical Bulletin*, 27 (09), 7-11.

[9] Chen M. R. (2014). Strategies for Cultivating Students' Logical Reasoning Ability in High School Mathematics Learning. *Mathematics Learning and Research*, 32 (01), 34.

[10] Chen Y. J. (2018). Taking Students as the Foundation, Cultivating Mathematical Logic Reasoning Ability. *Middle School Mathematics (High School Edition) in the First Half of the Month*, 40 (02), 48-49.

[11] Hua X. P. (2017). On Strategies for Developing Students' Mathematical Logic Reasoning Ability. *Secondary School Curriculum Tutoring (Teacher Education)*, 34 (11), 63.

[12] Gu W. S., (2012). On Strategies for Developing Students' Logical Reasoning Ability in Mathematics Teaching. *Mathematical Learning*, 06 (10), 84.

[13] Hou W. M. (2010). How to Cultivate Students' Mathematical Logic Reasoning Ability in Teaching. *Mathematics World (Teacher's Application)*, 01 (09), 25.

[14] Chang L. and Bao J. S. (2017). Mathematics Core Literacy from a Situational Perspective. *Journal of Mathematics Education*, 26 (02), 24-28.

[15] Yang B. R. (2017). Using the Pearl Necklace Method to Develop Logical Reasoning Literacy. *Secondary School Mathematics Teaching Reference*, 46 (32), 35-37.

[16] Xie B. L. Chen B. and Xie Z. Y. (2017). "Competition Teaching System" and Cultivation of Teaching Practice Ability for Full-time Master Graduate Students. *Academic Degrees & Graduate Education*, 34 (10), 10-15.