

# Research on Cultivation of Education Master Candidates Based on Intuitive Imagination Training

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## Abstract

As one of the six core qualities in mathematics subject, the intuitive imagination quality could help to develop students' geometric intuition and space imagination. Teachers should cultivate students' intuitive imagination quality in a targeted and efficient way. Therefore, universities need to teach education master candidates the knowledge and the teaching methods of intuitive imagination quality and improve teaching practice ability of education master candidates through school training, internship and practice in out of school education. At the same time, universities need to pay attention to cultivate their research ability and other qualities, so that they can be better qualified for the future teachers' work.

## Keywords

Mathematics, Education Master Candidates, Intuitive Imagination

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## 1. Introduction

The key to the revision of *General High School Mathematics Curriculum Standards* in 2017 is to implement the core quality of mathematics subject. The core quality of mathematics includes six aspects: mathematical abstraction, logical reasoning, mathematical modeling, intuitive imagination, mathematical operation and data analysis [1]. Intuitive imagination, which could help students understand the connection between algebra and geometry better, is a new requirement for mathematics teachers to cultivate the core quality of academic imagination. It is necessary for teachers to transform them in school education. Teachers are the key role in training students' core quality, so teachers themselves should have these core qualities and have ability to train students. Therefore, in the training of education master candidates, universities should consider and study how to improve the core quality of education master candidates.

## 2. Basic Conceptual Interpretation

### 2.1. Intuitive Imagination

Intuition imagination refers to the process of understanding and solving mathematical problems with graphics by means of geometric intuition and spatial imagination. It mainly includes: understanding the position relations, morphological changes and movement rules of things with the help of spatial form, describing and analyzing the mathematical problems by using graphics, establishing the relation between shape and number, constructing the intuitive model of mathematical problems, and exploring ideas to solve problems [1].

### 2.2. Intuitive Imagination Quality

Intuitive imagination quality refers to mastering the

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knowledge of geometric intuition and space imagination in the field of mathematics, understanding the history of the development of geometry and the culture of mathematics, having a good spatial imagination, it can accurately depict the related geometric figures in the mind, and can simultaneously restore the spatial stenographer according to the fast speed of the image, mastering various ways of observing, analyzing and plotting graphics, using graphics to describe and analyze problems in mathematics and other fields.

### **2.3. Intuition Imagination Quality Training Ability**

In the high school mathematics classroom, the ability of intuitive quality training means that teachers can develop students' spatial imagination by using demonstrations such as intuitive teaching tools and models, so as to develop students' ability to understand and describe geometric figures. On the basis of graphics, teachers can cultivate students to understand and explore geometric properties through the course of drawing and operation. And encourage students to establish connections between numbers and shapes and explore their ability to solve problems. So that students can gradually form the correct values and the intuitive imagination of the necessary character and key ability.

## **3. Requirements for Middle School Mathematics Teachers**

### **3.1. The Ability of Intuitive Imagination for Middle School Mathematics Teachers**

#### **3.1.1. Providing Intuitive Aids and Models to Accumulate the Representation of Spatial Graphics**

Intuitive perception is the premise and basis for the accurate judgment of the structure and relationship of geometric figures. During class, teachers should provide a variety of intuitive teaching aids, model or dynamic three-dimensional geometry courseware, and guide students to observe various basic graphics. By cultivating the students' ability of drawing maps and help students to apply the nature of the standard graphics in the same type of graphics as it is, students can intuitively and accurately summarize the nature of mathematical objects. In addition, teachers should guide students to make reasonable conjecture on geometry problems. Reasonable conjecture can stimulate students' intuitive thinking, and teachers should pay enough attention to students' conjecture [2].

The teacher guides the students to understand the intuitive

representation through the teaching aids and the model. Then they can guide the students to abstract the geometric features from the intuitive representation, clarify the quantitative relationship between things and apply the imagery to solve the related problems flexibly [3].

#### **3.1.2. Deepen Students' Perceptual Knowledge by Making Mathematical Drawing and Operation**

Geometry learning has to be constructed by students in active activities. Teachers should give students the opportunity to practice and operation. In the experiment activities such as measurement and drawing, they should exercise the students' ability to observe the graphics from different angles and accumulate images of space graphics through various senses [4]. Teachers can also instruct students to make space geometry models manually, so that students can include the structural characteristics of geometric bodies [5]. The mathematical operation, it not only trains the students' hands-on ability, deepens the students' perceptual knowledge, but also establishes the practical foundation for the understanding of the complex graphics, and reduces the difficulty of the abstract.

#### **3.1.3. Cultivating Students' Awareness of the Combination of Numbers and Shapes**

Spatial imagination includes reconstruction of graphics, decomposition of graphics, reorganization of graphics, and the ability to view the perspective of planar graphics [3]. Through the teaching of high school mathematics curriculum, teachers should strengthen the students' combination of number and shape, help students to carry out speculative argument and measure calculation, at the same time cultivate the students' ability to describe the real world with graphics and symbols [5].

At the same time, teachers should pay more attention to the mutual conversion between graphic language, symbolic language and literal language. During mathematics teaching, it is necessary to increase communication with students in the use of mathematical language [4]. Teachers should pay attention to cultivating students' communication skills and make use of mathematics to intuitively explain and communicate the concepts of mathematics, conclusions, applications, and methods of thinking.

### **3.2. Teachers' Necessary Conditions and Qualities**

In order to reach the requirement of mathematics teachers' intuitive imagination in middle school, teachers should have higher intuitive imagination quality at first. For instance, teachers can master diverse teaching methods of geometry

intuition and spatial imagination teaching. They can be proficient in establishing the relation between the shape and number and constructing an intuitive model of mathematical problems. Teachers can also grasp diversified solutions to students' problems in learning process.

### 3.2.1. Having Higher Intuitive Imagination Qualities

Teachers should have extraordinary intuitive quality. First of all, Teachers attempt to master the knowledge of geometric intuition and space imagination in the field of mathematics. Teachers should collect, read the historical data of the development of geometry, understand the process of the development of geometry, the important results, the main figures, the key things and the contribution to the human civilization. This can accumulate the mathematics knowledge about culture and history [1].

Teachers should have a great space imagination. They can show the corresponding spatial geometric figures in the brain according to the language and symbols expressed in geometric forms. And they can correctly imagine intuitive drawings, clear the shape, position and quantity relations of the geometric forms and components of the intuitive drawings. The geometric form could be decomposed and combined in teachers' mind to form new space geometry.

Geometric intuition is built on graphics. Teachers should be able to standardize mathematical drawing and use correct teaching aids such as rulers and compasses. Teachers should also master basic drawing software, skilled in their operation process, and can present many images and graphics, solve geometric transformation and dynamic problems.

### 3.2.2. Having Method of Cultivating Intuitive Quality

Teachers should master a variety of teaching methods in the teaching of geometric intuition and space imagination. They should also master the methods to guide students' learning to cultivate the consciousness and methods of the students' drawing and realize the goal of cultivating the students' core quality in the teaching.

In geometry teaching, teachers should promote intuitive demonstration teaching and guide students to master the method of observing simple geometry. After the intuitive demonstration has obtained the clear representation of the space figure, the teacher should have the method to guide the students to carry on the practical operation, such as the concrete steps of realizing the goal through the measurement, drawing, paper cutting, paper cutting, paper folding and the operation of teaching software.

Teachers should also systematically teach the solution to the problem of geometric types, and guide students to learn how

to add and use auxiliary lines and construct graphics according to change conditions. When students face geometric problems without graphics or algebraic problems which can be solved by geometry, teachers should guide them in time to form drawings to analyze and solve problems and combine the abstract mathematical language with the intuitive graphics. Reducing abstraction of thinking through graphically can make the problem more intuitive, and it gradually improves students' ability of reading, drawing and analyzing graphics [2].

### 3.2.3. Using Intuitive Imagination to Solve Problems Adroitly

Teachers have good intuitive quality could solve the following problems in Mathematics teaching: using the characteristics of columns, cones, platforms, balls and simple combinations to describe the structure of simple objects in real life and solve simple practical problems, using intuitive imagination to establish the theory of isometric transformation between plane and space. Combined with linear algebra and the geometry of space geometry, it can explore the essence of the problem and its relation to mathematics. In the practical situation, it can express complex mathematical problems through imagination, grasp the essence of mathematical problems and form the thinking of the problems [1].

Teachers cannot only skillfully apply intuitive imagination to solve mathematical problems, but also solve problems in other fields. For example, it can accurately perceive spatial orientation, it can utilize perspective drawing to describe objects in painting, it can assist engineering drawing, architectural design, physics and so on for three-dimensional modeling and display space objects on the plane.

### 3.2.4. Evaluating and Improving the Problems of Intuitive Imagination

Teachers should have scientific methods of examination and teaching evaluation, pay attention to the achievement of students' mathematical core quality. Teachers can effectively cope with students' problems in teaching and deal with the influence factors outside the teaching.

In the way of examination, teachers should be able to judge students' intuitive imagination accomplishment by three dimensions and their different aspects according to their scholarly quality [6]. It is necessary to innovate the form and method of evaluation and integrate the evaluation of knowledge and skill with evaluation of the core accomplishment of mathematics subject.

Teachers should know the problems that students may appear in teaching, such as lack of comprehensive observation, neglecting the main features of graphics, poor hands-on

operation, drawing no graphics, irregular graphics or false and real line drawing, errors in graphic modification, lack of conversion ability of intuitive and real graphics, the enthusiasm of learning geometry is not high and so on. In the design of teaching, teachers should prepare adequate teaching strategies to address problems. In practical teaching, we should concern about students' feedback and correct students' mistakes in time.

## 4. Training for Education Master Candidates in Universities.

### 4.1. Teaching the Knowledge of Intuitive Imagination

At present, the major courses for master of mathematics education in universities are as follows: mathematics curriculum and teaching materials analysis, education measurement and evaluation, the development and management of mathematics curriculum resources, basic theory of mathematics learning, the design and implementation of mathematics teaching and so on, which are less involved in the specific knowledge module of core quality. Universities should also strengthen the teaching in aspect of analytic geometry, higher geometry, differential geometry, elementary geometry, geometric foundation and topology, and introduce the related software of auxiliary teaching to help the education master candidates improve the ability of intuitive imagination.

#### 4.1.1. The Mathematical Knowledge of Intuitive Imagination Quality

In order to cultivate and improve the core quality of the education master candidates, universities should carry out elementary geometry teaching, so that the education master candidates can link the middle school mathematics with the higher mathematics closely. From two aspects of theory and practice, the plane geometry and geometry of middle school are widened and deepened. It not only enables the education master candidates to grasp the system and vein of the various branches of elementary mathematics, but also analyze the basic concepts and problems of elementary mathematics by using the modern mathematical viewpoint, and deal with the problems of mathematics teaching in middle schools [7].

Higher geometry is an extension of elementary geometry, and the two are closely connected. Through the teaching of higher geometry, universities guide the education master candidates to study prospective geometry, affined geometry and Euclidean geometry, understand the concept of geometric space, deepen the understanding of the axiomatic method,

discover the relationship between various geometry, and improve the ability to analyze and solve geometric problems [8]. It also provides a solution to some problems of elementary geometry, which helps the education master candidates to deal with the problems of middle school geometry from a higher point of view and to deepen the understanding of the theory and methods of middle school geometry.

*The Selected history of mathematics* has been added into the elective course of general high school mathematics. Therefore, universities should also improve the cultural quality of the education master candidates and explore the knowledge of intuitive imagination in the history of mathematics. Universities could guide education master candidates read famous mathematics books from ancient to modern times, such as Euclid's *geometric original*, Descartes's *geometry*, and so on. And they can understand the origin and development of mathematical knowledge.

#### 4.1.2. Teaching Software for Mathematics

In information-based classroom, universities should teach some teaching software operations to assist the education master candidates to solve the problems that cannot be displayed in the traditional classroom.

Education master candidates need to master special mathematical software, mainly including Geometer's Sketchpad, Super Sketchpad, GeoGebra and so on. After introducing the basic tool operation methods, college teachers should instruct some geometric operation knowledge related to middle school. Such as, construct and expand the application of basic graphics, list the common problems of moving points, moving lines and dynamic problems. The intuitive model of mathematical problems in geometric drawing cannot only study the steady state of geometric figures, but also study the dynamic changes of geometric figures.

### 4.2. The Teaching Method for the Training of Education Master Candidates

After education master candidates master the basic knowledge needed for instinctive quality, universities should guide the concrete implementation of the teaching methods to education master candidates in the classroom, so as to establish the organic connection between the content of teaching and teachers and students to achieve the goal of teaching.

#### 4.2.1. Method of Intuitive Demonstration and Observation

Intuitive teaching tools and models are the main tools to cultivate intuitive quality. Therefore, universities should

guide education master candidates to use intuitive demonstration method in teaching, so that students can get perceptual knowledge through observation and understand abstract mathematical knowledge. In intuitive demonstration, it is usually combined with mathematical observation. Universities should teach the characteristics of the observation method, the common observation methods (such as classification observation, from general to special, from special to general, contrast observation, etc.), and then to master the general observation steps [9].

#### 4.2.2. Method of Experimental Operation and Heuristic

After education master candidates have obtained the clear representation of the space graphics through the intuitive demonstration, the university should guide their do actual operational activities. It can set up the practical foundation for the understanding of the complex graphics and reduce the difficulty of the abstract in the activity.

The experimental operation of intuitive imagination mainly includes measurement, drawing, paper cutting, origami, operation teaching software and so on. Universities should guide education master candidates to make clear steps in the operation of mathematical experiments, including determining the purpose of the experiment, preparing the materials needed, mastering the methods applied by the experiment, and controlling the operation process of the experiment [10]. Universities should also enlighten the education master candidates to find out the mistakes or unnecessary actions in the operation and analyze the reasons. So, they can learn how to effectively handle the problems in the operation and make the correct operation.

#### 4.3. Fostering Education Master Candidates' Practice Ability

After education master candidates master theoretical knowledge and teaching skills, universities need to improve the diversified forms of teaching practice, which is a vital link to link the dual identity of teachers and students. Universities should set up practical training course and carry out teaching practice in schools and arrange internship and practice in out-of-school education.

##### 4.3.1. School Training

The actual training in the school is mainly to carry on the simulation teaching, the college teachers should guide the geometric intuition teaching of the education master candidates, including the design of teaching, the skills of teaching, and the teaching methods adopted. When the education master candidates carry on the demonstration teaching, firstly, they need to clear the purpose of the teaching, to ensure that students can clearly perceive the

useful characteristics and relationships of demonstrable objects [11]. Secondly, in the process of demonstration, tutors should guide the education master candidates to combine the explanation method and the conversation method at the same time, to focus the attention of the students on the structural characteristics of the object which could not be disturbed by other factors. Thirdly, universities should cultivate education master candidates have the consciousness of finding inner, hidden structure and relationship characteristics while guiding students to observe. Finally, university should guide education master candidates to concern about the demonstration function and the standard language of the mathematics teaching in the demonstration, and analyze the relation between the line, surface and angle in the drawing process. Besides education master candidates should emphasize the mutual conversion among graphic language, symbolic language, and literal language, so that the demo things and learning knowledge are closely combined [12].

In the simulation of the experimental operation course because the intuitive imagination relies on the students to imagine and construct the space graphics, the university teachers can guide the education master candidates to learn the teaching mode of flipped classroom and let the education master candidates realize the idea of the students as the main body. First of all, education master candidates set up experimental operations in advance, such as requiring the use of rules to make target graphics, developing their practical operation ability and creativity. Secondly, the class asks other education master candidates to do the demonstration in class, so that they can understand the location relationship between lines and planes in the drawing process. Once again, education master candidate leads all the students to analyze the demonstration, inspire and guide the possible mistakes and reasons of education master candidates, and find ways to solve the problems. Finally, emphasize the correct operation method, and explain the drawing principle.

##### 4.3.2. Internship and Practice in Out-of-School Education

The double tutor system is commonly used in universities, both the tutors in school and the tutors outside can guide education master candidates. Tutors can lead education master candidates be familiar with the working environment of the secondary school teachers and take part in them to supplement the lack of practical knowledge and deepen the understanding of the core quality.

The tutor should guide the education master candidates to participate in class preparation, lecture, correction and so on, and provide the education master candidates opportunities to find problems and deal with problems in secondary school. Education master candidates should learn to choose the

appropriate problem situation to introduce the geometric knowledge before the class and try to know and record the students' intuitive quality level in classroom observation and take a targeted approach to develop students' spatial imagination and intuitive ability in class [13]. So, education master candidates can summarize and classify the problems of the students' geometric appearance by correcting the homework after class. If necessary, they can take a class communication or interview to explore the reasons why students have difficulty in learning geometry and lack of imagination.

#### **4.4. The Cultivation of the Ability of Research for Education Master Candidates in Universities**

The improvement of the core quality of the education master candidates cannot be separated from the rich practical experience, but the education master candidates also needs to have ability of education research, research ability and other aspects of accomplishment, so that we can get rid of narrow experience and avoid simple and repetitive work.

##### **4.4.1. The Ability of Education Research**

Universities should enhance education master candidates' understanding of scientific research, and this is the key to transform teachers from experienced teachers to expert teachers in educational research. Universities should still cultivate the education master candidates to be good at discovering the intuitive imagination problems in the teaching and the problems during students' learning, and we should be good at learning teaching experience from the other teachers [1]. Universities should hold academic lectures on intuitive quality. On the one hand, tours are encouraged and invited to set up academic lectures. On the other hand, experts and scholars from outside schools are invited to give lectures, so that education master candidates can obtain the development of students' intuitive imagination [9].

Universities should set up the course of the research method of Education Science and in the form of case teaching. Education master candidates can analyze students' problems in the cultivation of intuitive imagination from the case: the lack of comprehensive observation, the poor hands-on operation ability, the drawing out of the graphics, the imaginary and real lines of the drawing, the error of the graphic modification and the lack of intuitive drawings. Education master candidates can investigate the causes of problems through school-based teaching and research, learning and discussion, and consulting periodicals, and try to put forward countermeasures to solve the problems. In this process, universities can cultivate the ability of education master candidates to innovate, think independently and cooperate with others.

##### **4.4.2. The Ability of Subject Research**

Subject research is the process of using scientific research methods to explore the objective rule of schooling. Teachers' quality of education and teaching would improve through mastering the rule of education. Universities should make research activities for students and encourage students to put forward or participate in the research topics of intuitive quality [9]. Universities also need to provide financially supporting and tutor guidance for students [9].

Universities should attach importance to the training of subject research, guide the education master candidates how to formulate research projects, grasp the most advanced academic achievements and trends of intuitive quality after the publication of *General High School Mathematics Curriculum Standards*, analyze the influence brought by the changes, and make up the difference between the original curriculum knowledge and the latest research [14]. The research topics include the goal and direction of the study of intuitive imagination, the research ideas and methods for intuitive imagination, the hypothesis of research and the design of the research. Universities organize students to carry out research on intuitive imaginary subjects. After summarizing the subject, the research process was organized into papers. Through professional assessment, universities make amendments to students' papers. In this process, we can also cultivate the ability of education master candidates to collect information and develop information, and to express and write.

##### **4.4.3. Other Abilities or Qualities**

The cultivation of education master candidates in universities should not be limited in the professional fields. It is necessary to help education master candidates improve their other abilities and qualities [15]. Firstly, universities should cultivate the patience of the education master candidates, so that they can pay attention to students' different intuitive imagination literacy level and put forward targeted counseling programs for the existing problems and be able to instruct patiently and teach students in accordance with their aptitude. Secondly, universities should cultivate the good learning habits of the education master candidates, make them have the concept of active learning and lifelong learning. Education master candidates can continue to learn and use new techniques and tools to improve the teaching content and teaching methods of intuitive imagination in the information age [16]. Lastly, Universities must cultivate education master candidates to have the awareness of self-improvement, form the ability to analyze and solve problems, and constantly improve their theoretical level and scientific research ability.

## 5. Concluding Remarks

In order to make the teachers carry out the core accomplishment of mathematics subject in the senior school mathematics teaching, the university should guide the education master candidates to clear the requirements of the teachers, and the conditions and qualities of their own, and thus they will know how to cultivate the students better in the teaching. Specifically, during the postgraduate period, universities help the education master candidates master the systemic knowledge of intuitive quality and introduce auxiliary teaching software. On the basis of mastering knowledge, universities instruct the education master candidates the corresponding methods of teaching. In practice, it helps the education master candidates to further leak out the vacancy and improve the training ability of intuitive imaginarity accomplishment. In addition, universities should pay more attention to training the scientific research ability and other qualities of them. So education master candidates would realize the relative consistency between the training of teachers' accomplishment and the development of the core quality of the students after obtaining comprehensive development, that they can be better qualified for the future teachers' work.

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