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A Research of the Influence of Teaching Understanding of Solid Geometry on Mathematics Teaching

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The study found that teachers' understanding of the educational value of solid geometry tends to affect mathematics teaching, especially in the teaching goal orientation and in the teaching process. Therefore, in order to achieve effective teaching that reflects the nature of mathematics, teachers need to improve their mathematics culture, the level of teaching understanding，and math teaching ability.

***Key words**:* geometrical intuition, spatial perception, logic reasoning, geometry teaching

Introduction

It is a worthy problem to research how mathematics teachers understand the mathematics content and characters in middle school and primary school, how they recognize the value of mathematics education and what level of this content will influence mathematics education. This paper sets forth the Theorem Assessment of Parallel Line and Plane as an example of how to study teaching knowledge of Solid Geometry and how it influences teaching objectives and processes.

The research content is as follows: Firstly, how do mathematics teachers recognize the teaching value of solid geometry? How do teachers treat space concept, geometric intuition and logical reasoning? Secondly, what is the key point of teaching objectives and process in the teaching practice of solid geometry? Finally, how does the teachers' knowledge of educational values of solid geometry influence solid geometry teaching? To what kind of level will the influence be?

Method

Study Design

This study selected Theorem Assessment of Parallel Line and Plane as a carrier. First, materials related to the theorem in the existing textbook were displayed, including the three parts of introduction of context, theorem

statements and examples and exercises. Then, three questions were raised to be answered by research subjects, that is, they were asked to talk about the value of solid geometry in high school teaching, describe the teaching objectives of this section, and specify the teaching process.

Sample Description

Research subjects are masters of education in the Institute of Mathematical Sciences, NJ University, which come from star high schools around JS Province，and have rich teaching experiences. Sixty questionnaires were released, and 57 valid questionnaires were gained, and the response rate was 95%.

Data Processing

This study selects three areas of concern (knowledge of the value of solid geometry teaching, teaching goals and teaching process), and the data results of the questionnaire were collected by "keyword search", "semantic matching", "meaning reasoning". Sub-division items were coded by levels, and statistical software SPSS 16.0 for Windows was used to accomplish statistical analysis.

Results

This study subdivided the issues concerned into 4 sub-problems, that is, mathematics teachers' knowledge of the educational value of solid geometry in high school, the proof of the theorem, the location of theorem's teaching objectives and teaching design of theorem, and the impact of the first the item on the latter two. Detailed code analysis and statistical analysis results are listed following.

Teachers' Knowledge

Table 1

Math Teachers' Knowledge of the Educational Value of Solid Geometry

Educational value	Example	Percentage	Differences
perce	0 ·Research intuition images and three-view images, teach to read and draw images	21.1%	
	1 ·Enhance the understanding of space and	75.4%	

	graphics, understand human living space better		p = 0.120
	·Train spatial concept and spatial imagination		
	2 ·Use physical objectives for observation, operation by hands, image description, think and reasoning to experience the practical meaning of spatial reasoning and graphics	3.5%	
	·Start from space and graphics to understand the position relations of graphics in space		
Geometric intuition	0 ·Understand problems by visualization of space		
	·Transform solid geometric problems into plane geometry problem so as to study then	66.7%	
	1 ·Sense intuitively, operate to identify		
	·Develop the ability of geometrical intuition	29.8%	
	2 ·Understand problems with the help of the graphics		
	·Set cuboids as carriers to understand the location relationship of point, line, surface and body, especially the parallel and perpendicular	3.5%	
	0 ·Calculate volume and area, and prove	31.6%	
	1 ·Develop logical reasoning skills and rigorous proof ability	59.6%	
	2 ·Do logic reasoning with graphics, and write prove process		
Logic Reasoning	·Calculate with the nature of proof, compute as to prove	7.0%	
	3 ·From the obtainment of theorem, the establishment of concept, develop logical thinking and reasoning ability		
	·Strict language expression of the location relationship of point, line, surface and body, and attend to the conclusion's logical proof	1.8%	

Mathematics teachers' knowledge of the educational value of solid geometry mostly comes from the Mathematics Curriculum Standards, and they have only vague concepts, without a clear understanding of the specific

meaning and the teaching requirements. Moreover, teachers consider that students should be trained with spatial ideas and geometric intuition in the solid geometry teaching process, and that students' development of logical reasoning is not that important.

Location of Teaching

Table 2

Math Teachers' Teaching Objectives of the Theorem Assessment

objectives	Examples	Percentage	Differences test
Visual image	0 ·No hint, or not mentioned	45.6%	
	1 ·Introduce line and plane parallel with everyday examples ·Find decision theorem with life examples and graphics	38.8%	
	2 ·Feel decision theorem intuitively with multimedia presentations and objects in classrooms	17.5%	
Rigorous logic	0 ·No hint, or not mentioned	64,9%	χ^2 =28.155, df = 4, p <0.001,
	1 ·Draw graphics to prove the theorem ·Clearly articulate the proof process	19.3%	
	2 ·Develop proven ability of solid geometry ·Be familiar with and understand the ideas and the process of reduction to absurdity	15.8%	

It is obvious from teaching orientation that nearly half of the teachers do not realize that the teaching of geometry should qualify students with intuitive ability and logical reasoning. Meanwhile, most teachers do not realize that students should be trained to learn critical thinking and logical reasoning ability in geometry. Some teachers only have a vague understanding of these two，but they have no clear understanding of how to guide students to discover and prove.

Teaching Process

Table 3

Math Teachers' Teaching Process of the Theorem Proof

Teaching orientation	Scoring Rules	Percentage
Visual image	0 ·No graphics, or involve a limited graphic display	45.6%
	1 ·Basic geometry shapes (basically the same as questionnaire's)	15.8%
	2 ·Adds some graphics, and refer to specific examples of life	38.6%
Theorem assessment	0 ·Do not prove, but provide only an intuitive explanation	50.9%
	2 ·Use only one way to prove, with no analysis	38.6%
	3 ·Use only one way to prove, but with guidance of analysis	5.3%
	4 ·Prove flexibly, in several ways	5.3%
Rigorous exercise	0 ·Use examples imitating these on the questionnaires, with simple answers	64.9%
	1 ·Use examples on a questionnaire, with rigorous solution processes	8.8%
	2 ·Add some proof practices (with examples variant.)	24.3%

Mathematics teachers mainly use the examples from the textbook to introduce the decision theorem, reflecting that the teachers usually stick to the textbooks, and seldom guide students to link real-life to math and to discover mathematical conclusions and establish mathematical concepts. Many teachers are not concerned about the generation and proof of the theorem, which to some extent reflects that teachers only concern with the formal training in problem solving, rather than the theorem's role to develop thought and improve knowledge level.

Influence to Teaching

In order to study the influence of a teachers' mathematics training on their teaching, a chi-square test was conducted of the former item and later two items. In the context of clear correlation, correlation analyses were carried out to check the influence. Results follow.

Table 4
Influence on Teaching by Understanding

Correlation tests		Orientation of Teaching objective		Ideas of Teaching design		
		Intuitionist perception	Reasoning proof	Geometrical intuition	Theorem proof	Rigorous exercise
Understanding of educational value of solid geometry	Spatial perception	0.039*	0.509	0.435	0.318	0.530
	Geometric intuition	0.681	0.068	0.022*	0.163	0.455
	Logic reasoning	0.008**	0.157	0.582	0.000***	0.038*

Note: * indicates significant correlation, ** indicates a very significant correlation, *** indicates a extreme significant correlation.

Logic reasoning has a significant affect on teaching design, therefore teaching mainly focuses on logic reasoning and pays attention to the proof of the theorem and chooses the appropriate consolidation exercises. This shows that teachers with a strong ability of geometric proof focuses on the logical reasoning teaching, while the weak ones' teaching focuses on geometric intuition. The understanding of the teaching value of any intuitive understanding, space concept of solid geometry and geometric visual capacity, has little effect on the teaching of geometric proof of Proposition. Rigor features of geometry and the view that solid geometry develops logical thinking ability determine the teaching of the theorem proof significantly.

Discussion and Conclusion

The statistical data shows that the teachers with the view that solid geometry focuses on training students with geometric visual capacity and the development of geometric concept focus on the intuitionist interpretation of the decision theorem and strengthen intuitive teaching. It also shows that the teachers with the understanding that the educational value of solid geometry is to develop logical reasoning ability emphasize the strict proof of the theorem and organize proof problems for teaching. These phenomena show that a teachers' understanding of the educational value of mathematics and mathematics knowledge teaching influences their math teaching remarkably.

Teachers' mathematics concepts, mathematical ability, mathematical cognition and understanding of the educational value of mathematics affects their mathematics teaching,。The teachers' selection of teaching content and

teaching activities, the interaction between teachers and students, choice of evaluation methods, and teachers' thinking habits demonstrated the influence among the students by their teachers, and the attitude shown by teachers, intentionally and unintentionally, will all affect students' access to knowledge, improvement of their ability to understand, their intellectual development and the formation of various concepts（National Research Council，1995）.

It can be seen that mathematics teachers' culture must be optimized and improved in order to optimize and improve act of teaching. Therefore, mathematics teachers must improve their own mathematics training to carry out high-quality mathematics teaching, namely to improve the understanding of the mathematical nature and characteristics, to improve understanding of the value of mathematics education, to improve their mathematics level and optimize the structure of mathematical knowledge, to improve the students' ability to comprehend mathematical thinking.

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