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A Study on the Consistency of Primary School Mathematics Teacher's Beliefs and Teaching Behavior

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With the gradual advancement of education reforms all over the world, teacher's beliefs and teaching behavior have gradually become two tasks essential for improving teaching practice and teacher education. The requirement for teachers to update teacher's beliefs and improve teaching methods have become increasingly prominent. With the purpose to give subtly supplement to the research into the beliefs of primary school mathematics teachers, and provide a certain theoretical reference for research related to the relationship between the beliefs of primary school mathematics teachers and their teaching behavior. This study used mixed method, such as interviews and case studies combined with questionnaire survey result, analyzed the beliefs and teaching behavior of 84 elementary school mathematics teachers from 12 cities in mainland of China and three case study teachers. This research offers solutions to the following issues: The belief that elementary school mathematics teachers hold at this stage, the consistency between teacher's beliefs and teaching behavior; and the cause of inconsistency between teacher's beliefs and teaching behavior. The main conclusions are as follows: espoused beliefs tend to be a positive modern; and consistency and inconsistency coexist in elementary school mathematics teacher's beliefs and teaching behavior. We should pay more attention to the individual needs of each teacher and carry out targeted training to achieve the essential internalization of teachers' deep teacher belief.

Keywords: teaching behavior, teacher's beliefs, primary school

Introduction

In recent years, following a gradual advancement of curriculum reforms across the world, the requirement for teachers to update teacher's beliefs and improve teaching methods have become increasingly prominent. Research into teaching behavior has gradually shifted from the outside to the inside, focusing on research into internal beliefs. Studies (Yu, 2014) have shown that teacher's beliefs, as a relatively stable and systematic cognitive variable in the minds of teachers, affect teacher's judgments during the process of teaching and also have an impact on the way teachers dealing with situations happening in class. Teacher's beliefs play an important role in determining the teaching goals and tasks (Yu & Xin, 2000; Pajares, 1992). Therefore, teachers' systematic cognition of their own beliefs and the relationship between their beliefs and teaching behavior is conducive to better implementation and development of teaching.

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When literature regarding mathematics teacher's beliefs was examined, we found that most of the published studies of teacher's beliefs only focused on one of teachers' beliefs (such as epistemological beliefs, learning beliefs, and so on) (Yu, 2014; Xie, 2017). Some researchers focused on influence of several beliefs on teachers' teaching behavior. At the same time, these studies focus more on the teacher's beliefs of middle-school teachers (Zhou, 2007; Xu, 2001) or pre-service teachers (Zhou, 2017). In-depth and detailed research into the beliefs of in-service primary school mathematics teachers is rare. Primary school education belongs to the initial stage of school education. The research on primary school mathematics teachers' beliefs is beneficial to students' mathematics learning and cultivating innovative talents.

Therefore, the aim of this research is to subtly supplement to the research into the beliefs of primary school mathematics teachers, and provide a certain theoretical reference for research related to the relationship between the beliefs of primary school mathematics teachers and their teaching behavior. It is necessary to carry out further research on the consistency between teachers' beliefs and their teaching behavior. What kind of teacher's beliefs do elementary school mathematics teachers hold at this stage, and how consistent are their teacher's beliefs and teaching behavior? This research focused on the aforementioned question.

Literature Review and Conceptual Framework

Mathematics Teacher's Beliefs

Mathematics teacher's beliefs are generally divided into four aspects: mathematics beliefs, mathematics teaching beliefs, mathematics learning beliefs, and mathematics achievement beliefs (Jin & Guo, 2009). Mathematics beliefs refers to teachers' views on mathematics, which is embodied in their views on mathematics as a subject in general (Lin, 2008). In the field of mathematics education, the most famous research on teachers' mathematics beliefs is Ernest's (1989) research, who divides mathematical beliefs into three types (see Table 1).

Table 1

Mathematics Belief Structure

Type	Content
The problem-solving view	Mathematics is a subject of dynamic development, which is accumulated by human beings in the process of exploring and pursuing the truth. Any mathematical results need to be improved and supplemented.
The Platonist view	Regards mathematics as a static subject. All structures in the mathematical system are combined with truth according to logic.
The instrumentalism view	Mathematics is a set of tools composed of facts, rules and skills to meet the needs of the objective world.

Source: Ernest (1989, p. 249).

Most of the follow-up studies (Ball, 1990; Zhou, 2001; Barkatsas & Malone, 2005; Wu, 2006; Shahvarani & Savizi, 2007) are based on Ernest's model. In view of the authority of its research, referring to Ernest's result, this study divides mathematics belief into three types: problem-solving view, Platonist view, and instrumentalism view.

Mathematics learning beliefs refer to teachers' views on math learning, that is, how to learn math, including teachers' opinions on the process of math learning, students' behavior, students' mental activities, and components that constitute learning activities (Jin & Guo, 2009). Throughout the research all over the

world, there are mainly three kinds of mathematics learning concepts in the field of education: behaviorism view, information processing view, and constructivism view (see Table 2) (Yu & Xin, 2000; Wang, 2001).

Table 2

Mathematics Learning Beliefs

Type	Content
Behaviorism view	Regard learning as a mechanical process. In this process, the successful response to specific situations will be strengthened automatically, while the unsuccessful response to specific situations will be weakened automatically. Emphasize the transmission of knowledge, mathematical formula steps and exercises and results rather than the learning process, and individual learning. Students strictly follow the established methods and advocate pure mathematics.
Information processing view	When information is transferred from a person with more knowledge to a person with less knowledge, learning process occurs. Students are information processors and teachers are information distributors.
Constructivism view	It is emphasized that when students study new knowledge, they should construct their own psychological representation, learn other people's choice of relevant information and understand reasons, place it in a consistent structure, and explain new knowledge with existing knowledge.

Mathematics achievement beliefs refer to the achievement of students, whether they can study math well (Schommer, Duell, & Hurter, 2005). According to the previous research and the question tendency in the teacher education and development study in mathematics (TEDS-M) questionnaire, the researchers divide the teachers' belief in mathematics achievement into pessimistic type and optimistic type. The pessimistic type tends to think that students' mathematics achievement is decided, that is, smart children are easy to learn mathematics well, while the optimistic type thinks that whether they can learn mathematics well is more determined by the acquired efforts.

Mathematics teaching belief refers to teachers' views on the teaching of mathematics, that is, how mathematics should be taught, including teachers' views on teaching objectives, teachers' roles in the teaching process, students' roles, appropriate classroom activities and teaching methods, teaching priorities, teaching steps, and teaching results (Lin, 2008).

Kuhs and Ball (1992) put forward four kinds of mathematics teaching beliefs, in view of the fact that this classification method is similar to the structural classification of mathematics teaching class in the background of this study (New Curriculum Reform in mainland of China), this study used these four kinds of mathematics teaching beliefs proposed by Kuhs and Ball to divide the classroom types and teaching beliefs held by case teachers (see Table 2).

Table 3

Mathematics Teaching Belief

Type	Content
Student center	Mathematics teaching should focus on students' mathematical knowledge structure.
Content center	Emphasizing basic mathematics concept understanding, teaching should take teaching content as the core of the whole class.
Practice center	Mathematics teaching should emphasize students' practice, which is the mastery of mathematical rules and steps.
Classroom center	Mathematics teaching should take effective class as the center.

Source: Kuhs and Ball (1992).

When it comes to the evaluation of belief. Many scholars have developed scales based on their own teaching practice (Lin, 2011; Yu, 2013), among which is the internationally representative teacher's belief scale of the TEDS-M, which was the first international comparative study of mathematics teacher education. On the basis of analyzing and improving the existing teacher knowledge and the theory of classroom teaching, and also constructed the conceptual framework of mathematics teacher competencies and believed that mathematics teacher competencies are the main indicator of measuring the effectiveness of mathematics teacher education (Döhrmann & Kaiser, 2012). In TEDS-M research, a special scale was developed to measure the beliefs of mathematics teachers. The scale takes the teacher's belief of mathematics teachers as the first-level indicator, and mathematics belief, the belief in mathematics learning and the belief in mathematics achievement as second-level indicators (Ye, 1997). In view of its professionalism and authority, this study directly used this scale to measure mathematics belief, mathematics learning belief, and mathematics achievement belief.

Teaching Behavior

Wang (2014) believed that teaching behavior mainly included classroom management behavior, blackboard writing behavior, example explanation behavior, questioning behavior, and answering behavior. Cao and Yu (2017) proposed 16 key teaching behavior, which were divided into A and B categories according to the importance of key levels. The key teaching behavior contained Category A mainly include five aspects: teacher-student interaction, teacher presentation, students listening, students doing exercises, and teachers' explanation, which have been seen to have the most critical influence on class. Eleven key teaching behavior including independent learning, students' feedback, teachers' feedback, content presentation, class management, cooperative learning, student's explanation, student's presentation, student's questioning, and tutoring, are all classified into Category B. This research draws on some of the key classroom behaviors that have great impact on class from Cao and Yu's research to complete the classroom observation form. This study defines teaching behavior as the behavior of a teacher in class, and includes student-centered class, teacher-centered class, and interactive class. It is mainly divided into five dimensions: classroom management behavior, blackboard writing behavior, example explaining behavior, questioning behavior, and answering behavior. In the follow-up study, considering its widely used, professionalism and authority (Yang, 2016; Sun, 2017; Liu, 2015), the researchers mainly referred to the research conclusions of Cao and Yu's compiled a classroom observation scale (see Appendix B), so as to record teachers' teaching behavior.

When it comes to the relationship between belief and teaching behavior, Li (2007) proposed that teachers' beliefs include both old and new belief systems, and teachers are in a dilemma. Teachers' beliefs often influence teachers' decision-making in the form of belief package, and then change their teaching behavior. Ernest (1989) proposed that there is a difference between "espoused belief" and "enacted-belief" in the teacher's beliefs system. Ernest believed that teachers' espoused beliefs are teachers' idealized beliefs. The espoused beliefs will be transformed into behaviors in practice depending on the restrictions or conditions of educational situation. Enacted beliefs refer to those beliefs embodied in teaching practice. Therefore, some studies may draw the conclusion that belief is inconsistent with enacted belief behavior. In order to figure out the consistent relationship between teaching behavior and teacher's belief, this research decided to use Ernest's research result, believed there are "espoused belief" and "enacted-belief" in the teacher's beliefs system. Conceptual framework is as followed (see Figure 1). Research tends to understand the espoused beliefs through what orally expressed by teachers in interviews and the answers in questionnaire, and then excavate the enacted

beliefs adopted in teachers' actual behaviors in class through classroom observation (observing and recording classroom key behaviors). The espoused belief and enacted belief were compared and analyzed to obtain consistent conclusions.

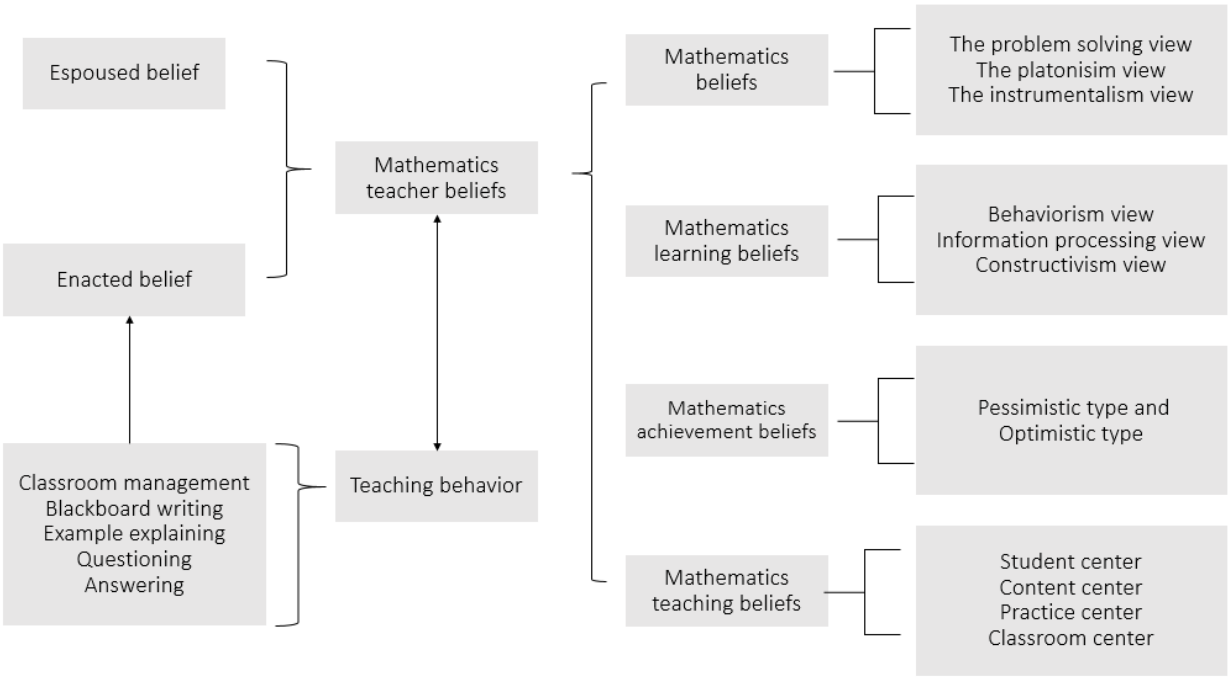

Figure 1. Conceptual framework.

Methodology

This study adopts a combination of qualitative and quantitative methods. In qualitative research, the definition and test of validity are not as clear and definite as quantitative research. Qualitative research is not the authenticity of the so-called "objective reality" itself, but the truth seen by researchers and the angle and way they see things (Chen, 2000). Teachers' beliefs reflected the personal belief and the interaction between the social values and role, the process of study of teachers' beliefs are very complicated (Zhou & Lin, 2003). Quantitative study cannot fully achieve the result of such an elaboration. So, in this study, it is more convincing to draw conclusions through mixed method by understanding and analysis of teacher's behavior and language, combined with the quantitative conclusion from the questionnaire survey.

Research Participants

In the selection of participants for the questionnaire survey (quantitative), this research mainly focus on primary teachers, also researchers try to ensure the differences in teachers' professional development stage, years of experience in teaching, educational background et al., so as to ensure the universality of samples. So, research is conducted with selected 84 primary teachers who responded to the questionnaire from 12 cities in mainland of China (mainly from four cities in the Central part, five provincial capitals in the Southern part, and three cities in the Eastern part). Among the 84 participants, male teachers accounted for 21%. The grades taught by the participants were mainly distributed from Grade 2 to Grade 5. Seventy-four point five percent of the teachers had more than three years of teaching experience, and 25% of the teachers had less than three years of

teaching experience. According to the analysis results, these 84 teachers have been divided into three distinct types: A, B, and C. Representative case teachers were selected from the three different types of teachers. In order to prevent any differences in teachers' professional development stage, teaching years, educational background, and gender, among other factors, from affecting the research results, case teachers who were similar in all the aforementioned aspects were selected, so as to attempt to control the variables as much as possible, so that the difference would be seen in teacher's beliefs. The courses to be analyzed through covered geometry and algebra. Based on aforementioned considerations, three groups of teachers were selected, and finally, six classes of Teacher D, Y, and Z were selected for analysis (see Table 3).

Table 4

Case Teachers

Category	Name	Gender	Age	Teaching age	Education background	Topic of lesson (code)	
A	D	Female	40	18	Bachelor	Parallel and vertical (D1)	Meaning of decimals (D2)
B	Y	Female	38	12	Bachelor	The area of the parallelogram (Y1)	The meaning of fractions (Y2)
C	Z	Female	42	10	Bachelor	The area of the parallelogram (Z1)	Parallel and vertical (Z2)

Data Collection

As mentioned earlier, the instruments used for my data collection was a questionnaire from TEDS-M for quantitative data and interviews and classroom observation for qualitative data.

TEDS-M has compiled a special scale to measure the professional beliefs of mathematics teachers. The scale is based on Richardson and Thompson's (1992) research on the beliefs of mathematics teachers. The content and cognitive classification framework of scale follows the analysis framework in trends in international mathematics and science study (TIMSS). This scale takes the professional beliefs of mathematics teachers as first-level indicators, and mathematics beliefs, mathematics learning beliefs, and mathematics achievement beliefs as second-level indicators.

The purpose of an interview is to find out the participants' beliefs and explain the corresponding teaching behavior. An interview outline (see Appendix A) is generally used. According to the specific response of the interviewee, the researcher will make adjustments to the questions asked depending on individual differences and situational changes.

Semi-structured interviews before-class were conducted after a questionnaire survey, mainly focusing on the teacher's teaching intention, teaching design, lesson plan, understanding of the course, and so on, with the purpose of gaining an in-depth understanding of the teacher's beliefs, views, and opinions.

After-class, teachers watched the classroom video to stimulate memories and allow them to reflect on the teaching, and made comments on every aspect of the class (such as the introduction before-class, students dealing with math problems, discussions, and so on). Researchers asked questions following the interview outline (see Appendix A). If teachers' teaching behavior or some decisions in class were found to be different from their beliefs, they could conduct follow-up in-depth interviews according to the actual situation, so as to understand the reasons and influencing factors for such situations. This section explores the motivation of teachers to display corresponding teaching behavior, and looks into the influence that teachers' beliefs have on their teaching behavior and corresponding decisions, as well as the relationship between them.

The classroom observation scale was developed based on Wang's (2014) middle school mathematics teachers' teaching behavior habits questionnaire and 16 key teaching behavior developed by Cao and Yu (2017). The observation scale divides teaching behavior into classroom management behavior, blackboard writing behavior, example explanation behavior, questioning behavior, and task response behavior. During the observation, researcher records the frequency of these behaviors (see Appendix B).

Data Analysis

Statistic package for social science (SPSS) 20.0 was used for description of questionnaire statistics. At the same time, cluster analysis of data from questionnaire was performed. Eighty-four primary teachers have been divided into three distinct types: A, B, and C. Then, through the data analysis result of three groups of teachers' scores in three belief dimensions, we can have a general understanding of the current situation of primary school mathematics teachers.

The qualitative data in this study were three case teachers' interview and classroom observation accounts. Notes were also taken about the classroom atmosphere and students' reaction. By counting the frequency of teachers' key behaviors and analyze these data from class observation, we can find the characteristics of teachers' teaching style. Through recording the teaching process, we can capture the key events in class, study and explore teachers' enacted belief. Also, participants' espoused beliefs are found through the results of pre-class semi-structured interviews combined with questionnaire survey result. Through comparing the espoused belief and enacted belief, we find out the consistency between teacher's behavior and teacher's belief. Table 5 illustrates details of data collection.

Table 5

Data Collection

Research question	Participants	Data collected	Analysis
What is the espoused belief? (Mathematics belief, mathematics learning belief, and mathematics achievement belief)	84 primary teachers	Questionnaire semi-structured interview	According to the questionnaire survey results, cluster analysis is carried out. According to the analysis results, teachers are divided into three categories. Combined with the results of pre-class semi-structured interviews, exploring teachers' espoused beliefs.
What is the enacted belief? (Blackboard writing behavior, example explanation behavior, classroom management behavior, questioning behavior, and task response behavior)	Three case teachers: D, Y, and Z	Classroom observation after-class stimulus recall interview	Understand the teaching process, find the characteristics of teachers' teaching style, record the teaching process, capture the key events in classroom teaching, study and explore teachers' enacted belief and decision-making process under different types of teaching segments.
What is the consistency of teachers' belief and teaching behavior?	Three case teachers: D, Y, and Z		Compare espoused belief and enacted belief to find the consistent relationship between them.

Results

Quantitative Research Results and Discussion

According to the analysis results, teachers have been divided into three distinct types: A, B, and C (see Figure 2). It can be seen from Figure 2 that teachers who belong to Category A had lower scores for mathematics beliefs and achievement beliefs, while having a higher score of learning belief. The scores of three beliefs of teachers who fell under Category B were all in an average state. In comparison to the two other

categories, teachers in Category C had higher scores of three beliefs with the mathematics achievement belief score being the highest.

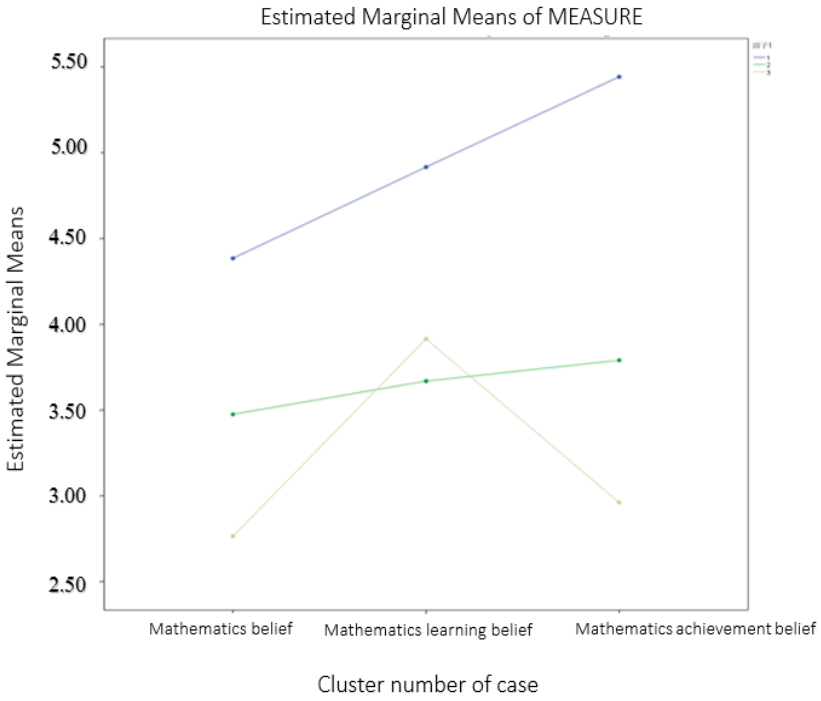

Figure 2. Result of cluster analysis.

This study used scale from TEDS-M, which is divided into three dimensions, each question up to six points, at least 1 point, the higher the score is, the higher the tendency of agreement, the participants scored less than 3 points tend to be traditional orientation, 3-4 points on behalf of tending toward the moderate orientation, more than 4 points tend to be a modern tendency, Table 6 is obtained after quantitative analysis of the results of the questionnaire survey.

Table 6

Quantitative Analysis of Research Results

Category	Mathematics belief		Mathematics learning belief		Mathematics achievement belief
	Mathematics is a set of rules and procedures	Learning mathematics is a process of exploration	Learning mathematics well requires a teacher's guidance	Students can learn math well independently	Mathematics is an innate competency
A (average)	3.69	5.08	2.16	5.22	2.76
B (average)	4.49	5.35	2.5	5.23	3.91
C (average)	5.23	5.66	2.67	5.28	2.96
Grand mean	4.47	5.36	2.44	5.24	3.21
Standard deviation	1.24		1.85		1.40

Espoused Beliefs Tend to be Positive and Modern

Generally speaking, the differences in the declared beliefs of different teachers are not significant. As it can be seen from Table 6, the standard deviation of the first dimension is 1.24, the second dimension is 1.85,

and the third dimension is 1.40. The standard deviations of the three dimensions are all less than 2, which indicates that the data distribution is relatively compact and the teachers' overall teaching beliefs differ slightly.

In terms of average, the two parts of the first dimension were 4.47 and 5.36 respectively with a tiny difference, indicating that the teachers of the subjects basically agreed and strongly agreed. Teachers' belief in the mathematics belief tended to be modern. The average scores of the two parts of the second dimension were 2.44 and 5.24 respectively with a large difference, which shows that teachers tend to believe that it is more important to learn mathematics well independently than rely on teachers' guidance. The average score of the third dimension is 3.21, indicating that participants do not agree with that students themselves are different and unchangeable in math learning, and that hard working is more important than smart minds.

As we can see from above, affected by curriculum reform, most teachers have a progressive concept that keeps in pace with the times, and accept and implement new ideas and concepts. Espoused beliefs tend to be modern, and they promote active learning methods, focus more on students, emphasize the study of the nature of mathematics, and believe that students' independent study is more important. Whether students are good at math is not decided at first and efforts matters a lot.

Qualitative Research Results and Discussion

In order to analyze the characteristics of teachers' behavior, we first extract teachers' behavior from the classroom environment through class observation. The enacted beliefs of the three teachers are classified according to the characteristics reflected in the teaching behaviors, and the espoused beliefs and enacted beliefs of three teachers can be summarized (see Table 7).

In the observation of teacher D's class, teacher D's class shows the tendency of interactive type. After the whole class, we can feel teacher D's enthusiasm for teaching and love for students. She interacts with students a lot, and allows students to express more without interrupting students. This can also be observed from Table 8. Compared with the other two teachers, teacher D has more questioning behaviors and more communication with students.

When asking about mathematics beliefs in the questionnaire, teacher D believed that "Many aspects of mathematics are related to reality" and "Math helps people solve problems in daily life". When asked about the design of the summary part of the class, she mentioned, "In the end, I want to show students more applications of parallel and vertical in life, which is more helpful for students to understand the knowledge". It can be said that teacher D focus more on the relationship between mathematics and daily life when teaching. She tends to be instrumental view both on espoused belief and enacted belief. Teacher D's mathematics belief and teaching behavior tend to be consistent.

About mathematics beliefs in the questionnaire, teacher D thought that "In addition to getting the correct mathematical answer, it is also very important to understand why the answer is correct" and "Teachers should allow students to come up with their own solutions to solve mathematical problems". When asked about the problem-solving part, teacher D mentioned that "When solving problems, although some children came up with part-correct conclusions, but the answer was not complete. I didn't tell them directly, because I wanted them to stick to it again to see if any students could automatically generate answer that is, summarizing through his observation". From the above conversation, we can see that teacher D's learning beliefs tends to constructive type both in espoused and enacted belief, and believes that mathematics knowledge learning is a process of students' self-construction. In class, it is more important for students to gain, and it is more important to obtain

a complete knowledge system through their own summary and induction. It can be said that in mathematics learning beliefs, teacher D's beliefs and teaching behavior tend to be consistent.

Table 7

Result of Classroom Observation

Teaching behavior	Categories	D1	D2	Y1	Y2	Z1	Z2	Categories	D1	D2	Y1	Y2	Z1	Z2
Blackboard writing behavior	The number of boards used	1	2	1	3	2	1	Whether the key points presented on the blackboard	Y	Y	Y	Y	Y	Y
Example explaining behavior	The number of topics basically explained by teachers	0	1	3	0	0	0	The number of questions that students complete and answer by themselves	4	3	2	3	3	1
	The number of questions the teacher guides the students to complete	10	4	1	2	3	2	Total number of examples	5	6	2	3	3	3
Questioning behavior	The number of extensive questions	40	20	6	5	6	2	The number of invalid questions	14	8	0	2	2	1
	The number of asking students by name	16	43	20	29	10	19	Total number of questions	70	60	26	31	16	22
Answering behavior	The number of ignoring answers	0	0	2	2	0	0	The number of behaviors mainly explained by teachers	3	2	1	1	0	1
	The number of summarizing the students' right and wrong answers to the questions	4	5	1	4	0	0	The number of teacher guided thinking behaviors	7	4	6	3	10	5
Classroom management behavior	Number	0	0	2	4	0	1							

Table 8

Teacher D's Consistency of Belief and Teaching Behavior

Case teacher	Class type	Mathematics belief		Mathematics learning belief		Mathematics achievement belief	
		Espoused belief	Enacted belief	Espoused belief	Enacted belief	Espoused belief	Enacted belief
D	Interactive class	Instrumentalist view: Math helps people solve problems or things in daily life.	Instrumentalist view: Mathematics serves for life.	Constructivism view: Mathematical knowledge learning is a process of students' self-construction.	Constructivism view: Focus on what students gain and emphasize on students' own summary and induction to obtain a complete knowledge system.	Pessimists: Some people are good at math, some are not.	Optimism: Every student can improve.
Consistency		Consistent		Consistent		Inconsistent	

When it comes to mathematics achievement beliefs in the questionnaire, teacher D believes that "Some people are good at mathematics; some people are not good at it". In the classroom observation, however, when selecting students to answer questions, teachers do not deliberately select students with excellent mathematics achievements, but give students with poor academic performance more opportunities, hoping that all students can improve. Therefore, there is some inconsistency between achievement belief and teaching behavior.

Table 9

Y's Consistency of Belief and Teaching Behavior

Case teacher	Class type	Mathematics belief		Mathematics learning belief		Mathematics achievement belief	
		Espoused belief	Enacted belief	Espoused belief	Enacted belief	Espoused belief	Enacted belief
Y	Student-center class	Platonism view: Mathematics requires a lot of practice, proper use of routines, and problem-solving strategies; Mathematics involves creativity and new ideas.	Instrumentalist view: Practice and problem-solving are the core of mathematics; Content that is not relevant to the class may not be mastered; Focus more on "what's in the exam".	Constructivism view: The process of learning mathematics is important; Emphasize the practicability of learning; Emphasize "thinking" process in which students acquire knowledge.	Constructivism view: Emphasis on "learning by doing".	Pessimists: Some people are good at math, some are not.	Pessimistic: Math performance is a label to judge whether students are smart or not.
Consistency		Inconsistent		Consistent		Consistent	

In the observation of teacher Y's class, teacher Y's class shows the tendency of student-center class. She maintained students' attention through a variety of methods. Teacher Y strives for every student to have the opportunity to answer questions and show themselves. Teacher Y manages the class in two ways: "The former student chooses the latter student to answer questions" and "group bonus competition system", which stimulates the students' initiative, improves the students' awareness of participation to the greatest extent, and makes the students realize that they are the masters of the class.

According to the classroom observation, teacher Y holds the view that "Mathematics needs a lot of practice, the correct application of routine procedures and problem-solving strategies". We can also see that in Table 9, compared with other two teachers, teacher Y presented more examples to students. When asked what is the most important moment in class, she mentioned that math, especially new knowledge, needs a lot of practice to support, and questions should be deal with step by step. Children probably know this when asked, but he/she really cannot do it after-class. Although he/she can say it orally, he/she still cannot link to the questions. In the questionnaire, teacher Y chose, "Mathematics involves creativity and new ideas", which is contrary to the teacher's belief expressed in the interview. It can be said that teacher Y's espoused belief tend to be Platonism view, but the tendency reflected in practice is instrumentalism, so teacher Y's mathematics belief is inconsistent with teaching behavior.

In the questionnaire, teacher Y believes that "Listening to the teacher's explanation carefully is the best way to learn mathematics well" and "Teachers should allow students to come up with their own solutions to solve mathematical problems". It can be noted that teacher Y basically encourages students to solve problems

in a variety of ways, paying more attention to students' communication and experience the process of knowledge generation. When asked which moments in the class are the most important to students, teacher Y mentioned three moments: the process of children cutting and discussing, the process of discussing the results and then reporting, and the process of final summary. She mentioned that the reason for the two-level differentiation of students is the difference in participation. She said, "The reason why level of students in this class uneven is that some children keep following, raising their hands, discussing, and then reaching a conclusion, questioning and thinking". It can be seen that teacher Y adheres to the constructivist concept of mathematics learning, emphasizes that students' experience the process of problem-solving, construct by themselves, and obtain knowledge and ability from the process. She believes that the ability to think and solve problems brought by mathematics learning can benefit for the whole life. It can be said that teacher Y's belief and teaching behavior tend to be consistent in mathematics learning, which belongs to constructivism.

Teacher Y disagreed with "Only students with better ability can participate in multi-step problem-solving activities" in the questionnaire. In the interview, she mentioned that good mathematics achievement is a sign to measure students' intelligence. When it comes to practice, she chose students with different grades to answer according to the difficulty of the problem. When encountering difficult problems, she will ask students with better mark. It can be said that in terms of mathematical achievement belief, teacher Y's belief is consistent with teaching behavior, which belongs to pessimistic type.

Table 10

Z's Consistency of Belief and Teaching Behavior

Case teacher	Class type	Mathematics belief		Mathematics learning belief		Mathematics achievement belief	
		Espoused belief	Enacted belief	Espoused belief	Enacted belief	Espoused belief	Enacted belief
Z	Classroom-centered class	Instrumentalism view: Mathematics means learning, memory, and application; Mathematics is essentially a collection of programs; The final goal of mathematics teaching should be in the level of knowledge, emphasizing the importance of "doing right" and "being able to deal with problems".	Problem solving view: Emphasis on students to "constantly explore" independent learning.	Behaviorist view: Learning is a mechanized process, which emphasizes the equal relationship between "good grades" and "good study". It is necessary to be able to solve problems quickly in order to learn well.	Behaviorism view: Students only study the knowledge of the test Learning serves for test.	The pessimistic: Aptitude is more important than hard work in mathematic.	The optimistic: Everyone can study math well.
Consistency		Inconsistent		Consistent		Inconsistent	

From teacher Z's class, we can see that teacher Z's teaching behavior reflects tendency of classroom center and emphasizes the integrity of the class. The main form is to delegate tasks, students are master of the class, and the role of teachers is more like a "director". In terms of classroom management, teacher Z's classroom management mode is democratic, loose, but not chaotic. Students can freely express their ideas in the class. In the class, teachers tend to play a more encouraging role for students and a booster to complete task. In terms of blackboard writing, teacher Z has less blackboard writing behaviors, focusing more on presenting the results of students' group discussion. In terms of example explanation, it can be seen from Table 10 that teacher Z rarely explained the examples all by herself. Teacher Z mainly adopts the method of large task

arrangement, focusing on the class itself. Teachers guide students to carry out activities, assign tasks to students, monitor students' learning, ask students to complete it independently and report in groups.

About mathematics belief, teacher Z believes that "Mathematics involves definition, formula, mathematical facts, and program memory and application" and "Mathematics means learning, memory, and application", it shows that teacher Z held instrumental view, but in class, instead of focusing on the right and wrong answers to the questions, teacher Z is more inclined to cultivate students' autonomy and encourage students to constantly explore. She said, "When answering questions, no matter what they say is right/wrong, they should be encouraged to finish, we need to respect them and let them fully express points, which may not be explained clearly. However, it is very important to cultivate students' autonomous learning ability". At the same time, she also said that "Such a method may not be very solid in the learning of knowledge and the consolidation of problem-solving skills; it also needs to continue to be connected and deepen the follow-up knowledge". It can be seen that teacher Z holds a deep "problem-solving" view on the mathematics belief and believes that the ultimate goal of mathematics teaching should be at the knowledge level, that is, the so-called "being able to deal with problems" and "being right", which is inconsistent with her espoused belief. It can be said that teacher Z's mathematics belief is inconsistent with teaching behavior.

Teacher Z believes that "Students need to be taught the steps of mathematical problem-solving accurately" and "As long as they can solve the answer to a problem when it comes to mathematics learning beliefs, it doesn't matter whether they understand the problem". From the arrangement of practical activities in the classroom, it can be note that teachers pay more attention to whether students can solve problems than group activities. Teacher Z's teaching purpose is very directional, and the classroom arrangement is also more focused on examination evaluation. Her belief in mathematics learning is more inclined to the orientation of "serving the examination". In the interview, she mentioned that "By guiding students to cut, spell, swing, and other operation activities, promote students to have a profound experience in the process of doing mathematics. For example, activities are very conducive to students' active and successful derivation of formulas, preparation, and laying a solid foundation for the understanding, memory, and application of formulas". It can be said that teacher Z holds the behaviorism learning view, and her teacher's belief is consistent with her teaching behavior.

In the questionnaire, about mathematics achievement belief, teacher Z believes that "Only students with better ability can participate in multi-step problem-solving activities", "Talent is much more important than effort in mathematics", and "Some people are good at mathematics and some people are not good at it". It can be seen that Z's espoused belief is more inclined to that there is no way to change the ability of mathematics learning, but in class, teacher Z tried to take care of the majority, so that all students can take part in. For example, she focused on the students who have not answered the questions and tried to make sure every student gain knowledge. She mentioned that "Mathematics in primary school is actually very simple, as long as students work hard, everyone can learn it well". It can be said that, teacher Z's achievement belief is inconsistent with his teaching behavior.

Consistency and Inconsistency Coexist in Elementary School Mathematics Teacher's Beliefs and Teaching Behavior

Teacher's beliefs is an important factor that has an effect on teaching behavior. Teacher's beliefs permeate the teaching experience and teaching habits. They affect teaching behavior. At the same time, teacher's beliefs and teaching behavior are also found to be inconsistent. Espoused beliefs and teaching behavior that should be

produced under these beliefs are very different. This shows that even though most teachers have made progress in their belief innovation under the influence of curriculum reform, innovation in beliefs does not represent a certain change in their teaching behavior. Therefore, consistency and inconsistency coexist in elementary school mathematics teacher's beliefs and teaching behavior.

In this research, it can be seen that even though the participant teachers had different classroom types and their teacher's beliefs are also very different, their teacher's beliefs and teaching behavior are consistent to a certain extent. For example, for teachers with negative beliefs in mathematics achievement, teachers will be dominated by their beliefs. During teaching, they have lower expectations for students with low mathematics achievements. It can be seen that teacher's beliefs have a certain degree of influence on teaching decisions in class. Beliefs permeate teaching experience and teaching habits, are the internal basis of teaching behavior, and affect the teaching behavior of teachers.

However, through this research, it can also be seen that participant teachers showed a certain degree of inconsistency in one or several aspects among three beliefs, indicating that the relationship between beliefs and behavior is very complicated. Teaching behavior are not affected by teacher's beliefs in a one-way manner. Teachers' beliefs cannot be fully implemented in teaching behavior.

Discussion and Conclusion

Espoused Beliefs Tend to be a Positive Modern

Generally speaking, the differences in the espoused beliefs of different teachers are not significant. Among them, the differences in mathematics learning beliefs are significant, and the differences in mathematics beliefs are relatively not significant. Affected by the curriculum reform, most teachers have a progressive concept that keeps pace with the times, and accept and implement new ideas and concepts. Declared beliefs tend to be modern, and they advocate active learning methods, focus more on students, emphasizes the study of the nature of mathematics, believes that students' independency is more important and compared to smart minds, efforts are more important.

Consistency and Inconsistency Coexist in Elementary School Mathematics Teacher's Beliefs and Teaching Behavior

Teacher's beliefs have a certain degree of influence on teaching decisions in class. Beliefs permeate teaching experience and teaching habits, are the internal basis of teaching behavior, and affect the teaching behavior of teachers. However, it can also be seen that participant teachers showed a certain degree of inconsistency in one or several aspects among three beliefs. Teachers' beliefs cannot be fully implemented in teaching behavior. The relationship of teaching behavior and teacher's belief has inconsistency. How should this inconsistency be understood?

The difference between the teacher's belief system and the intensity of teaching behavior: The strength of different beliefs in the teacher's belief system is different. It can be divided into deep beliefs and superficial beliefs (Kaplan, 1991), and the corresponding practical behavior can also be divided into deep practice and surface practice. Some ideas that exist in teachers' superficial beliefs are not reflected in deeper practice under the influence of deeper beliefs, and transformed into corresponding teaching behavior, especially in terms of experienced teachers. They actually tend to use their old beliefs unconsciously during the process of teaching a class.

With the deepening of curriculum reforms, new curriculum and learning concepts are constantly impacting teachers' beliefs and affecting and changing teachers' teaching behavior. Although some teachers, especially experienced teachers, still retain their old form of thinking, under the influence of the curriculum reform, they are willing to make changes in class, part of which is reflected in the inconsistency between teaching beliefs and teaching behavior.

In this study, many teachers expressed their "helplessness". They expressed the "dilemma" between "curriculum reform" and "examination culture", "teaching tasks", and "progress rate". Taking into account the teaching tasks and the length of teaching time, students must meet test standards within a limited period of time. Teachers have to keep some beliefs in words and cannot put them into practice. Therefore, they unconsciously adjust their teaching behavior, causing some teachers' teaching behavior to be inconsistent with their beliefs or even to be in conflict with their beliefs.

Comparison of Different Stage

Internationally, many studies on primary school mathematics teachers beliefs have also reached almost the same conclusions as this study, which is inconsistent relationship and consistent relationship coexist between teaching behavior and teacher's belief. However, in terms of the research on teachers' beliefs of pre-school teachers, the relationship tends to be more consistent.

Compared with preschool teachers, primary school teachers are more limited to the length of teaching hours, pre-school teachers generally use the whole three hour teaching time, except for some special subject teaching (Rao, Ng, & Pearson, 2003; Sun, 2017; Zhou, 2017). As for the research on middle school teachers' beliefs (Xu, 2001; Brighton, 2003; Zhou, 2007), the conclusions are often inconsistent. One of the possible reasons is that sometimes under the pressure of school and society, teachers must adopt skill-oriented teaching approach which maybe against teachers' beliefs. The syllabus of primary school teachers is more flexible and the teaching content is not as full as that of middle school.

Dialectical Discussion of Teacher's Beliefs and Teaching Behavior

Although restricted by aforementioned reasons, it has been seen that teaching behavior are sometimes inconsistent with the beliefs of teachers. It is claimed that the relationship between declared beliefs and practical beliefs is not a one-to-one correspondence. They are essentially a dynamic system, as espoused beliefs and enacted beliefs are in the dynamic process of mutual influence, interaction, and support, mutual transformation and construction. Therefore, in future research, we should examine the connection between these two, and cut in from these points.

Implication

In the teacher's training of in-service teachers and pre-service teachers, in addition to including the necessary teaching knowledge and skills, trainers also should pay attention to the construction of teachers' belief system, along with in-time thinking and summarizing their teaching behavior. Teachers should pay enough attention to belief and abandon the "incorrect" beliefs that are not conducive to students' learning, mathematics class and teachers' own development, and keep updating and keeping pace with the times. At the same time, trainers should try more "problem-solving" training methods. Different teachers have different understandings of training contents due to different teaching years and educational backgrounds. Therefore,

trainers should pay more attention to the individual needs of each teacher and carry out targeted training to achieve the essential internalization of teachers' deep teacher's belief.

It is undeniable that the curriculum reform has achieved very excellent results, but from the results of this study, it is obvious that some teachers cannot relatively correctly understand and implement the concept of the new curriculum reform, and even have the phenomenon of "superficial work". In the process of implementing the curriculum reform, compared with telling teachers what to do in class, we should focus more on explaining to teachers why they do this, the purpose and significance of reform, make it better integrate with students' learning evaluation system, so that students can make great progress.

Limitation and Prospect

Only through a limited time of classroom observations and interview, we cannot fully understand teachers' teaching beliefs and teaching behavior characteristics, so the reliability of the conclusions is restricted to a certain extent. At the same time, the proportion of educational background and other factors of the research objects in the questionnaire survey are not balanced in various places. There are very few teachers with educational background below high school degree and above doctoral degree. Because there are some sensitive issues in the questionnaire and the degree of cooperation of teachers is different, there may be some inconsistencies between "what they think" and "what they answer", and the results of the questionnaire will be limited to a certain extent.

We should realize that belief is an implicit psychological phenomenon, so we need a lot of classroom observation and in-depth and long-term follow-up interviews to explore it. Teaching behavior is also rich and easily changeable, and especially need timely tracking and long-term recording and analysis. Therefore, in the follow-up research, large-scale interviews, and long-term observation, and the forms should be diversified as far as possible. At the same time, we should pay more attention to the construction of relevant theoretical models and evaluation systems for mathematics teachers' beliefs and teaching behaviors with distinctive local area or subject characteristics.

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Appendix A

Interview outline

Before-Class Interview Outline

1. Please describe your adjustment to the course plan and give the reasons for the adjustment.
2. What do you think is the most important part of this class? Please explain.
3. What parts (if any) do you think are challenging for your students? Please explain.
4. Which part (if any) do you think will bring you special challenges? Please explain.
5. Please describe anything you learned from reading the instructional design provided and modifying the instructional design during your participation in the research. Please explain.
6. Please describe what you want your students to learn from this class. Please explain.
7. Have you considered the teaching and design of subsequent courses?

Stimulate Interview Outline

1. Looking back at this class, when do you think the most important moment in this class is? Why are these moments so important? Please explain. If the teacher doesn't provide relevant information, ask, "Did anything happen in class that you didn't expect?"
2. Are there any moments in class when you realize that you need to make a decision? (Exploratory questions: Please describe the nature of your decision; ask questions about each decision separately, what special event makes you think you need to make a decision? What influenced the decision you actually made?)
3. What moments in the classroom are most important to students' learning? What did they learn? (Give examples and evidence for each moment. Can you give me an example? How do you know the students have learned? Where did you see it?)
4. What moments in the classroom do you think provide you learning opportunities? What did you learn? Can you give me an example? What makes you think you've learned something?
5. The interviewer said, "Now let's start dragging the video. Please point out these moments" (Refer to another interviewer's previous notes/flowchart). In the process of dragging the class, the teacher may say other moments that are not mentioned earlier. Pay attention to them and discuss them with the teacher. Once, the teacher points out that an event is related to his decision-making or teacher learning locate this part in the classroom video and ask the teacher to explain the importance of the event and what he has learned from it.
6. What do you think of the follow-up courses?

Appendix B

Teaching behavior	Categories	Number	Categories	Number
Blackboard writing behavior	The number of boards used.		Whether the key points presented on the blackboard.	
Example explaining behavior	The number of topics basically explained by teachers.		The number of questions that students complete and answer by themselves.	
	The number of questions the teacher guides the students to complete.		Total number of examples.	
Questioning behavior	The number of extensive questions.		The number of invalid questions.	
	The number of asking students by name.		Total number of questions.	
Answering behavior	The number of ignoring answers.		The number of behaviors mainly explained by teachers.	
	The number of summarizing the students' right and wrong answers to the questions.		The number of teacher guided thinking behaviors.	
Classroom management behavior	Number			