Teachers’ belief in mathematics teaching: a case study of early childhood education teachers

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Abstract. This article aims to analyze teachers’ belief in mathematics teaching. Furthermore, this article will be used as a reference for a professional development program that the researcher is going to develop. This research is a case study with five respondents in a city in West Java, Indonesia. Semi-structured interviews towards five respondents were conducted using an interview guideline that refers to the instrument The Mathematical Development Beliefs Survey. The thematic analysis was used for data processing in this research. The result of the research revealed all respondents agreed that mathematics is a substantial part of early childhood education curriculum, contributes to the confidence of the students, development activities could be carried out, and early childhood is ready for mathematics. However, they are unsure and less confident in teaching mathematics and basic math knowledge. This research suggests that professional programs given should aim to boost teachers’ belief in teaching mathematics.

1. Introduction

Teachers play roles in building children's mathematical abilities. Teaching strategies of teachers in linking children's skills and skills to new situations encourage understanding and stimulate their thinking [1, 2]. Teachers are responsible for directing children to gain learning experience. For this reason, teachers must be of good quality and have the ability to make learning mathematics impressive and enjoyable for early childhood. To facilitate the learning process, teachers need to provide various activities to explore and stimulate children's thinking [2].

Teachers’ belief has an important role in the flow of teaching mathematics for early childhood education (ECE). It represents a broad belief of people about competence in a given domain [3]. Belief functions as a determinant of one's motivation and actions and is often a better predictor of human behavior than their actual abilities [4, 5].

Teachers’ belief is an important part to be analyzed because there are several opinions which state that teachers’ belief influences their development activities in the classroom. Teachers’ belief in teaching mathematics also affects their teaching practices in the classrooms [6, 7]; influences teacher's motivation and attitude in the classroom [5]; and affects the practice of curriculum implementation to the changes of pedagogy [8]. Teachers’ high confidence is believed to have an impact on the completeness of curriculum implementation and learning process in the classroom. Moreover, teachers’ confidence of their mathematics ability correlates significantly with students’ confidence as mathematics learners [5].

This article is aimed to analyze the teacher’s belief in mathematics. Also, this article will be used as one of the references for a professional development program that the researcher is going to develop.

2. Method
2.1 Research design
This research is a case study research because it helps the researcher to understand the complexity of the problem and to explore the problem in depth [9]. Therefore, this article gives information about teachers’ belief in ECE mathematics teaching in detail, which is further used as reference in developing the professional development program (PDP).

2.2 Participants
The participants were selected purposively. In this case the researcher determined the sampling by defining specific characteristics, namely five ECE teachers who teach kindergarten (aged 5 years) in a city in West Java, Indonesia. The five participants have teaching experience of approximately 10 years. The duration of teaching is chosen as one of the indications because by 10 years of teaching experience in ECE teachers already have the ability to manage classes, interpret and improve children's mathematical thinking [10]. At the beginning of the research, the researcher collaborated with the Education Office to reach these participants. In this research, the participants use aliases, namely Ani, Popon, Santi, Siti, dan Srimaya.

2.3 Technique of Data Collection
This activity examined how beliefs and perspectives affect teachers in helping children understand mathematics. In this activity, semi-structured interviews towards five respondents were conducted using an interview guideline referring to the instrument The Mathematical Development Beliefs Survey developed by Platas [11, 12]. Platas categorized these instruments into four groups, namely 1) Age appropriate; 2) Locus of Generation of Mathematical Knowledge; 3) Socio-Emotion Vs. Mathematical Development as Preschool Goals; 4) Teacher Comport in Mathematics Instruction.

2.4 Data Analysis
Thematic analysis was applied in this study. Thematic analysis is a way of identifying themes that are formed in a phenomenon [13]; with the objective to identify patterns or to find themes through data that have been collected by the researcher [14]. Thematic analysis for this study was guided by the steps formulated by Creswell [15]; 1) Preparing and interpreting data; 2) Exploring and coding databases; 3) Describing and forming themes; 4) Representing findings and reporting findings; 5) Interpreting the meaning of the findings.

3. Result and Discussion

3.1 Result
Based on the thematic analysis, the themes which were identified/resulted are 1) the belief of the importance of ECE mathematics; 2) the belief of early childhood readiness to learn mathematics; 3) the belief and confidence in teaching mathematics; 4) the importance of basic mathematics; and 5) the role of teachers. The following is the explanation of them.

3.1.1 The belief of the importance of ECE mathematics
All respondents agreed that mathematics is an important part of the ECE curriculum. Siti and Srimaya have the same reasons regarding this, that mathematics is needed by the children in their daily life of present and future. Meanwhile, Santi and Popon stated that mathematics influences children social life. “When the children understood mathematics, it is easier for them to make contact and understand others. For example, when talking about the number of marbles, adding which marbles are more, etc,” said Popon. While Ani said, “mathematics already exists in the area cognitive of the curriculum, so teachers must teach mathematics”. Regarding the confidence of the children, all respondents agreed that mathematics contributes to the confidence of the children.

Popon and Santi believed that mathematics is related to other skills of the children, such as language skill and art skill. They thought that children could learn to count while they are singing and dancing so that all three skills can run well. However, the other three respondents thought that the importance of mathematics is below the importance of language skill. Because by having good language skill, children
easily socialize and interact with their environment. Siti and Ani said that mathematics is not the main objective of ECE. They argued that there are other aspects which are the objective of ECE learning, such as social and emotional development. All respondents thought that mathematics activities do not require that much time so that social and emotional development will not be neglected.

3.1.2 The belief of early childhood readiness to learn mathematics
All respondents agreed that mathematics development activities could be carried out at kindergarten. Srimaya added that it is very important for teachers to make the children ready for that. She said that normally 5 year old-children are ready to learn mathematics. While Santi said, “actually 2 year old-children are also ready to learn mathematics if there are people who can introduce numerals to the children.” Santi added that some strategies to teach mathematics to the children are such as by introducing numerical symbols or asking the children to imitate the counting. This is because children are able to count by memorization. According to Popon, ECE age is the golden age. If it is not stimulated or facilitated correctly, the children will not develop.

Nevertheless, all respondents agreed that the learning strategies must be conducted properly in order not to make the children feel bored. According to Siti, if it seems that the children are not ready yet, teachers must apply a particular approach or even delay the learning until the children are ready. Popon said, “teachers must teach mathematics to the children in the right way, that is learning by playing.” Also, all respondents do not agree if it is obliged for the children to memorize numbers before kindergarten level. Besides, the concepts of mathematics should be introduced carefully by considering children readiness.

3.1.3 The belief and confidence of teaching mathematics
Regarding the teachers’ confidence, Siti, Srimaya, Popon, and Ani felt unsure and less confident that they can conduct mathematics development activities properly. They assumed that they are lack of concepts of mathematics knowledge. However, they always put effort armed with adequate experience to design and apply particular strategies in introducing mathematics to the children to create effective mathematics activities in the classroom.

Unlike others, Santi felt confident in performing mathematics development activities because she has joined PLPG (Professional Education Program). From the experience of the training and education program, Santi has conquered knowledge about the media that is used to improve children motivation. The knowledge could directly be implemented in the classroom.

3.1.4 The importance of basic mathematics
Regarding the importance of basic mathematics, all respondents agreed that knowledge is important. According to Popon and Srimaya, knowledge of mathematics is useful to determine proper strategies when conducting developmental activities. While Siti thought that knowledge affects the teachers’ confidence. She said, “if we have the material mastery, we will not be doubtful when introducing numbers and objects to the children. On the contrary, if we don’t have the mastery, we become worried and nervous that we might give wrong concept.” Santi also agreed that knowledge of mathematics is important for teachers. She thought that a simple analysis of children progress, an ability to deal with problems when interacting directly with children cannot be done if teachers don’t possess knowledge of basic mathematics.

3.1.5 The role of teacher
All respondents agreed that the role of the teacher is as a facilitator. In this context, teachers don’t have to play a central role in mathematics activities, but to facilitate to make the children improved. All respondents also disagreed when they were asked whether early childhood could learn mathematics without the support of teachers. In other words, children should learn mathematics according to the instruction from teachers to minimalize children errors.
3.2 Discussion
The result of the research revealed all respondents agreed that mathematics is a substantial part of the ECE curriculum and contributes to the confidence of the students. All respondents agreed that mathematics development activities could be carried out and that early childhood is ready to learn mathematics. However, they emphasized that the learning strategy must be applied properly in order not to make the children feel bored.

It is indicated that the respondents supported mathematics be taught to the children. It certainly brings a good impact on the developmental activities in the classroom. The teachers’ belief about the proper age of children to learn mathematics affects their support upon mathematics development in the classroom [16]. According to Ginsburg and Ertle [17], the teachers’ belief about the readiness of the children to learn mathematics is considered important considering educators have argued the proper age in the learning process of mathematics for some decades.

Regarding the teachers’ confidence, Siti, Srimaya, Popon, and Ani felt unsure and less confident that they can conduct mathematics development activities properly. The four respondents became unsure with their knowledge of basic mathematics. Besides, all respondents agreed that knowledge is important and useful to determine the proper strategy when conducting developmental activities.

It is in line with the finding stated by Clements and Sarama [18] that ECE teachers often became uncomfortable with mathematics, and they were lack of information about standards of mathematics. Also, ECE teachers believed that teaching mathematics is difficult [19]; and were more comfortable with teaching reading and other skills related to language [11].

It seems that the teachers’ belief of their mathematics teaching skill affects their work, for example, “I am never good at mathematics ... that is one of the reasons I choose early childhood ... I don’t have to know mathematics ...!” [19]. Moreover, research in the motivation field showed that a reason why teachers do not teach mathematics in the preschool classroom is the fear of failure [3]. [20] added that for a teacher who thought that he or she is not good at mathematics, developing mathematics activity in the classroom intimidates their pride. Mathematics is a difficult subject that they thought could not teach [19].

The implication of that finding is that if there is an effort to teach mathematics, the feel of being incompetent could be avoided [11]. One of the ways is by providing more mathematics education and training programs [16]. It is in line with a view from Platas [11] which stated that there are two primary challenges faced by the implementation of ECE mathematics, they are a) lack of effective teacher training in ECE mathematics [20] and b) the influence of belief towards the implementation of mathematics development activities in the early childhood classroom [21].

Based on the finding which indicated that respondents were unsure and less confident in conducting mathematics development activities properly, professional programs or other intervention should aim to boost teachers’ belief to develop children mathematics in a way that is more than just serving the curriculum [7]. It is hoped that the professional development program for early childhood teachers can decrease the phobia reactions towards mathematics, which are often expressed by ECE teachers and pay attention to their teaching experiences [19]. When the teachers’ experiences, education and knowledge about children mathematics development increases, it is predicted that the respondents are tend to (a) view that mathematics instruction is appropriate for early childhood, (b) view that teachers and students are as locations of mathematics knowledge generation, (c) show the belief of the importance of supporting mathematics development, and (d) report higher belief in presenting mathematics teaching in the preschool classrooms [11].

4. Conclusion
This article will be used as one of the references for a professional development program that the researcher is going to develop. The result of the research revealed all respondents agreed that mathematics is a substantial part of the ECE curriculum and contributes to the confidence of the students. All respondents agreed that mathematics development activities could be carried out and that early childhood is ready to learn mathematics. It is indicated that the respondents supported mathematics should be taught to children.
Regarding the teachers’ confidence, some teachers felt unsure and less confident that they can conduct mathematics development activities properly. All four respondents became unsure with their knowledge of basic mathematics. Based on this finding, it is hoped that the professional development program for early childhood teachers can strengthen their belief, increase their confidence in teaching mathematics, and improve their knowledge of basic mathematics.

Acknowledgments
I want to thank the educational institution, which has supported this study and the teacher who has given the opportunities to conduct this study in her classes. I would also like to thank people for their constructive comments on this paper.

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