Prospective Teachers' Belief of an Ideal Mathematics Classroom: Changes over Time

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Abstract

This research aims to qualitatively portrait the changes of beliefs that the prospective teachers have since they were at the middle of their second year until the end of their third year in university. The data from this research is taken from the reflection two prospective teachers made in February 2017 and an interview done on the same prospective teachers in May 2019. The research shows that prospective teachers' belief of an ideal classroom changes over time and their reason is categorized by several reasons such as the courses they take, their experiences when practice teaching students in schools, and also by the exposure they have related to the resources related to teaching and learning mathematics. The portraits found from this research provides insights to help understand the circumstances that might possibly affect how prospective teachers change their beliefs especially related to their ideal mathematics classroom.

Keywords: teachers' belief, changes of believe, prospective teachers, ideal mathematics classroom

INTRODUCTION

The term 'beliefs' is usually used in many ways. Opinions, perceptions, values, judgments, are examples of terms used to define beliefs. Despite that beliefs have variety of meanings; beliefs can be differentiated from knowledge. The foundation of someone's belief are their evaluation or judgment. On the other hand, knowledge is based on objective facts (Pajares, 1992). Teachers' beliefs are important because it affects how they act, including when they teach in the classroom. They also influence how teachers interpret and perceive teaching situations and how they respond to those situations (König, 2012). This research focuses on the prospective teachers' beliefs of an ideal mathematics classroom – the beliefs that teachers have when they before they really become teachers.

Prospective teachers' beliefs of an ideal mathematics classroom will develop overtime. Before entering university, prospective teachers have experienced schooling for at least 12 years (from elementary school until high school). Their beliefs of an ideal mathematics classroom are influenced by those experiences. As Lortie (1975 in Feiman-Nemser, 2012) said, 'Images of teaching, learning, students, and subject matter formed during elementary and secondary school provide a basis for interpreting and assessing ideas and practice encountered during teacher preparation'. For example, as students in schools, prospective teachers might experience learning mathematics through listening to their teachers' explanations and working on many mathematical exercises (drilling). Hence, they also view their ideal mathematics classroom as a class where teachers explain about mathematical concepts, then students' practice working on mathematical exercises diligently.

Feiman-Nemser (2012) argues that teacher learning should be viewed as a continuum. Related to this, teacher learning is categorized in three different phases, the pre-service preparation, the induction phase, and the early professional development phase. Both prospective teachers and teachers are suggested to complete a certain task which is called the "central tasks of teacher

learning". There are different central tasks for each phase. One of the central tasks of prospective teachers is "analyzing beliefs and forming new visions (of teaching and learning). As part of their learning prospective teachers are suggested to critically analyze their beliefs which they have developed during previous school experience then form new visions for teaching which will help them "construct a normative basis for developing and assessing students' learning". Consequently, teacher education institutions should provide prospective teachers the opportunity to analyze their beliefs and create new visions of teaching and learning. However, question arises on how that opportunity can be provided. What kind of learning processes that facilitates prospective teachers complete that central task?

Throughout their time in university, prospective teachers process of learning, both inside and outside of the classroom might affect their beliefs of their ideal mathematics classroom. As part of the curriculum, all prospective teachers, who are students at the Mathematics Education (MEdu) Study Program at the Faculty of Education (FoE), Sampoerna University (SU) must take courses related to mathematics (such as Number Theory, Discrete Mathematics, Calculus, and Geometry) and mathematics teaching (such as Teaching and Learning Mathematics 1 & 2, Mathematics Curriculum and Assessment, and Problem and Project Based Learning in The Mathematics Classroom). They must also join a program called School Experience Program (SEP). SEP is a series of clinical experiences which is compulsory for all prospective teachers in FoE, SU. Every semester, the prospective students must spend several weeks in schools. Their activities during SEP range from observing to leading the teaching and learning processes in real classrooms. The program duration in every semester varies, depending on the year of study and learning objectives that students should achieve (FoE SU SEP Guideline, 2018).

The belief of prospective teachers' ideal classroom might be affected by the courses they take. As well, by their clinical experiences in school. Nevertheless, prospective students also learn from other sources. Outside of the classroom, prospective teachers have dialogues with many different people such as their peers, families, neighbors, and much more. Some prospective teachers also work, for example as private tutors, writers of educational articles, and do other types of activities such as join organizational activities. Furthermore, they also learn through reading articles, books and through many other ways. It is possible that some these experiences, affect the prospective teachers' belief of an ideal mathematics classroom.

This research aims to qualitatively portrait the changes of beliefs that two prospective mathematics teachers have since they were at the middle of their second year (February 2017) until the end of their third year in university (May 2019). Specifically, this research addresses the following questions: (1) What kind of changes do the prospective teachers have regarding to their belief of an ideal mathematics classrooms? (2) What aspects did affect those changes? By answering these two questions, we might gain insights to understand what teacher education institutions can do to support prospective teachers in analyzing their beliefs about teaching and learning and creating new visions about teaching and learning.

METHOD

To portrait prospective mathematics teachers changes of beliefs of an ideal mathematics classroom, a qualitative methodology is used. Qualitative research is chosen because it 'places more emphasis on the study of phenomena from the perspective of insiders' (Lapan et al., 2012). In this research, the 'insiders' are the prospective mathematics teachers who participated in this study.

Two participants, P1M tand P2F took part in this research. They both are prospective teachers in the MEdu, FoE, SU. P1M is male while P2F is female. The data for this research is taken from their written reflections, about their ideal mathematics classroom, which they made in February 2017. The reflection was part of their assignment in a course they took in the second year of university named 'Teaching and Learning Mathematics (TLM) 1'. It should be noted that before PIM and P2F wrote their reflection, I, as the lecturer gave an example of my own an ideal mathematics classroom. They were also asked to read the book chapter "Introduction: Understanding the Urgency" from "What's Math Got to Do With It? : How Parents and Teachers can Help Children Learn to Love Their Least

Favorite Subject" written by Boaler (2015). Both, the example and the reading might have influenced their writings.

In May 2019, both participants were already in their third year of university. They were interviewed to find out whether have they changed their belief of an ideal mathematics classroom. Firstly, they were asked to reread their own writing, about the ideal mathematics classroom, which they made in 2017. Then, they were asked to describe the kinds of changes in their belief, if any. They were also asked to explain the reasons why their belief changed.

RESULT AND DISCUSSION

Based on the findings, both participants have changed some of their beliefs about an ideal mathematics classroom. P1M explained that his perspective on how mathematics should be taught has changed. In the other hand, P2F belief of an ideal classroom did not change much. Since the beginning, she believed that an ideal mathematics classroom is a place where students feel safe to have dialogues with the teacher. She also views that students should learn mathematics in an enjoyable way. Although P2F ideal mathematics classroom is based on the same values she had in the past, now she can imagine her ideal mathematics classroom in a more concrete and detailed way.

P1M Ideal Mathematics Classroom

P1M used to view think that students learning happens when teachers explain a material and students listen. Although his view is not completely wrong, in 2019 he noticed that there are other ways of learning mathematics. P1M reflection of an ideal mathematics classroom in 2017 is as follows:

TABLE 1. P1M reflection of an ideal mathematics classroom in 2017

Reflection
My ideal mathematics classroom, from the perspective of me as a student and from the perspective of a teacher (when I become one) are as follows: First, whenever the teacher explains, students listen and follow the teacher's instruction. All the students must focus on the teacher's explanation so their understandings of the content will be better.   Second, after the teacher explains, the teacher gives the students exercises so students can practice applying what they have learned.   Thirdly, I would be very happy, whenever a student is not afraid to ask teacher whenever they do not understand the content. I also like when students can explain their understandings to their peers. This makes the classroom feel more fun because students feel like they are learning with their own friends.   Fourthly, when students finish their lesson, they are given homework so they can review their understandings and understand what they have learned better.   Overall, to me, an ideal mathematics classroom is when the teacher explains a content, students listen and then practice exercising. Whenever the student finds difficulties, they are not afraid to ask their teacher or friend. Students also should study at home so that is why homework is given to them.

After reading his previous writing, P1M said he had changed most of his ideas about an ideal mathematics classroom. P1M said:

> *"Before I believed that teaching mathematics meant the teacher explains than the students listens. Now my view has changed. I now believed that mathematics can be learned in many other ways, for example through games or through creating projects."*

P1M mentioned two main events that changed his idea of an ideal mathematics classroom. First, his experience during SEP. Second, the Problem and Project Based Learning Course he took during his second year at university.

As part of the SEP program P1M had to spend two weeks in a public primary school. For that SEP, his role was to be the teacher's assistant. Being in school gave him opportunities to interact with primary school students. P1M explained:

> *"During SEP, I had the opportunity to talk with primary school students. They said that they were bored whenever they had to learn mathematics. The teacher talked and talked while they had to listen. That made them bored. I then realized that listening to the teacher seemed to work for me, as a student. Nevertheless, that does not always work for other students. Other students learn differently. Maybe we could use games or other kinds of activities to learn mathematics. Student can learn mathematics through a more fun way"*

P1M also explained that one the courses also influenced his new belief of an ideal mathematics classroom. The course was Problem and Project Based Learning in The Mathematics Classroom. The idea that mathematics can be taught through letting students solve problems and creating projects was eye-opening for P1M.

In the Problem and Project Based Learning Course, prospective teachers had to design a lesson using problem-based learning. They also had to design a lesson plan, create a worksheet, and implement problem-based learning on school students. Learning how to design project-based learning were also part of the course. Prospective students were asked to design a written guideline on how to conduct a mathematical project. Some of the examples of the projects were inspired by the website developed by Buck Institute of Education (BIE). P1M explained how the course changed his belief about an ideal mathematics classroom as follows:

> *"Through the Problem and Project Based Learning in The Mathematics Classroom Course, for the first time I realized that mathematics can be learnt through projects. For example, we can ask the students to learn statistics by identifying the type of vehicles students go to school with. Taking that course gave me new insights on how mathematics can be taught. My ideal mathematics classroom is not just about teachers explaining mathematics but also involving students in solving problems and working on projects."*

P2F Ideal Mathematics Classroom

P2F has always believed that her ideal mathematics classroom would be a place where her students felt comfortable at. For her, it is important that students feel safe to have dialogues with their teacher. P2F reflection of an ideal mathematics classroom in 2017 is as follows:

TABLE 2. P2F reflection of an ideal mathematics classroom in 2017
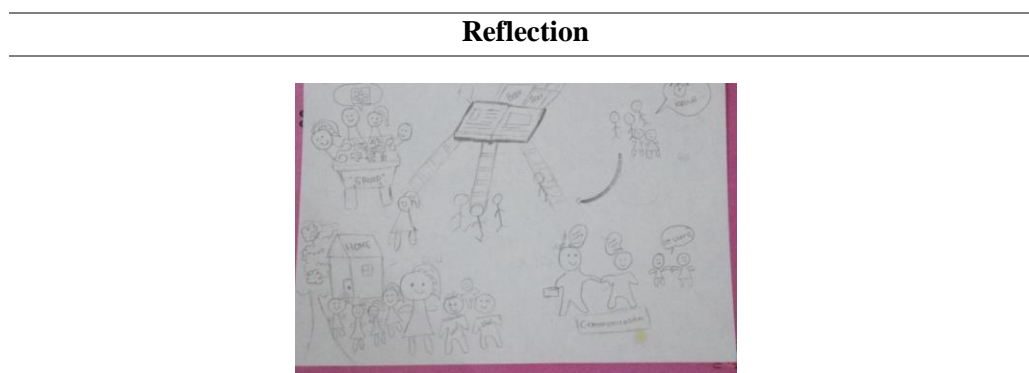
Reflection
Every future educator, especially teachers have an idea of the ideal classroom they wish to have. Talking about an ideal mathematics classroom, above is a picture,

which I made by myself. The picture represents my ideal mathematics classroom when I become a mathematics teacher in the future.

On the bottom left, there is a picture of students, feeling like they are at their own home. The picture means that my ideal mathematics classroom is where my students feel comfortable, safe, and enjoy being in the classroom, like they feel at home. When they are in the classroom, most of the students feel that they want to go home earlier. When I was still a child, whenever the classroom feels uncomfortable, when my teacher explains something I did not understand and my friends are unkind, it makes me feel like I want to go home earlier. Furthermore, I want to have students who have the high level of motivation to learn something in the classroom when they go to school and excited when they learn it. I hope it can make students feel that they need knowledge. When they go to school, they get something that give benefit to them and they do not want to go home with an empty brain.

On the top left, there is a picture of students siting in the groups. They are working together to arrange a puzzle. This picture means I want to make students coordinate with each other whenever they solve a problem. As a result, they solve the problem more quickly than if they solve it individually. Students discuss problems in groups. Each group consist of a variety of students. So, they can share everything and discuss the topic together. In addition, working in groups help students build sympathy with each other. I also think it is an effective way to help each other.

On the top right and the middle, there are pictures of students when they listen to the school bell when it is ringing. It indicates that the class is already finished. However, they are not satisfied, to gain knowledge yet. After they learned something in the classroom, they go to other places where that they can find resources to learn new knowledge. I want to create a situation like that, where my students are interested in exploring everything what they want to know. However, it is still in my control. In other words, students have a great sense of curiosity. It is not only the students who must have a great sense of curiosity, but I also must have it too. A teacher must be long life learners.

On the bottom right is a picture of people communicating to each other. It is the picture of students communicating with teachers and students communicating with students. I expect to be able to communicate well. Communication is very important in the classroom. When there is good communication, students and teacher can become closer and understand each other. Good communication also prevents misunderstanding or some mistakes. Therefore, serious but relax is my principle of teaching.

After reading her previous writing, P2F said that there are still values, which are reflected in her ideal mathematics classroom that she still believes in. P2F said:

> *"I always believed that learning mathematics should be fun. I believed that students should feel comfortable with their teachers. Students must also feel safe to talk about anything to their teachers. I still believe that is the case."*

However, P2F's belief of an ideal mathematics has changed slightly. She started to realize that learning mathematics can be done by integrating technology. This view was influenced by a the "Educational Technology" which she took. Besides that, she realizes that most of her lecturers use Learning Management Systems (LMS) for teaching. Seeing that, she imagines that her ideal mathematics classroom could happen not online through face-to-face sessions but also online sessions. P2F explained:

"Before, I did not think of incorporating technology in the classroom. In the Educational Technology Course, the lecturer showed how to use an I-Pad to help students with special needs to learn mathematics. In this era, it is inevitable not to incorporate technology in the classroom. Here most of the lecturers use LMS teaching. Students can learn both offline and online. I think I can use that too."

Furthermore, P2F also was affected by a workshop she attended on Hypothetical Learning Trajectory (HLT). This workshop was held by MEdu, FoE in collaboration with Southeast Asian Minister Education Organization Regional Centre for Quality Improvement of Teachers and Education Personnel in Mathematics (SEAQiM). The facilitator of the workshop exhibited various ways of using GeoGebra for teaching mathematics. P2F said:

"By joining the HLT workshop I learned how GeoGebra can be used to make geometrical figures and can be used for teaching. My ideal mathematics classroom would be fun. I had the same idea before. However, now I also would like to use technology as a tool for learning."

P2F also explained that now she considers play as an important part of learning mathematics. This was affected by two of the courses she took which was Social Emotional Learning and Number Theory. P2F described:

"Students should not feel that learning mathematics is a burden. They should feel the enjoyment of learning mathematics. In the Social Emotional Learning Course, the lecturer showed a video about how 'play' was considered important for students learning, especially in the Finland schools. Through play, students can learn new things. In the Number Theory Course, I learned mathematics by playing a game of the Tower of Hanoi. That was an example of how learning mathematics could be done through play."

P2F also took two courses which were TLM 1 and TLM 2. Both, encouraged her to read more references on teaching and learning mathematics. This made her have a clearer idea of how her ideal classroom would look like. P2F explained:

I always wanted students to learn mathematics in a fun way. In the past I did not really know what 'fun' would look like. Now, I can imagine the details of the strategies that can be used for teaching mathematics. When teaching fractions, there are certain strategies that can be used, for teaching other topics it would be different. In TLM 1 & 2 there was a lot of reading, especially about the strategies that can be used to teach mathematics. Now I know more references that give new ideas on how to teach mathematics."

Besides the courses she took, P2F belief of an ideal mathematics classroom was also influenced by SEP. During SEP she had to teach a classroom. Students in her classroom did not seem interested in learning. So, based on a discussion with her SEP peer, she decided to use puzzles for teaching. The idea of using puzzles was inspired by the TLM 1 course. In the TLM 1 course, prospective teachers learned how to use toothpicks to solve geometric puzzles. She explained:

"One of my SEP was done in a public junior high school. The students in that classroom were so noisy. They were supposed to learn about the properties of two-dimensional shapes. I was supposed to teach the class with another peer. She told me that it would be a good idea to use the toothpick puzzle to gain the students attention. We tried it and it worked."

CONCLUSION

This research reveals that prospective teachers' belief of an ideal mathematics classroom is not static. From February 2017 until May 2019, the prospective teachers' beliefs have changed. Each prospective teacher's belief has changed in a unique way. P1M used to believe that mathematics learning can be done simply by listening to a teacher explain about mathematics and practicing

mathematics exercises. To him, mathematics used to be something that a teacher 'teaches' to students. Now his ideal mathematics classroom is when students can learn mathematics through games, problems, and projects. He now believes that mathematics learning should be more engaging, students should not learn mathematics passively. P2F always believe that mathematics learning should be enjoyable. In the past her view of an enjoyable mathematics classroom is simply a safe classroom, where students work in groups and can feel comfortable with their teacher. Now, P2F thinks of her ideal mathematics classroom in a more detail way. Students learn mathematics through using technology and other forms of play.

Both P1M and P2F are affected by the courses they take in university. Although both take the same courses, what influences each prospective teacher are not the same. P1M was influenced by the Problem and Project Based Learning Course, while P2F were influenced by many other courses such as Educational Technology, Social Emotional Learning, Teaching and Learning Mathematics 1 & 2, and Number Theory. P2F change of belief of an ideal mathematics classroom were also affected by her readings about teaching and learning mathematics. P1M and P2F were both influenced by their clinical practices in schools. P1M was affected by his experiences of having dialogues with primary school students, on how they hated mathematics. In the other hand P2F was affected by her experiences in using games for teaching mathematics to middle school students.

Although this research only provides a portrait of prospective teachers change in terms of their belief of an ideal mathematics classroom, it is still valuable. The finding shows that the education that the prospective teacher gets does affect their belief. Consequently, teacher education institution must design their curriculum carefully, by considering the beliefs the prospective teachers have and might have in the future. Further research regarding to this issue can be done by analysing the changes of prospective teacher beliefs their ideal mathematics classroom in teacher education institutes programs. This may give a more broader insight to understand how change can happen in different teacher education contexts.

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