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Factors that Influence the Understanding of Good Mathematics Teaching

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This study explored the factors that influenced the understanding of good mathematics teaching. A mixed methodology was used to investigate the beliefs of beginning secondary teachers on good mathematics teaching. The two research instruments used in this study were the survey questionnaire and an interview. Beginning teachers selected Immediate Classroom Situation, Mathematical Beliefs, Pedagogical Content Knowledge, and Colleagues as the top four factors from the survey analysis that influenced their understanding of good mathematics teaching. The study's results have implications on investigating specific mathematical content knowledge that is important for classroom instruction at the secondary level. Furthermore, this study can be used as a reference for teacher education programs to improve the effectiveness of the pedagogical courses in mathematics education.

Keywords: understanding, influence, good mathematics teaching, beginning secondary teachers, teacher education, PCK

INTRODUCTION

Polya (1962) asserts that "If the teacher is bored by what he is teaching, it is a certainty that all his students will be too" (p. 60). It is important for teachers to know their subject matter, as explained by Polya (1981) in his Ten Commandments for Teachers. Thom (1973) asserts that the conception of mathematics influences how one perceives the preferred way of teaching and learning of mathematics. Thompson (1992) points out that there are not many common definitions of what constitutes good teaching. Shulman (2003) explains that good teaching "relies on whether teachers have a deep and flexible understanding of what they are teaching" (p. 1). Cooney (2005) fills in the gap on what constitutes good teaching. The study used the perspectives of nine experienced mathematics teachers.

Teachers without adequate content knowledge spend more time learning the content instead of planning the lesson to enhance student understanding

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(Brown & Borko, 1992). These authors stated that teachers with strong content knowledge are able to explain the concepts instead of just the mathematical procedures. Caroll (2005) and Nickson (1998) had different views and argued on how the content knowledge was acquired makes the difference and not the level of content knowledge. Another study found that even though content knowledge is important, teachers also require knowledge of students and learning to be effective (Shulman, 1986).

Review of Literature

Several studies have also connected students' conception of learning and descriptions of good teaching in college (Marton & Saljo, 1984; Van Rossum & Taylor, 1987). Van Rossum and Taylor (1987) mention that the perception of college students on good teaching is "presenting the subject matter in such a way that those who were already interested remain so, or become more so" (p. 18). Looking at studies done by Brown and Borko (1992), Sowder (2007), and Wilson et al. (2002) can inform educators on what is good teaching and how it is developed along the main theme of teacher education. A greater understanding of "good

State of the literature

- Arbaugh (2010) asserts that the two attributes of mathematics teachers that are essential to student learning are the teacher's knowledge of teaching and the teacher's belief about teaching and learning mathematics. With these attributes, classroom teaching is better.
- Carroll (2005) and Nickson (1998) have different views and argue that how the content knowledge was acquired makes the difference and not the level of content knowledge.
- At the secondary level, Cooney et al. (2005) conducted a study on what constitutes good mathematics teaching and how it develops, not from the researcher's point of view but instead focusing on the perspectives of nine high school teachers

Contribution of this paper to the literature

- In this study the factors that influenced the understanding of good mathematics teaching were explored.
- This study looked at where to attribute the elements of good mathematics teaching: to some personality trait, to teacher's classroom behavior, to teacher's mathematical knowledge or to teacher education programs.
- This study sought to answer the following research question: What are the factors that influence beginning teachers' understanding of good mathematics teaching?

mathematics teaching" and beliefs of high school teachers will add to the body of literature.

Arbaugh (2010) asserts that the two attributes of mathematics teachers that are essential to student learning are the teacher's knowledge of teaching and the teacher's belief about teaching and learning mathematics. With these attributes, classroom teaching is better. What kinds of knowledge are important for effective mathematics teaching? Studies indicate that identifying kinds of knowledge is pertinent for the mathematics education community, especially for professors training pre-service teachers and in-service teachers at the university (Arbaugh, 2009, 2010; Lampert, 2002).

Wasserman (2011) examined how beginning secondary mathematics teachers defined success and the attributes of good teaching. The sample was from a traditional certification program. Ham (2011) conducted a similar study using a sample from an alternative certification program. Both studies identified several important attributes of good mathematics teaching and when success was acquired. More studies on the

definition and attributes of good mathematics teaching from the perspectives of beginning secondary teachers would contribute to the body of literature on teacher education.

Teachers' content knowledge is important in the teaching of mathematics, but other forms of knowledge such as pedagogical content knowledge (PCK) (Shulman, 1986) are also pertinent. Other studies of teacher education have shown that different kinds of knowledge are needed by teachers to be effective such as: 1) theory of knowledge (Schoenfeld, 1998); 2) teacher knowledge and its impact (Fennema & Franke, 1992); and 3) mathematics knowledge for teaching (Ball & Bass, 2004) and for elementary school teachers and their content knowledge (Ball, 2004, 2007; Brown & Borko, 1992; Ma, 1999). Much research has focused on content knowledge, but little is known about the connection between PCK and good mathematics teaching (Chamberlin, 2005). Ball (2007) conducted many studies on this issue and then developed the concept of Mathematics Knowledge for Teaching (MKT), which is defined as "mathematical knowledge needed to carry out the work of teaching mathematics" (Ball et al., 2009, p. 96) to bridge the gap in good teaching. The researcher divided MKT into subject matter knowledge and PCK.

Murphy (2004) explored beliefs about the characteristics of good teaching. The study was carried out on pre-service teachers, in-service teachers, and second graders using a combination of survey, drawing diagrams, and interviews. Beginning secondary school teachers' perception of good mathematics teaching and some connections with content knowledge have also been studied (Murphy, 2004; Sowder, 2005).

One interesting area to investigate in good mathematics teaching is understanding how this concept is influenced by the age and mathematics background of the teacher. It is also important to know how beginning teachers acquire and develop good mathematics teaching. Many studies have been done to investigate the connection between effective teaching and teachers' knowledge of mathematics (Ball, 2005; Brown & Borko, 1992; Conney, 2005). The better the understanding of how good mathematics teaching is developed, the more teacher education programs and in-service training can be improved (Cooney, 2001; Frykholm, 1999; Shulman, 2001).

At the secondary level, Cooney et al. (2005) conducted a study on what constitutes good mathematics teaching and how it develops, not from the researcher's point of view but instead focusing on the perspectives of nine high school teachers. The study sought to find out whether the views of the teachers were similar to the Standards suggested by the NCTM (1989, 1991) documents. The findings indicated that the teachers' perspectives of good mathematics teaching

were consistent with the NCTM Standards and the pedagogy prescribed in the NCTM documents. The study also concluded that good mathematics teaching requires prerequisite knowledge, promotes mathematical understanding, and requires effective management.

One might conclude that the views of the teachers were towards a more student-centered classroom as per what they learned during their teacher preparation program. Surprisingly, this was not the case, however, as the teachers mentioned that they were more comfortable with the teacher-centered approach “as long as their instruction styles could exercise different ways of reaching out to students” (Cooney et al., 2005, p. 105). Is the knowledge gained from teacher preparation programs sufficient for good mathematics teaching? According to the participants in Cooney et al.’s study, “knowledge learned at the university was important but that it had to be tempered with more important knowledge gained from classroom experience” (p. 99). Another dimension of the notion of good mathematics is connected more with the teachers’ experience rather than with being a student in a teacher preparation program (Cooney et al., 2005).

Purpose of Study

In this study the factors that influence the understanding of good mathematics teaching were explored. This study looked at where to attribute the elements of good mathematics teaching: to some personality trait, to teacher’s classroom behavior, to teacher’s mathematical knowledge or to teacher education programs. This study sought to answer the following research question: What are the factors that influence beginning teachers’ understanding of good mathematics teaching?

METHODOLOGY

To answer this research question, the responses to the survey and interview were utilized. To answer this research question, the researcher analyzed the survey responses of the participants. Several descriptive statistics were calculated such as mean, standard deviation, median, and mode. With these values, the researcher was able to make several generalizations about the factors that influenced the understanding of good mathematics teaching among the 33 participants. Next, the survey questionnaire was analyzed using the percentage of responses with the 5-point Likert scale. To further investigate the factors that influenced the understanding of good mathematics by the beginning teachers, the researcher utilized the qualitative section of this study. The data obtained from the 10 randomly selected participants interviewed were then analyzed. Selected participants were asked to select their top two

choices of the factors that influenced their understanding of good mathematics teaching from the list of factors provided in the survey item. Next, the interviewed participants were asked to justify their choices of the selected factors.

Participants of study

Using the number of graduates from previous years, the cohort of the participants invited to participate in the study was approximately 80 beginning teachers; 33 of them responded and became the subjects of this study. All the participants who joined this study answered the web-based survey questionnaire were from a graduate school of education.

The interview participants were randomly selected. The technique used was a simple random sampling of the 33 participants who participated in this study. This subsample was selected randomly based on their participation in the survey questionnaire. Based on the criteria for selecting the subsample for the interview, the researcher randomly selected 10 beginning teachers.

RESULTS

The research question was: What were the factors that influenced the understanding of good mathematics teaching? To answer this question, the researcher analyzed the survey responses of the participants. Several descriptive statistics were calculated such as mean, standard deviation, median, and mode. With these values, the researcher was able to make several generalizations about the factors that influence the understanding of good mathematics teaching among the 33 participants. Table 1 below provides a summary of the descriptive statistics for the first item on the survey based on the responses of the participants.

Participants rated each indicator from the survey responses. The scale used was a 5-point Likert scale. On average, most of the participants selected Immediate Classroom Situation with the highest mean of 4.27, followed by Mathematical Beliefs, PCK, and Colleagues. These were the top four factors that influenced the understanding of good mathematics teaching as selected by the participants of the survey. The least selected factor was Teacher Education, with the lowest mean value of 3.36.

The item with highest standard deviation was Teacher Education. A high standard deviation indicates a lot of variation in the survey responses, perhaps because beginning teachers were still finding the best methodology for good teaching. Moreover, they were strongly influenced by what they learned from their teacher education program. Immediate Classroom Situation recorded the lowest value for the standard deviation. This indicated that most of the observations

Table 1. Descriptive statistics of the indicators ($n=33$)

Indicators/Factors	Mean	St. Dev	Median	Mod
Teacher Education	3.36	1.295	4.00	4
Mathematics Background	4.30	0.810	4.00	5
Colleagues	3.85	0.939	4.00	4
Professors in methods classes	3.48	1.278	4.00	4
Personality and Experiences in growing up	3.55	1.121	4.00	4
PCK and awareness	3.88	0.960	4.00	3
Immediate Classroom Situation	4.27	0.626	4.00	4
Mathematics Beliefs	4.09	0.805	4.00	4

Table 2. Percentage of responses by factors ($n=33$)

Indicator/Factor	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Teacher Education	3	9.09	7	21.21	5	15.15	11	33.33	7	21.21
Mathematics Background	0		1	3.03	4	12.12	12	36.36	16	48.48
Colleagues	1	3.03	1	3.03	8	24.24	15	45.45	8	24.24
Professors in methods classes	3	3.03	5	15.15	6	18.18	11	33.33	8	24.24
Personality and Experiences in growing up	0		8	24.24	7	21.21	10	30.30	8	24.24
PCK and awareness	0		2	6.06	11	33.33	9	27.27	11	33.33
Immediate Classroom Situation	0		0		3	9.09	18	54.54	12	36.36
Mathematics Beliefs	0		2	6.06	3	9.09	18	54.54	10	30.30

clustered around the mean value of 4.27. Immediate Classroom Situation was one of the top factors that influences understanding of good mathematics teaching, and this corresponded with the attribute of Classroom Management, which was also one of the top choices selected by the survey participants.

Next, the survey questionnaire was analyzed using the percentage of responses using the 5-point Likert scale as shown in Table 2. The factor with the highest percentage of respondents selecting Agree and Strongly Agree was Immediate Classroom Situation, with 90.9%. This was followed by Mathematical Beliefs, with 28 or 84.85% of the respondents choosing this factor. Next was Colleagues, with 23 or 69.7% of the respondents. These results were similar to the top three factors analyzed using the mean of the factors. The factor with the lowest percentage of Agree and Strongly Agree was Teacher Education, with 18 or 54.55% of the respondents selecting this indicator.

Qualitative Analysis

The research question was: What were the factors that influenced the understanding of good mathematics teaching? To know the factors that influence the understanding of good mathematics by the beginning teachers, the researcher utilized the qualitative section of this study. The data obtained from ten selected participants interviewed were then analyzed. Selected

participants were asked to select their top two choices from the factors provided. Next, the interviewed participants were asked to justify their choices.

These were some of the interview questions:

As you reflect on your early years of teaching, what were the factors you believe were MOST important in developing your understanding of good mathematics teaching (Question 24 of the Survey, for example: professors, former teachers, mathematical beliefs etc). Pick the top two factors and explain your reasons.

Are these the factors that helped you practice good mathematics teaching in your classroom like the way you defined good mathematics teaching earlier?

Immediate Classroom Situation was one of the factors picked by the selected participants. Table 3 presented the coded interview reasons for the selection of the factor. This factor includes the students, the mathematics topic at hand, and time constraints in the classroom. It was interesting to note that one of the reasons given was that each class had its own characteristic, whether the class consisted mainly of students with strong content or weak content. Thus, the personality of each class did play a part in understanding good mathematics teaching and how a teacher differentiates her teaching pedagogy. As one participant shared:

Table 3. Coded Interview Reasons for Immediate Classroom Situation (Select Group, $n=10$)

Category	Reasons
Immediate Classroom Situation	<ul style="list-style-type: none"> • Really important to be able to recognize the classroom situation because each class is a little different from the others • One class might be more stronger, one class might be a bit weaker • In terms of the knowledge, one class might do the workload faster or slower • And this was the case with the classroom that I taught and I had to kind of learn the personality of that classroom • Even though it was the same lesson for both the classes. I would have move things around, go over more examples in one classroom. • And do less in another classroom • Until you are actually teaching in a class, you do not really have a full understanding of what works and what doesn't • A lot of what I have learn is on the go like until harm arise I realize how I should have reacted, what I should have done • And I think that the most important is what happens in the classrooms

Table 4. Coded Interview Reasons for Colleagues (Select Group, $n=10$)

Category	Reasons
Colleagues	<p><u>Experiences</u></p> <ul style="list-style-type: none"> • Classmates in my teacher education program as well as the colleagues I currently work with • When we were student teaching, people had different experiences in the classroom with different structure schools and so on and so forth. And to learn from them • Everybody has different experiences, through sharing experiences, ideas and strategies we can help each other better • Or whereas in a more traditional school, or a more constructivist school, I could learn some strategies from them on how to teach effectively • Having a good, having colleagues who are able to help with their understanding on how to teach something is very important. <p><u>Sharing of Ideas</u></p> <ul style="list-style-type: none"> • Whenever I got a good idea, whether from my classmates or co-worker, I try to implement it right away so that my students benefit immediately • Is really good to have a strong group of colleagues where you can bounce ideas off • New school I am teaching, there are 4 to 5 math teachers for me to like to work with and collaborate with. • That my classroom and my other colleagues, and seeing them in their classroom and hearing about their experience • Meeting them once a week, talking with them also with a math coach, that has help me a lot in understanding how I should teach if I have done a non-effective way of teaching • We share our experiences, our problem and also our successes. <p><u>Observation</u></p> <ul style="list-style-type: none"> • Co-operating teachers. Because seeing what is going in their classrooms, what's working, what's making them an exemplary teacher is really then able to take me, you know in a point where I think • Observing what works in a colleagues class and trying to implement it in my class

And this was the case with the classroom that I taught and I had to kind of learn the personality of that classroom. And kind of tweak the way I taught the lesson. Even though it was the same lesson for both the classes. I would have move things around, go over more examples in one classroom. And

do less in another classroom. The more time for them to work together and not in one classroom versus another.

Another reason cited was only when the teacher steps into his or her own classroom will they learn what works and what does not in the classroom. This cannot

be taught by the teacher education program. The participant even elaborated that during student teaching, one gets some understanding of good teaching, but the real experience only happens when one is in charge of one's own classroom. One participant mentioned:

A lot of what I have learned is on the go like until harm arises, I realize how I should have reacted, what I should have done. And I think that the most important is what happens in the classrooms.

The next factor selected by the four interviewed participants were Colleagues. Table 4 presented the coded interview reasons for the selection of Colleagues. This factor included collaboration in school between teachers and also classmates in the teacher education program. The reasons cited by the participants can be partitioned into three categories, namely Experiences, Sharing of Ideas, and Observation. The first category of Experiences focused on the experiences of the senior teacher that could be learned by the beginning teachers. Furthermore, the participants mentioned that they learned some teaching strategies from the different schools

They visited during student teaching. Finally, having a colleague who could help one understand what is good teaching was extremely important to improve the lesson. One participant summarized as follows:

Everybody has different experiences, through sharing experiences, ideas and strategies we can help each other better. When we were student teaching, people had different experiences in the classroom with different structure schools and so on and so forth. And to learn from them. Or whereas in a more traditional school, or a more constructivist school, I could learn some strategies from them on how to teach effectively.

Sharing of Ideas was the next sub-factor mentioned in the interview. Participants asserted that the sharing of ideas definitely assisted in their daily teaching. What was more important was the sharing of successful lessons and unsuccessful ones. The essential point was also the weekly meeting between the senior teachers and other teachers to exchange ideas. It worked even better when colleagues could share ideas and discuss constructively what works and what does not. As one participant reasoned:

Meeting them once a week, talking with them also with a math coach, that has helped me a lot in understanding how I should teach. If I have done a non-effective way of teaching, because I am not the only first year teachers, some other teachers in my department are also first year teachers. We share our experiences, our problem and also our successes/

The final point discussed was the classroom Observation of the more experienced colleagues. One participant mentioned that what worked in the lesson by an experienced colleague would be implemented in his/her classroom. This helped the beginning teacher learn by observing an experienced teacher conduct the

successful lesson and seeing how students responded. Then the beginning teacher could implement some of the techniques that were observed immediately in his own class. One participant shared:

Because seeing what is going in their classrooms, what's working, what's making them an exemplary teacher is really then able to take me, you know in a point where I think, Oh I see how's that working. Oh I agree that it is important. That is what is going to make it work. And then obviously doing it in my classroom. Seeing oh, it doesn't work. Because it is missing this or doesn't work because I am missing that. Or oh this is working, what is making that work.

Personality and Experiences Growing Up was one of the top factors that influenced the understanding of good mathematics teaching. Table 5 presented the coded interview reasons for the selection of this factor. Five beginning teachers who were interviewed selected this factor. All the reasons mentioned could be categorized into four sub-categories such as Good Example, Former Teachers, Beliefs from Childhood, and Own Experience. In Good Example, the participant mentioned that he wanted to be a successful teacher by setting a good example for his students in his classroom. The participant added that teaching suits his personality. Furthermore, setting a good example for his siblings was something that was expected of him since he was young and he could accomplish this by becoming an effective mathematics teacher. The participant said:

My personality and experiences growing up. Just wanting to set a good example for the students. I have two younger brothers and two younger sisters. I was expected to set an example and something that I was used to growing up. It kind of fit my personality.

The second sub-category of Former Teachers illustrated the importance of former teachers who were exemplary to the beginning teachers. Taking qualities of that exemplary teacher and using them in their present classrooms were things the beginning teachers intended to happen in their classrooms. This showed the strong influence of former teachers who taught well in the classrooms. Former students like the beginning teachers in this sample recalled the effective teaching methods of those wonderful teachers. As one participant mentioned: "I mean to some extent, I think back on what those teachers did that I would want to imitate or what I would want to emulate. But I think for me, in some ways it is so."

Beliefs from Childhood was strongly connected to how the beliefs of beginning teachers were influenced by the successful lesson they remembered. The feeling of this great lesson strongly influenced how the beginning teachers developed their lessons. How they felt in the classrooms while growing up strongly influenced the teaching styles of the beginning teachers.

I feel like my math belief, I got my math belief mostly from my childhood. When you feel like as a

Table 5. Coded Interview Reasons for Personality and Experiences Growing Up (Select Group, $n=10$)

Category	Reasons
Personality and Experiences Growing up	<u>Good Example</u>
	<ul style="list-style-type: none"> • Just wanting to set a good example for the students • Was expected to set an example for my siblings and something that I was used to growing up • Fits my personality
	<u>Former Teachers</u>
	<ul style="list-style-type: none"> • My experiences in growing up, I am still a new teacher so that is important right now • Reflecting on my past teachers did that I would want to imitate or what I would want to emulate • The real big part of it is that the school that I went to was a Catholic school, it was predominantly White and Asian
	<u>Beliefs from Childhood</u>
	<ul style="list-style-type: none"> • Got my math belief mostly from my childhood because I was taught this way • That the fact that I remembered this feeling, it was successful way the teacher taught me • A constructivist, you might think deal with the students sort of develops the mathematics knowledge on their own • Just very hard to do sometimes in a real life situation
	<u>Own Experience as a Student</u>
	<ul style="list-style-type: none"> • Based on my own experience as a student, I all through elementary till high school, it was mostly a lecture based learning • I try to do more of student-centered approach when it is feasible • I love to be able to do that more group work in the future.

Table 6. Coded Interview Reasons for Mathematics Background (Select Group, $n=10$)

Category	Reasons
Mathematics Background	<ul style="list-style-type: none"> • Always keeping up with practice, taking courses, staying sharp with the math and the content. • Always important because it is good to know what you are talking about • Show the students that you are interested in it and well worth for them to be interested in it. • Mathematics background is like the way I learnt and just my knowledge in general • It helps for good mathematics teaching

child, I was taught this way. And you know, it worked for me. It was successful. I feel like that the fact that I remembered this feeling, it was successful way the teacher taught me. Therefore they can help me teach the same way, it would be successful.

Finally, Own Experience as a student also influenced the teaching style of the beginning teachers as they did not seem to want to emulate teachers who were not producing good lessons. Instead, the beginning teachers wanted to implement something good they learned from the teacher education program such as the student-centered approach in teaching.

Pieces that I often think, based on my own experience as a student, I all through elementary till high

school, it was mostly a lecture-based learning. And I as much as I want to move away from it, that is mainly the way I teach. I try to do more of student-centered approach when it is feasible. But it usually we do not have time. I love to be able to do that more group work in the future.

One more factor important in the understanding of good teaching was the teacher's Mathematics Background. Table 6 presented the coded interview reasons for the selection of this factor. As two of the interview participants mentioned, this particular factor was essential for teachers to know the materials they were going to teach. Another reason asserted was that the knowledge of mathematics helps in producing good

mathematics teaching. Also when one knows the subject, one can share the subject in an interesting way and get the students interested also. The participant mentioned:

Always keeping up with practice, taking courses, staying sharp with the math and the content. I feel that it is always important because it is good to know what you are talking about. You show the students that you are interested in it and well worth for them to be interested in it.

Mathematics background is like the way I learned and just my knowledge in general. It helps for good mathematics teaching.

Teacher Education was also one of the factors that influenced the understanding of good teaching. Table 7 presented the coded interview reasons for the selection of Teacher Education. Four of the selected participants picked this factor as their top choice. Most of them mentioned that their teacher education program prepared them well for the mathematics lesson in the classrooms. The video analysis of a mathematics lesson was an effective way to improve teaching. With a deep understanding of different methodologies of good teaching, a beginning teacher would be able to use the best ways to make the mathematics lesson in the classroom comprehensible to the students. Learning how to plan lessons and various ways of devising lessons also helped the beginning teachers. Some of the participants' views are cited below:

I think the teacher education program is the most important, explaining how to plan lessons, make it more interesting, various methods of curriculum that we could use. Something more constructivist, something more formal. I so like being in the classroom.

I think that it was the discussions during classes that really started me thinking. Oh really, I have this informal observation when I was student. But I wasn't thinking about

what makes this teacher a good teacher when I was a student. So that is why I feel that before the teacher education program it wasn't a formal understanding and I think it was during classes we would break apart, what is this teacher doing in this classroom?

I would say the teacher education program because I got like an understanding of methods and what should be done and should be taught. How things should be taught a little more.

Mathematics Beliefs about the nature of mathematics, learning mathematics or teaching mathematics also influenced the development of good mathematics teaching. Table 8 displayed the coded interview reasons for the selection of this factor. One participant reasoned that this factor was equally important as everyone should have the same opportunity to learn mathematics and be good at it. Some students might take a bit longer to master the concepts, but given a chance, students would do well also:

That is really important because I feel that everybody can do math and I think anyone should be treated differently because of performances in a previous class or how they grow. The might take them more time to grow in the course of the year from another student. But they still have the possibility.

DISCUSSION AND CONCLUSION

Beginning teachers selected Immediate Classroom Situation, Mathematical Beliefs, PCK, and Colleagues as the top four factors from the survey analysis that influenced the understanding of good mathematics teaching. Immediate Classroom Situation included the students, the mathematics topic at hand and the time constraints in the classroom. It was interesting to note that teachers mentioned that each class had its own personality due to the diversity of the students. This

Table 7. Coded Interview Reasons for Teacher Education (Select Group, $n=10$)

Category	Reasons
Teacher Education	<ul style="list-style-type: none"> • Prepared me well for math teaching • It was the discussions during classes that really started me thinking • Wasn't thinking about what makes this teacher a good teacher when I was a student • Before the teacher education program it wasn't a formal understanding • Was during classes we would break apart, what is this teacher doing in this classroom? • Student teaching • An understanding of methods and what should be done and should be taught • How things should be taught a little more

Table 8. Coded Interview Reasons for Mathematics Belief (Select Group, $n=10$)

Category	Reasoning
Mathematics Belief	<ul style="list-style-type: none"> • I feel that everybody can do math and I think anyone should be treated differently because of performances in a previous class or how they grow • This might take them more time to grow in the course of the year from another student.

finding is consistent with Cooney et al. (2005) study that classroom experience is equally important for a beginning teacher to ensure a good mathematics lesson happens. Another reason given was how the personality of the class at the moment does influence how a teacher also differentiates the teaching pedagogy in the classroom.

Colleagues were crucial in a beginning teacher's good classroom teaching especially collaboration among mathematics teachers in school. The reasons mentioned by the beginning teachers could be divided into three categories such as Experiences, Sharing of Ideas, and Observation. Sharing of experiences, and strategies in a mathematics classroom with the senior teachers surely helped a beginning teacher develop a good lesson. The study by Ham (2011) and Wasserman (2011) also stated that colleagues as an important factor that influenced the understanding of good mathematics teaching.

Beginning teachers asserted that sharing of ideas definitely assisted in their daily teaching. What was more important was the weekly sharing of successful lessons and unsuccessful ones between colleagues. A beginning teacher that observed what worked a successful lesson by an experienced colleague would emulate this lesson in his classroom. By observing an experienced teacher conduct the successful lesson and seeing how students respond could help a beginning teacher improve his lesson. A similar study by Pietila (2001) found that good mathematics teachers also require sufficient knowledge of mathematics teaching and learning teaching and additional pedagogical knowledge to arrange successful learning situations. The influences of experienced teachers on good teaching plays a major role in the development of a successful beginning teacher.

The interviewed participants selected three similar factors that were Immediate Classroom Situation, Mathematical Beliefs and Colleagues. The difference was the selection of Personality and Experiences Growing Up and Teacher Education as the top two factors. The reasons the participants selected Personality and Experiences Growing Up could be categorized into 4 sub-categories such as Good Example, Former Teachers, Beliefs from Childhood and Own Experience. In Good Example, the reason given was wanting to be a successful teacher by setting a good example for the students in the classroom.

The second sub-category of Former Teachers illustrated how strong the influence of former teachers that were exemplary to beginning teachers. Taking the qualities of the role model teacher and applying that successful technique was something the beginning teachers intend to do in their classroom. This is consistent with results from Arbaugh (2010) study that teacher's belief about teaching especially from their

former teachers strongly influences the beginning teachers classroom practice on good teaching.

Beliefs of Childhood is an important factor that connected the beliefs of beginning teachers to the successful lessons they had in the past. And finally Own Experience as a student also influenced the good teaching of the beginning teachers as they might do not want to emulate unsuccessful lessons they experienced. Instead beginning teachers wanted to implement the pedagogy strategies that were successful in the teacher education program.

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