International Electronic Journal of Elementary Education, 2015, 8(1), 21-40.

Investigation of Teachers' Mathematics Teaching Self-efficacy *

Özge NURLU**
Gazi University, Turkey

Received: July 2015 / Revised: September, 2015 / Accepted: September 2015

Abstract

The aim of this research is to investigate primary school teachers' characteristics by comparing their mathematics teaching self-efficacy beliefs. In this research, qualitative research method is used. In order to determine the participant teachers, firstly, "Self-Efficacy Beliefs toward Mathematics Teaching Scale" (Dede, 2008) was applied to 33 primary school teachers, at seven public primary schools, in Adana, Turkey, in 2011-2012 school years. Then, according to results of the scale, four teachers are chosen to carry out semi-structured interviews. The interview data were analysed by conducting qualitative analytic methods. The results demonstrated that teachers with a higher self-efficacy belief have some different characteristics to those with a lower self-efficacy belief such as showing a higher level of effort and persistence with students, being more open to new ideas and new methods, believing in students' achievements and taking responsibility for students' success, placing more importance on building a warm relationship with their students rather than with the parents.

Keywords: Primary schools, Primary school teachers, Mathematics teaching, Self-efficacy belief.

Introduction

The contribution of mathematics to scientific development and its importance in people's lives, are critical factors in giving mathematics high priority in all levels of education programmes. The aim of teaching mathematics is to provide students with mathematical knowledge and abilities which are needed in everyday life, to solve problems and to develop strategies based on problem-solving approaches (Altun, 2005). Through mathematics education, people can find opportunities to develop abstract, logical and critical thinking, to become confident in using mathematics to analyse and solve problems both in school and in real-life situations. Students' mathematical learning and achievement are extremely important because of these reasons. According to Trends in International Mathematics and Science Study (TIMSS) (2011), there are many affective variables that

* This paper was originally submitted to the University of Warwick for the degree of Master of Arts and supervised by Mike Ollerton.

** Özge Nurlu, Gazi University, Gazi Faculty of Education, Beşevler, 06500, Ankara, Turkey. E-mail: ozgenurlu@hotmail.com Phone: +905446841311

ISSN:1307-9298

www.iejee.com

influence students' learning and achievement in mathematics, such as student attitudes, home support for learning, type of school, school resources, instructional approaches and teacher characteristics.

Teacher characteristics, such as gender, age and experience, are regarded as affective variables that can influence student learning experiences and achievement (Clotfelter et al., 2006; Hanushek et al., 2005). In addition, researchers agree that teacher beliefs toward mathematics and the teaching profession are also important factors in order to have a positive effect on students' learning (Borko et al., 1992; Borko & Rutnam 1996; Shulman 1986). In this regard, teacher self-efficacy, which is defined as teachers' sense of personal ability to organise and execute their teaching (TIMSS, 2011), is not only linked to professional behaviour, but also to enhancing students' achievement (Allinder 1994; Ashton & Webb 1986; Woolfolk & Hoy 1990).

The construction of self-efficacy belief is presented in Bandura's article (1977) Toward a Unifying Theory of Behavioral Change'. He (1995, p. 2) defines self-efficacy as "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations". In other words, self-efficacy refers to an individual's 'I can' or 'I can not' belief. Since the 1970s, Bandura (1982, 1986, 1993, 1996, 1997) has carried out many studies in order to develop and defend the idea that people's beliefs in their capabilities powerfully affect their behaviour, motivation, and ultimately their success or failure.

Thus, exploring teachers' self-efficacy belief toward their mathematics teaching, as an affective variable in students' mathematical achievement, is of paramount significance for researchers. Understanding this factor is directly associated with the increase of students' achievement in mathematics.

Therefore, the aim of this study is to investigate the differences between teachers who have high and low self-efficacy belief regarding their mathematics teaching in terms of efficacy in mathematics teaching, belief in their ability to motivate students and to take on responsibility, effective teaching. In order to answer this question, the following broader research questions must be addressed:

1. What are teachers' perceptions about how their teaching abilities of mathematics help students to learn mathematics?
2. What are teachers' perceptions about the reasons for some students' low mathematics achievement?
3. What are teachers' perceptions about which factors can increase the efficacy of the mathematics teaching process?
4. What are teachers' perceptions about how students' motivation toward mathematics can be improved?
5. What are teachers' perceptions about if parents commented that their child is showing more interest in mathematics, what they would attribute this to?

Method

Qualitative research method is used for this study. In this research, semi-structured interviews are conducted to compare results and gain insights into primary school teachers' self-efficacy beliefs toward their mathematical teaching in terms of efficacy in teaching, their belief in ability to motivate students and to take on responsibility for students' learning and success, and effective teaching.

Sampling

In this study, as a non-probability sampling method, purposive sampling strategy (Cohen et al., 2005) is used. Firstly, 'Self-Efficacy Beliefs toward Mathematics Teaching Scale' (Riggs & Enochs, 1990; adapted by Dede, 2008) is administrated to 33 primary school teachers in 7 schools in Adana, Turkey, in 2011-2012 school years. Results of the Self-Efficacy Beliefs toward Mathematics Teaching Scale are illustrated in Table 1.

Table 1. *Summary of descriptive statistics for teachers' self-efficacy belief*

	N	Minimum	Maximum	*M*	*sd*
Teachers' Self-efficacy Beliefs	33	47	66	55.63	4.29

As shown in Table 1, 33 primary school teachers participate in the study. According to the results of the study, it is evident that all teachers have quite high self-efficacy beliefs toward mathematics teaching.

The questionnaire used to conduct the study has three sub-factors: efficacy in mathematics teaching (4 questions), the belief to motivate students and to take on responsibility for students' learning (6 questions), and effective teaching (4 questions). The results of the sub-factors are shown in Table 2.

Table 2. *Summary of descriptive statistics of sub-factors for teachers' self-efficacy belief*

	N	Minimum	Maximum	*M*	*sd*
Efficacy in mathematics teaching	33	12	20	16.06	1.87
Belief to motivate students and to take on responsibility	33	17	27	22.36	2.68
Effective teaching	33	8	15	12.82	1.59

As Table 2 shows, primary school teachers' self-efficacy belief toward their mathematics teaching is comprised of three sub-factors. According to results of the questionnaire, with regard to the first sub-factor almost all (97%) of the teachers have fairly high efficacy in teaching mathematics and only one teacher out of 33 (3%) indicate that his self-efficacy belief is average. With regard to the second sub-factor, a substantial majority of teachers (90%) respond that their belief to motivate students and to take on responsibility is high, while 6% state that their belief is average, and only 3% report that they have low belief. On the other hand, the questionnaire does not produce similar results when it came to the third sub-factor related to self-efficacy belief in providing effective teaching. Here, 57% of teachers indicate that they have high self-efficacy in providing effective teaching, 24% of them are average, and 18% have a low self-efficacy belief for this factor. These findings reveal that participant teachers felt themselves to have high efficacy in mathematics teaching and in motivating students and taking on responsibility for students' learning. However, they do not feel such high self-efficacy when it came to providing effective teaching for their students.

Secondly, by using purposive sampling strategy, the 4 primary school teachers who get the highest and lowest scores from the questionnaire are included in the study through conducted interviews. The ages of the interviewees are between 35 and 45 and all of them

are female. In addition, their teaching experiences are changing between 12 and 20 years. While three of them are graduated from a department of elementary education, one of them is originally a vocational high school teacher.

The aim of the study and details of how the knowledge would be used are clarified before the contribution of participants in order to make sure they understand the nature of the research as well as its potential impact on participants. All the participants are also informed that participation in the questionnaire and the interview is voluntary, and that they have a right to withdraw from the study at any stage, for any reason. It is also specified in the questionnaire that participants have the right to ask questions during the implementation of the instruments. During the interviews, the interviewees are asked whether they are comfortable being audio-recorded. Moreover, because of the importance of the right to privacy of participants, all questionnaires and interview transcripts are anonymous and confidential; their names are not required and not used in reporting the outcomes of this research.

In addition, a permission is gained from the Turkish Ministry of National Education by using an informed consent form which is about "the nature of the research and the purpose of the research, the risks and the benefits" (Anderson & Arsenault 1998, p. 18) in order to carry out the study in schools in Turkey.

Data collection instruments

For this study, two data collection instruments are used: a survey questionnaire and semi-structured interviews. In order to determine the interview participants, 'Self-Efficacy Beliefs toward Mathematics Teaching Scale' is administrated 33 primary school teachers. The questionnaire, the Self-Efficacy Beliefs toward Mathematics Teaching Scale, was adapted by Dede (2008). Some items of the questionnaire are based on the Science Teaching Efficacy Belief Instrument which was developed by Riggs and Enochs in 1990. As Dede indicates, constructional validity is established in the scale. In addition to this, the reliability of the questionnaire is calculated as 0.799. The questionnaire survey has 14 questions, which is sufficient for indicating teachers' opinions by using a five-point Likert scale of strongly disagree, disagree, unsure, agree and strongly agree. The minimum score of the questionnaire is 14, while the maximum score is 70.

Based on the results of the scale, the two teachers are chosen as participants in the interview who had the highest sense of self-efficacy toward mathematics teaching, and the two teachers with the lowest sense of self-efficacy belief are also chosen. After determining participant teachers, in order to compare results and gain insights into elementary teachers' self-efficacy beliefs toward their mathematical teaching in terms of efficacy in teaching, their belief in ability to motivate students and to take on responsibility for students' learning and success, and effective teaching, a semi-structured interview form is developed and used by the researcher. Interviews are carried out in a silent room. All of the interviews are audio-recorded. These interviews with teachers are lasted between 17 and 34 minutes. The audio-recorded interviews are subsequently transcribed.

Data analysis

In order to determine the participant teachers, data gained from 'Self-Efficacy Beliefs toward Mathematics Teaching Scale' (Dede, 2008) are analysed by using Statistical Package for Social Sciences (SPSS) 19 program. After that, the interview data (n=4) are analysed by conducting qualitative analytic methods. Firstly, the data recorded during the interviews are transcribed in detail on a Microsoft Word document. Secondly, the interviews are transferred into segments which represented complete thoughts on the research question with the purpose of comparing and combining data to find the best

answer to the research question. In addition to this, findings are presented by using abbreviations to quote from participants. For example, (H) is used for teachers with high sense of self-efficacy, and (L) is used for teachers with low sense of self-efficacy. Moreover, numbers are given for each participant such as (H1) and (L1).

Results

In this section, the results of the analysis of the interview data are presented. The interviews are carried out on the basis of the sub-factors the Self-Efficacy Beliefs toward Mathematics Teaching Scale. Four teachers are asked five semi-structured interview questions. Based on the results of the scale, the two teachers are chosen as participants in the interview who have the highest sense of self-efficacy toward mathematics teaching, and the two teachers with the lowest sense of self-efficacy belief are also chosen. The aim of this is to enhance understanding by comparing their answers to the interview questions. Throughout the comparison of the results of the teacher interviews, direct quotes from participants are provided in order to reinforce themes and categories. These quotes have been edited as little as possible; they are translated from Turkish to English language by the researcher.

Efficacy in mathematics teaching

The first sub-factor on the Self-Efficacy Beliefs toward Mathematics Teaching Scale refers to the teachers' efficacy in mathematics teaching. The following question is asked directly of each teacher: 'How do the teaching abilities of mathematics teachers help students to learn mathematics?' The teachers talk about teachers' characteristics and the most effective methods used in helping students to develop their mathematical learning. The results of the interview questions are set out below in Table 3.

Table 3. *Teachers' views about how their mathematics teaching abilities help students' learning in mathematics*

Teachers	The ways the teaching abilities of mathematics teachers help students to learn mathematics	
	Teachers' characteristics	Methods used
H1	Tolerance, the ability to develop a positive student-teacher relationship and to gain parental support.	Giving positive feedback, following students' personal development, and helping students gain self-confidence.
H2	Tolerance, the ability to develop a positive student-teacher relationship and to make students feel valued.	Providing opportunities for all students to participate in classroom activities, following students' personal development.
L1	(Not mentioned)	Providing opportunities for all students to participate in classroom activities.
L2	The ability to develop positive parent-teacher relationships and to gain parental support.	Organising activities to improve students' motivation.

As findings indicate, three of the teachers who participate in the interviews highlight the importance of teachers' characteristics. Teachers with higher self-efficacy belief stress in the interviews that being tolerant is a helpful factor in enhancing students' learning:

> "Teachers should be tolerant. Some families are not as tolerant as teachers. Another mission of teachers is to keep up the tolerance at home." (H1)

> "To love, to be tolerant, to be a model, these are very, very important things for students." (H2)

Also, respondents with higher self-efficacy belief comment on the importance of developing positive student-teacher relationships in order to make students feel valued, as follows:

> "That is to say, teachers' attitude and love toward their students. Students can feel their teacher genuinely love them. Teachers should make students feel it. You give students energy. When you respect your student, the child respects you so much more." (H2)

Likewise, two of the teachers who participate in the study touch upon the ability of teachers to develop parent-teacher relationships in order to gain parental support. The response of one participant is as follows:

> "Regardless of how well the teacher teaches, if there is no support at home, achieving success is difficult. If it is said that Ayse did this, Fatma did that, but you couldn't do it, the child would be affected negatively. … A parent came to the school. His child is fifth grade (11). He said that his child is probably stupid beside the student. His style was entirely wrong. I said, firstly, you should believe your child. You never say, 'You cannot do.' This causes fear of mathematics. You should always say, 'You will do, I believe in you'." (H1)

On the other hand, all teachers highlight the methods used as a way of helping students' learning in mathematics. Particular emphasis is placed by the teachers with stronger sense of self-efficacy on giving positive feedback. For example:

> "Teachers' mathematical teaching ability can enhance many aspects of students' learning. For example, it is important to say 'you can do this' or 'well done'." (H1)

Two interviewees with higher self-efficacy belief recount the impact of following students' personal development in helping students gain self-confidence. One statement from the interviews is as follows:

> "Not every child will enter a mathematics competition and will be the winner, but each of them can be improved. At least, students can gain self-confidence." (H1)

Furthermore, three teachers report providing opportunities for all their students to participate in classroom activities help them to learn. One of the interviewees mentions her students with special education needs:

> "At the moment, I have so many students with special education needs. If you do not compare their achievement with others, if you approach them by considering them at their own level, they show an unbelievable improvement." (H2)

In addition, one teacher with lower self-efficacy belief highlights the importance of organising activities in order to improve students' motivation:

> "A teacher's mathematical teaching ability is effective in organising classroom activities in order to motivate students toward mathematics. Motivation is a necessity for learning anything, not just about mathematics." (L2)

The results do not reveal a great differentiation in teachers' perception of their self-efficacy level. Nevertheless, it should be noted that teachers with higher self-efficacy place

more importance on developing the student-teacher relationship in helping students to learn. Building a positive relationship with students, which is something lower self-efficacy teachers miss out on, leads students to adjust to school more easily, view school as a positive experience, display better positive social skills, and have higher academic achievement (Buyse et al., 2009). In this sense, teachers with a lower self-efficacy belief can be regarded as having fewer efficacies in mathematics teaching than others.

Belief to motivate students, and to take on responsibility for students' learning

Another sub-factor on the Self-Efficacy Beliefs toward Mathematics Teaching Scale refers to the teachers' efficacy belief in motivating students and taking on responsibility for students' learning. In this regard, three main questions are asked of the participant teachers. The first question asked is, 'What do you think is the reason for some students' low mathematics achievement?' The participant teachers indicate that student, parent and teacher characteristics are important factors in determining some students' low achievement in mathematics. The results of the interview question are set out in Table 4.

Table 4. *The views of teachers about the reasons for some students' low achievement in mathematics*

Teachers	The reasons for some students' low achievement		
	Students' characteristics	Parents' characteristics	Teachers' characteristics
H1	Inherited ability, fear of mathematics.	(Not mentioned)	Student-teacher relationship, the ability to help students gain self-confidence, encouraging, tolerance of students, the ability to use body language and mime, different teaching methods.
H2	Perspectives on mathematics, prejudgement, the ability to use language.	The ability to use language.	(Not mentioned)
L1	Interest, the ability to do mathematics, numeric intelligence, personal talent.	(Not mentioned)	(Not mentioned)
L2	Mathematical intelligence, readiness, interests, doing exercises.	Supports	(Not mentioned)

In the light of the findings presented in Table 4, all teachers identify students' characteristics as an effective variable for determining the reason for some students' low achievement in mathematics. Three respondents highlight genetic endowment, personal talent, mathematical (numeric) intelligence, students' interests and the ability to do mathematics as reasons for some students' low achievement:

> "Some children show an inherited ability for mathematics." (H1)

> "Low achievement depends on students' interests and the ability to do mathematics. For example, let's imagine I am in a classroom. When I teach mathematics, I teach the same thing to all students. It is not different; the same thing is for all students.

> Why do some students have a low level of achievement? – It's because their mathematical intelligence is different." (L1)

One respondent with higher self-efficacy belief refer to the importance of students' perspectives of mathematics, the ability to use language, and prejudgements about some students' low achievement:

> "I think it depends on students' perspectives of mathematics and the ability to use the Turkish language. When a student cannot understand what I mean, naturally the student cannot do mathematics. Then, the student makes a prejudgement; he says that he cannot do mathematics. Absolutely, low achievement arises from this." (H2)

One of the teachers who have a lower self-efficacy belief comment on the effects of readiness and doing exercises on students' achievement:

> "It depends on student learning from previous classes. It depends on readiness. It depends on doing exercises at home." (L2)

On the other hand, two teachers who participate in the interviews indicate that the characteristics of parents can be the reason for some student low achievement. One of them mentions the parents' lack of ability in using language as an indicator of low student achievement:

> "I am sure that the language used by parents at home is important. Low student achievement depends on the number of words parents use, because students have difficulty in understanding and interpreting the Turkish language." (H2)

The other teachers indicate that parent characteristics, more than teacher characteristics, are a reason for low student achievement by stressing parental support at home:

> "It [low achievement] is not completely related to teachers. If parents do not help students at home, the expected result is for students to be unsuccessful." (L2)

In addition, one teacher who has higher sense of self-efficacy highlights the characteristics of teachers as a reason for students' low achievement. She mentions the impact of positive student-teacher relationships on students' achievement:

> "Positive student-teacher relationships are important for being successful. For example, some students have a fear of mathematics. I think this is an obstacle to low achieving students. Unless these students liked their teachers, it would be difficult to overcome this problem and to be successful." (H1)

She also indicates that helping students gain self-confidence, encouraging them and using different teaching methods can all play a vital role in preventing low achievement:

> "While the student was a first grade, I used all methods to teach 1+1=2, and finally, she has learned that 1+1=2, 1−1=0. I managed to teach these simple concepts. Finally, the child had gained self-confidence. She was able to solve simple problems. If there had been a different teacher, or a different approach had been implemented, maybe the result would have been very different." (H1)

She highlights the importance of the use of body language and humour in as factors in students' achievement:

> "If a teacher solves a problem in 40 minutes and never makes eye contact with students, never uses body language and humour, they can not achieve success." (H1)

She also refers to the importance of teachers' tolerance of students in encouraging achievement:

> "In this regard, I have never said, 'You can't do it'. When she makes mistakes, I have never asked 'Why can't you do it?' I have always accepted her and shown tolerance towards her." (H1)

The interview results demonstrate that teachers who have lower self-efficacy beliefs tend to suggest that student characteristics and parental support are the reasons for students' low achievement, while teachers with a higher sense of self-efficacy suggested that teacher characteristics are the reason for some of their students' failings as well. In this sense, teachers with lower self-efficacy beliefs could have an inadequate approach to taking on the responsibility for some students' failures. This is because research indicates that teacher characteristics such as the ability to develop a positive relationship with students, and the use of body language and humour, is related to the quality of the education process and student improvement (Çalışkan & Yeşil, 2005).

In order to elaborate the part played by teachers' efficacy beliefs in motivating students and taking on responsibility for students' learning, a second question is directly asked of the participant teachers: 'What factors can increase the efficacy of the mathematics teaching process?' Student characteristics and teacher characteristics are both mentioned by teachers as important factors in increasing the efficacy of the mathematics teaching process. The results of the interview question are shown in Table 5.

Table 5. *Teachers' views about the factors that increase the efficacy of the mathematics teaching process*

Teachers	The factors that increase efficacy of the mathematics teaching process	
	Students' characteristics	Teachers' characteristics
H1	(Not mentioned)	The ability to use various methods, various solutions, to provide various types of exercises and classroom connections with real life experiences, maintaining whole class involvement.
H2	Attention span, motivation, concentration, readiness, intelligence.	Student-teacher dialogue, the ability to help students gain self-confidence, to use various different methods.
L1	Numeric intelligence.	(Not mentioned)
L2	Readiness.	(Not mentioned)

As can be understood from Table 5, all teachers who participate in the interviews, except for one teacher who have a high sense of self-efficacy, describe student characteristics as an effective factor in increasing the efficacy of the mathematics teaching process. One interviewee highlights the effect of students' readiness as being an important factor in the efficacy of the mathematics teaching process:

> "As I said, whatever methods we use to teach mathematics, students' readiness affects the efficacy of the mathematics teaching process." (L2)

However, another teacher with higher self-efficacy belief mentions students' attention span, motivation, concentration, readiness and intelligence as important student characteristics for increasing the efficacy of the mathematics teaching process, while highlighting the importance of teachers' characteristics such as using different methods and helping students gain self-confidence as well:

> "It is related to students' threshold of perception. It is related to students' attention span, motivation, concentration, readiness, intelligence. The characteristics of students are critically important, but using different methods and helping students gain self-confidence are also important." (H2)

In addition to this, this teacher touches upon student-teacher dialogue as an important teacher characteristic in helping students gain self-confidence:

> "For example, I had a student who could not even count her fingers. I regularly talked with her; I always applied different methods for helping her learning. Now, she is very good – even she does not believe it. She has increased her self-confidence as she can do mathematics." (H2)

Another teacher with higher self-efficacy belief stresses teacher characteristics, including the ability to use various methods, provide various types of exercises and find different solutions:

> "… different methods, for example, dramatization is important. For want of a better word, not to take a limited perspective, not to have blinkers on: mathematics should teach with different examples. For instance, sometimes I say to students that they should find different ways of solving problems. Some teachers show only one certain solution. That narrows students' ideas. In this regard, students should be allowed to be free." (H1)

She also refers to the importance of whole class involvement in increasing the efficacy of the mathematics teaching process:

> "I said, 'What we can do now? Let's look together.' If the problem is too difficult, I say 'Let's solve it together.' One of them raises his hand, and says we should do this first. I say 'Okay.' Then, 'What we should do now?' You say, you say, you say 'Let's solve it together.' Then the achievement of the class approximates to 100 per cent." (H1)

The interview results reveal that teachers with a higher sense of self-efficacy refer to both student and teacher characteristics. On the other hand, teachers with lower self-efficacy belief only address student characteristics as a factor in increasing the efficacy of mathematics teaching. This means that teachers with lower self-efficacy belief do not feel sufficient responsibility for improving their mathematics teaching, which could lead to better student performance.

The third question 'How can students' motivation toward mathematics be improved?' is asked in order to broaden the data regarding the teachers' belief about motivating students and taking on responsibility for students' learning. The data related to the question is quite clear, because all teachers who participate in the interviews responding the same direction and talk about the importance of the role of teachers in improving students' motivation toward mathematics. The results of the interview question are presented in Table 6.

Table 6. *The views of teachers about the ways of improving students' motivation towards mathematics*

Teachers	The ways of improving students' motivation toward mathematics Teachers' role
H1	Giving positive feedback, setting modest goals, making all students feel successful, providing opportunities for all students to participate in classroom activities.
H2	Helping students gain self-confidence, encouraging and supporting students.
L1	Making mathematics appealing to students, providing opportunities for all students to participate in classroom activities, making all students feel successful.
L2	Giving positive feedback, providing opportunities for all students to participate in classroom activities, making all students feel successful.

As shown in Table 6, all teachers state that teachers play a vital role in improving students' motivation toward mathematics. Particular emphasis is placed on the importance of giving positive feedback in improving students' motivation toward mathematics. For example:

> "Well done, it is perfect. How beautiful it is, you did it. For example, during a mathematics exam assessment, a student solves half of the problem. He cannot find the exact answer. I give him the thumbs up. Maybe, it isn't a good thing, but I do. I don't want to discourage them. I show them the shortcomings of the answer. In the next exam, I see that they find the exact answer." (H1)

In addition to this, three respondents comment on the teachers' role in providing opportunities for all students to participate in the classroom in order to enable all students to feel successful:

> "The teacher's role is vital. The teacher should provide a classroom atmosphere in which even low achieving students can participate in the activities and all students can feel themselves to be successful." (L1)

One of the teachers stresses setting modest goals to motivate students toward mathematics:

> "... that is to say, small steps to success. You cannot expect the same success from every student." (H1)

Related to this point, one teacher participating in the study touches upon the fact that teachers play an essential role in helping students gain self-confidence by encouraging and supporting students:

> "That student, who I mentioned just now, was terribly unhappy. I always give confidence to her. I always say 'No, you will do it, you can do it.' I always support her and I always stand behind her." (H2)

Making mathematics more appealing is also indicated by one interviewee as a factor in motivating students:

> "The most efficient way to improve motivation is by making the subject appealing [to the student]." (L2)

The interview results do not reveal a significant difference between the teacher statements of teachers with a higher sense of self-efficacy and those with a lower sense of self-efficacy in terms of the ways of motivating students' toward mathematics. They all highlight the importance of the teachers' role in increasing the students' motivation towards mathematics, which has a positive potential effect on student performance.

Effective teaching

The third sub-factor on the Self-Efficacy Beliefs toward Mathematics Teaching Scale refers to the effective teaching. In this regard, the following question is directly asked of participant teachers: 'If parents commented that their child is showing more interest in mathematics, what they would attribute this to?' Teachers touch upon teachers, students and parents' characteristics as possible factors in an increase in a student's mathematical interest that could be identified by parents. The results of the interview question are illustrated in Table 7.

As results illustrated, all teachers responding to this question highlight teachers' characteristics, and two teachers particularly say parents might attribute the increase in students' mathematical interests to the teachers' ability to teach mathematics:

"They attribute an increase in their students' interest to the teacher because, for parents, the teacher is everything. They think that everything is given by teacher." (L1)

Table 7. *Teachers' reasons for an increase in students' mathematical interests as commented on by parents*

Teachers	Reasons for an increase in students' mathematical interests		
	Teachers' characteristics	Students' characteristics	Parents' characteristics
H1	The ability to make mathematics appealing, to use different methods, to provide fun ways of teaching mathematics.	Individual differences, the ability to do mathematics, mathematical intelligence, inherited ability.	The ability to provide additional courses.
H2	The ability to teach mathematics, to use different methods.	The ability to do mathematics, intelligence.	(Not mentioned)
L1	The ability to teach mathematics.	The perception of students, the ability to do mathematics, intelligence.	Parental support at home, helping with homework, checking homework, the ability to provide additional courses.
L2	The ability to organise activities for students at each achievement level.	The ability to do mathematics.	Parental support at home.

One teacher with higher self-efficacy belief stresses that parents attribute the increase in children's mathematical interest to teachers' ability to make mathematics appeal to the children and to provide fun ways of teaching mathematics:

"I make solving problems fun for students. Who will be the first? I give students numbers. Actually, by doing this, I understand how many children solve the problem. But, they concentrate on solving problems, and compete with each other to take a number. I have endeared so many children to mathematics in my classes and they learn how to solve problems." (H1)

Teachers who have higher self-efficacy belief highlight teachers' ability to use different methods as a significant reason for an increase in students' mathematical interests for parents:

"If a student did not have any mathematical improvement before being taught by the teacher, and if the teacher dealt with the student and improved him, the parents would probably attribute this to the teacher. They think that the teacher has used the correct method for teaching mathematics." (H2)

One teacher with lower self-efficacy mentions the teachers' ability to organise activities for students at each achievement level:

"When we look at low achieving students, activities organised by teachers are probably not appropriate for low achieving students." (L2)

In addition to the teacher characteristics, all participants mention the ability to do mathematics as a student characteristic. They all mention student characteristics like inherited ability, individual differences, mathematical intelligence and the ability to do mathematics. For example:

> "… But, if the student was good at doing mathematics since before now, they would probably attribute this to their child's abilities to do mathematics." (H2)

Moreover, three teachers state that parent characteristics could be a reason for the increase in students' mathematical interest in the eyes of parents, while one of teacher with a high sense of self-efficacy does not mention it.

Two of the participants mention the parents' ability to provide additional courses:

> "Our school environment, ımmm… Our students can't get additional courses or private lessons. But, parents who can provide their children with additional courses, they probably attribute their child's interest to the courses." (L1)

Moreover, two teachers with lower self-efficacy indicate that parental support at home in helping with homework and checking homework are possible reasons for an increase in students' mathematical interest:

> "If parents check homework at home, if they help their children do their homework, if they study together, they will probably attribute the increase in their children's mathematical interests to their support." (L1)

The interview results could indicate that the perceptions of teachers are not considerably differentiated by their self-efficacy level. Nevertheless, minor differences do exist and should be noted. Teachers with lower self-efficacy tend to highlight student and parent characteristics rather than teacher characteristics and teaching methods used. On the other hand, teachers with higher self-efficacy belief highlight teacher characteristics and methods used – as well as student and parent characteristics – as reasons for the low achievement of some students and as the factors that increase the efficacy of mathematics teaching. However, it is difficult to say there is a significant differentiation between teachers' interview results in terms of helping students' mathematical learning, improving students' motivation toward mathematics and increasing students' mathematical interests for parents.

Discussion

In this sample it was found out that all teachers have quite high self-efficacy belief toward their mathematics teaching. Similar to this result, Tertemiz and Şahinkaya (2010) have also suggested that pre-service teachers have high self-efficacy belief scores in terms of teaching mathematics. Even all participant teachers have quite high self-efficacy belief; there are some differentiations between teachers with higher and lower self-efficacy belief in terms of teaching mathematics. Studies have suggested that students who have efficacious teachers are likely more successful than those in other classes (Akbari & Allvar, 2010; Anderson et al., 1988; Berman & McLaughlin, 1977; Moore & Esselman, 1992; Tschannen-Moran & Hoy, 2001). In addition to this, Ashton and Webb (1986) supposed that teachers' sense of self-efficacy belief is associated not only with enhanced student achievement, but also with an impressive profile of teacher behaviours including warmth, responsiveness, acceptance of student initiative and attention to individual needs. The interview results from this present study are quite similar to those of Ashton and Webb (1986) in terms of revealing these kinds of teacher behaviours. These are as follows:

Level of effort and persistence with students

The interview results from the present study have revealed that teachers' level of effort and persistence with their students is differentiated in a similar way to their sense of self-efficacy. In other words, teachers who possess a secure sense of self-efficacy demonstrate a high level of effort and persistence with their students, compared to teachers with lower self-efficacy belief. One of the teachers with lower self-efficacy says:

> "You have to organise activities for every level of student. This is, how can I put this, I cannot say this for whole class… In a word, is it boring to work with low achievement students? I suppose it is tiresome for teachers… Teachers work comfortably with successful students and enhance their achievement, but with low achievement students, how can I put it, with students who do not like doing mathematics, however much I make an effort, the result is zero since the student does not want to learn." (L2)

According to Gibson and Dembo (1984), in contrast to efficacious teachers, teachers who have lower self-efficacy belief easily give up on low achieving students. Parallel to the findings of the present research, Tschannen-Moran and Hoy (2001) have also suggested that teachers' perceived level of self-efficacy belief, which has the potential to predict outcomes such as student achievement, can also affect teachers' level of effort and persistence with students.

Openness to new ideas and new methods

The interview results from this study show that teachers with a stronger sense of self-efficacy tend to be more open to new ideas and more willing to experiment with new methods in order to better meet the needs of students, compared to teachers who have lower self-efficacy belief. In the light of these findings, it can be said that teachers who have high self-efficacy belief produce higher student achievement. Similarly, Tschannen-Moran et al. (1998, p. 215) indicate that teachers' self-efficacy belief is related to 'their openness to new ideas'. Guskey (1988), in his exploratory study, revealed a significant relationship between teachers' self-efficacy belief and their attitudes toward the implementation of new instructional practices such as minor changes in classroom activity, the use of an entirely new curriculum, or the adoption of a very different instructional approach. In addition, Stein and Wang (1988) conducted a study to investigate the relationship between teacher success in implementing innovative programmes and teacher perception of self-efficacy. The researchers used behavioural observations, interviews and questionnaires on several occasions to measure teachers' performance, self-perceptions and attitudes. The results of the Stein and Wang's (1988) work supports the interview findings of this study in terms of demonstrating a significant relationship between teachers' sense of self-efficacy and their implementation of innovative programmes.

Belief in students' achievements and taking responsibility for students' success

In addition, this study finds that teachers with high self-efficacy belief are more optimistic and take more responsibility for students' achievement and failures. As one of the more efficacious teachers states:

> "Exactly, it is achievable; no one can say, "I don't have the ability to do mathematics," "I can't do mathematics." If a teacher deals with the student, if a teacher finds the most appropriate method for the student, I believe it can be done …"(H2)

Teachers with high self-efficacy belief are more optimistic about achieving success and feel responsibility for enhancing their students' achievement. According to Ashton (1985), this is important because teachers who seek the solutions outside their own classroom and who attribute the cause to external factors tend to more often refer students for special education. In addition, Ware and Kitsantas (2007) stated that teachers with low self-efficacy belief tend to blame outside factors. Similarly, Shechtman et al. (2005) found that teachers with strong self-efficacy belief are keener to help their students achieve better, even when their students have learning and behavioural difficulties, and are more optimistic than teachers with low self-efficacy belief. This situation naturally affects teachers' performance which can be regarded as a predictor of students' achievement.

Need to build relationships with parents

Akbari and Allvar (2010) supposed that parental engagement leads to increased student achievement. Hoover-Dempsey et al. (1987, 1992) explored a significant positive relationship between teachers' sense of self-efficacy and parental involvement. They indicated that teachers with higher self-efficacy belief report greater participation by parents in conferences and volunteering in the school, and involvement in helping their children with school-related skill development at home, such as homework. Similarly, Ashton, Webb and Doda (1983) have suggested that teachers with low level efficacy can be a cause of a weaker teacher–parent relationship. According to Hoover-Dempsey et al. (1987), because they are more confident in their teaching ability, teachers with high sense of self-efficacy belief are more willing to invite parental involvement and to accept parents' initiation of involvement activities. However, the interview results of this study demonstrate that teachers who have lower self-efficacy belief touch upon parental involvement in helping their children at home, the importance of building parent–teacher relationships, and the need to gain parental support more than other teachers with higher self-efficacy belief. The reason for this result could be related to teachers' perception of taking responsibility for their students' achievements and failures. As mentioned previously, teachers with lower self-efficacy belief are likely to attribute their students' achievements and failures to outside factors, such as parents, while teachers with stronger self-efficacy belief tend to take responsibility for their students' failures or successes. For example, one teacher with lower self-efficacy belief points out:

> "Parents think that the teacher is everything. However, parent education is also an important factor in raising their children's achievement. Are they adequate to help their children at home? When children ask a question, when children ask about how to solve a question, can the parent support their children? This is important." (L2)

Building professional relationships with students

The interview results of this study find that there is a relationship between teachers' self-efficacy belief and their ability to build warm relationships with their students. One teacher who has a higher self-efficacy belief states the following:

> "Indeed, it is related to teachers' characteristics rather than teachers' mathematical ability, that is to say, teachers' attitude and love toward their students. Students can feel their teacher genuinely love them. Teachers should make students feel it. You give students energy. If you respect your student, the child will respect you so much more. There is no other explanation: to love, to be tolerant, to be a model, these are very, very important things for students." (H2)

Teachers with higher self-efficacy belief tend to rely on positive relationships with their students for raising student achievement, rather than parent–teacher relationships. These results regarding the ability to a build positive teacher–student relationship parallel those of Ashton et al. (1982) who reported that teachers who possess a secure sense of self-

efficacy are able to build a positive relationship with their students, even with low-achieving students. In this context, Babaoğlan and Korkut (2010) carried out a study to investigate the relationship between teachers' sense of self-efficacy belief and the level of their classroom management ability to regulate teacher–student relationships. The statistical findings of the study were similar to this study's results in terms of indicating a significant relationship between teachers perceived self-efficacy belief and the ability to build warm relationships with students.

Helping students develop their self-confidence as learners of mathematics

Some researchers have indicated that a negative attitude toward mathematics, including fear and anxiety about mathematics, has a negative effect on achievement (Townsend et al., 1998). This study find there is a relationship between teachers' perceived self-efficacy belief and their approach to improving students' attitudes toward mathematics. As one of the teachers with higher self-efficacy states:

> "I address difficult problems to the higher achieving students; I prepare the easiest for other students. Thus, they can join the activities in the classroom. They become happy. What has happened? They have got over the fear of mathematics." (H1)

Teachers with higher self-efficacy belief attempt to improve their students' attitudes toward mathematics and help them overcome fear of mathematics in order to enhance their achievement in mathematics. On the other hand, Showalter (2005) indicated that there is no statistically significant relation between a mathematics teacher's self-efficacy belief and his or her students' attitudes toward mathematics. Even though the statistical findings did not expose any significant relationship, data gathered from qualitative research methods of the study revealed that the teacher has an influential role in determining how a student views mathematics. In this regard, qualitative research methods can be regarded as more appropriate for exploring people's beliefs, attitudes and fears (http://projects.exeter.ac.uk/prdsu/helps). The findings of Showalter's study (2005) do not differ very greatly from the present study's results. In summary, it can be stated that teachers with high sense of self-efficacy positively affect their students' achievement by improving students' attitudes toward mathematics.

Understanding differentiation and supporting low attaining students

Besides helping students develop their self-confidence, the interview results from this study find that there is a relationship between a teacher's perceived self-efficacy belief and the ability to show tolerance. As one of the efficacious teachers emphasis:

> "… during a mathematics exam assessment, a student solves half of the problem. He cannot find the exact answer. I give him the thumbs up. Maybe, it isn't a good thing, but I do. I don't want to discourage them. I show them the shortcomings of the answer. In the next exam, I see that they find the exact answer." (H1)

Showing tolerance towards students' mistakes has a positive effect on students' achievement. In other words, teachers with stronger self-efficacy belief reveal that they tolerate their students' mistakes as a way of enhancing achievement. Similarly, Gibson and Debro (1984) indicated that teachers who have high self-efficacy belief are less critical of students' incorrect answers.

Conclusion

It is found that teachers with a higher self-efficacy belief have some different characteristics to those with a lower self-efficacy belief. For example, teachers who have a higher self-efficacy belief also show a higher level of effort and persistence with students. In addition, they are more open to new ideas and new methods, believe in students' achievements and take responsibility for students' success. Furthermore, they place more

importance on building a warm relationship with their students rather than with the parents. They are more tolerant, tending to support low-attaining students. They make more effort to help students improve their self-confidence as learners of mathematics. As discussed previously, these differences between teachers with higher and lower self-efficacy belief naturally lead to better student performance in mathematics.

In conclusion, teachers' sense of self-efficacy belief is an important factor in helping students to achieve success. Based upon this conclusion, I make the following recommendations.

1. Improve student teachers' self-efficacy belief toward mathematics.
2. Organise the learning environment to enhance student teachers' abilities to provide effective teaching in mathematics.
3. Provide in-service training courses.
4. Improve teachers' attitudes toward the teaching profession.

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