Self-Efficacy Beliefs In Mathematical Literacy And Connections Between Mathematics And Real World: The Case Of High School Students

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ABSTRACT

The aim of this study is to investigate high school student's self-efficacy beliefs in mathematical literacy (ML) and to explore their views on the connections between mathematics and the real world according to their levels of ML self-efficacy beliefs. Both quantitative and qualitative data was collected from 40 high school students. Data collection tools included an "ML Self-efficacy Scale" and an interview schedule. Data analysis indicated that high school students' had medium levels of ML self-efficacy beliefs. In relation to high school students' ML self-efficacy beliefs, participants had similar views on the connections between mathematics and the real world. Although students who had medium and high levels of ML self-efficacy beliefs had positive views on connections between mathematics and the real world, the findings suggested that these were limited to the benefits of connections, to the situations, circumstances of using mathematics in real world and to the mathematical concepts they can use. The findings also indicated that student views were below the preferred, expected levels.

Keywords: Mathematical Literacy; Self-Efficacy; Real World; Connections

INTRODUCTION

The current definition of literacy extends to multiple skills such as understanding, communicating, thinking, connecting and problem solving. The PISA study conducted by OECD also brings a new approach to literacy. Literacy is now considered as students' use of the information and skills they gain in foundation courses at the right place and time, their ability to analyse and rationalise problems in various contexts, and the effective presentation of the results they obtain (OECD, 2003).

As a result of the increasing expectations of the contemporary qualitative world, the need for mathematically literate individuals is also continuously increasing (Schoenfeld, 2002). Moreover, Pugalee and Chamblee (1999) emphasised the necessity of mathematical literacy for students' adaptation to innovations. Mathematical literacy (ML) can be defined as a concept related to mathematics but which is different from it in terms of its nature and aims (Venkat & Graven, 2008). Cooper (2000) states that a general consensus on the meaning and definition of ML does not exist. According to McCabe (2001), ML emphasises the understanding of basic characteristics of mathematical concepts, which is represented both orally and in writing. Wilkins (2000), on the other hand, states that ML includes mathematical content knowledge, mathematical reasoning, understanding the social effects and benefits of mathematics, understanding the nature and historical development of mathematics and mathematical disposition.

Similarly, De Lange (2001) stated that what is necessary for ML is the necessary competence in teaching mathematics. Kaiser and Willender (2005) indicated that the main components of mathematical literacy are modelling and solving problems of the real world. In terms of their views on what ML is, both OECD (2003) and NCTM (2000) do not limit it with the curriculum and mathematical content and furthermore, they both emphasise the ability of the individuals to operationally use mathematical knowledge, skills and abilities in all parts of their work, school and the real world. Likewise, for Edge (2009) ML is the understanding of mathematics beyond the knowledge content level.

Mavugara-Shava (2005) stated that the need for ML arises from; limiting didactical practices, pressure from the technologically changing society, pressure from the widening scope of the applicability of mathematics in real-life situations, pressure from the changing nature of mathematics due to its growth, pressure from the change in needs at workplaces and, the change in the emphasis of didactical practices. Given the definition and scope of ML, it is possible to argue for an emphasis on connections. Another facet of mathematical literacy is the formation of meaningful mathematical connections. According to Mavugara-Shava (2005), these include mathematical connections within mathematics itself, with other subjects in the school curriculum, connections with realities in the physical world, or connections with other contexts arising from real world situations.

Connection with the real world is defined as creating connections between mathematics and the external world (Mosvold, 2008). For mathematical understanding, it is crucial to create connections for both the teacher and the students (Mousley, 2004). In mathematics education, connection involves connecting mathematics to the real world, to other disciplines and to other concepts of mathematics. According to Umay (2007), connections between mathematics and the real world not only facilitates understanding but also contributes to making the abstract discipline of mathematics concrete and to its perception as real. Otherwise, "*connections*" is one of the process standards identified for school mathematics by NCTM (2000) and one of the skills to be developed by the high school mathematics curriculum as identified by MEB (2005) in Turkey.

On the other hand, self-efficacy beliefs are among the most important concepts of an individual's affective traits. An individual's belief in his own capacity to be able to organise necessary activities for a certain performance and carry these out successfully is called self-efficacy (Bandura, 1986). Moreover, the individual uses the effects of perceived self-efficacy through cognitive, motivational, affective and selection processes (Bandura, 1993). Self-efficacy beliefs can influence an individual's behavioural preferences. Students with high levels of self-efficacy participate in activities more willingly, work better and can be persistent (Bandura, 1986; Schunk, 2009; Zimmerman, 2000). This, in turn, significantly and positively affects the learners' learning processes.

Mathematical self-efficacy can be defined as the individual's personal judgement in relation to his mathematical skills. Hackett and Betz (1989) defined mathematical self-efficacy as an individual's belief in realising a mathematical situation, task or problem successfully or in his skills in succeeding it. As self-efficacy is task-specific within a single general structure and is the individual's belief in relation to his skills in a particular situation, the concept of mathematical self-efficacy does not sufficiently explain self-efficacy beliefs in mathematical literacy (Ozgen & Bindak, 2011). Given that self-efficacy is a multi-dimensional concept and that its measurement should be sensitive to changes in the content of performance (Zimmerman, 2000), students' ML self-efficacy beliefs need to be considered separately. Hence, ML self-efficacy beliefs can be defined as the individual's beliefs or judgements in his/her abilities in mathematical processes, skills and situations that he/she encounters in his/her school, work and real world (Ozgen & Bindak, 2011). Number of studies in the literature with student or pre-service teacher participants on ML self-efficacy beliefs is limited (Gunes & Gokcek, 2010; Ozgen & Bindak, 2011; 2008a; Yenilmez, 2010).

Many advantages of connections to the real world are expected (cited in Gainsburg, 2008): students' understanding of mathematical concepts (De Lange, 1996; Steen & Forman, 1995), motivating the learning of mathematics (NAS, 2003) and especially assisting students in applying mathematics to real problems encountered at work (NRC, 1998). In mathematics education under the topic connections, connections to the real world have been regarded as crucial and have been studied in various situations. These studies include research into students' views on connecting mathematics to the real world (Baki et al., 2009; Cankoy, 2002; Civelek et al., 2003; Gainsburg, 2008; Gulten, Ilgar & Gulten, 2009; Gebremichael et al., 2011; Ubuz 2002), students' levels of connecting mathematical concepts to the real world and its effects on the learning processes (Altinok et al., 2005; Diez-Palomar et al., 2006; Pierce & Stacey, 2006; Stillman & Galbraith, 1998; Yenilmez & Uysal, 2007) and teacher practices (Garii & Okumu, 2008; Mousley, 2004; Nicol, 2002). However, studies, which investigate the concepts of connections to the real world and ML together, are limited.

The concepts of ML and connections to the real world are not totally different, but in fact complementary. Thus, it is important to explore the effects of students' ML self-efficacy beliefs on their views on connections between mathematics and the real world. It is believed that identifying students' level of ML self-efficacy beliefs and their views on connecting mathematics to real world situations will contribute to a better understanding of the learning processes and to identifying difficulties and problems faced during this process. The aim of this study was to investigate high school students' level of ML self-efficacy beliefs and to explore their views on connections between mathematics and the real world in relation to their levels of ML self-efficacy beliefs. Thus, the following questions were addressed:

1) What are high school students' levels of ML self-efficacy beliefs?
2) What are high school students' views on connections between mathematics and the real world in relation to their levels of ML self-efficacy beliefs?

METHOD

This is a case study which aimed to investigate high school students' levels of ML self-efficacy beliefs and accordingly their views on connections between mathematics and the real world. The case study method was selected for a thorough exploration of beliefs and views. In order to explore and illuminate the case extensively both quantitative and qualitative data was collected. Therefore, quantitative data was collected in relation to high school students' ML self-efficacy beliefs and qualitative data was collected in relation to high school students' views on connections between mathematics and the real world.

Participants

Participants were 40 high school students studying at a state high school in one of the metropolitans in Turkey. Participants were selected from class 9, 10, 11 and 12 using purposeful sampling which is often associated with qualitative research (Yildirim & Simsek, 2005). As the high school education is 4 years in Turkey, equal numbers of students from each year group were included in the study. Moreover, high school students need to sit university entrance examinations in order to continue their studies in higher education. The present study was carried out in a high school that accepted students without examination. 16 (40%) of the participants were male while 24 (60%) were female.

Data Collection Tools

Data collection tools included an "ML Self-efficacy Scale" and a semi-structured interview schedule. The scale developed by Ozgen and Bindak (2008b) was administered in order to determine high school students' ML self-efficacy beliefs. It consisted of 25 items that aimed to measure beliefs in self-efficacy in relation to mathematics literacy and was a five-point Likert type scale with scale answers from "Totally Agree" to "Totally Disagree". The relatively high score obtained from the scale indicated a relatively high level of self-efficacy belief in ML. The reliability coefficient of the scale for this study was 0,83. Moreover, open-ended questions were prepared to be used in interviews in order to identify students' views on connections between mathematics and the real world. These open-ended questions included the following; "What do you think is the relationship between mathematics and the real world? Explain and provide reasons?", "What are the benefits in your life of being able to effectively use mathematical language, symbols, representations and thinking?", "What are the difficulties and delusions you experience in connecting mathematics to the real world? Explain and provide reasons?", "To what extent can you use what you have learnt in the mathematics course in the real world and in which areas? Please explain."

Data Analysis

In order to prevent any difficulties in the application of the data collection materials, participants were informed about the tools and the researcher administered the scale and the interviews. The ML self-efficacy beliefs scale was collected and analysed by the researcher in line with the research questions. While the positive items in the ML self-efficacy beliefs scale were scored from 5 to 1 for "Totally Agree" to "Totally Disagree", negative items were scored from 1 to 5. For the identification of high school students' views on ML self-efficacy beliefs scale descriptive statistics such as arithmetical mean, frequency and percentages were calculated. Total scale scores between 25-58,3 were considered to indicate “low”, scores between 58,4-91,7 were considered to indicate “medium” and scores between 91,8-125 were considered to indicate “high” levels of self-efficacy beliefs. Mann Whitney U test was conducted to determine whether students’ ML self-efficacy beliefs levels were significantly different. As the scale scores for each sub group were not normally distributed non-parametric tests were used in analysis.

Interviews were analysed using content analysis. Important processes of content analysis include compiling, organising and interpreting related data under certain concepts and themes (Yildirim & Simsek, 2005). The inductive analysis of the qualitative data included coding of the data, identifying themes, organisation of the codes and themes and defining and interpreting the findings. Each student was coded as “*S1-M, S2-H, …*” when collecting and analysing data. “S1” indicated the given number for the student, while the symbols “L, M, H” indicated whether the students’ ML self-efficacy beliefs were “low (L), medium (M) or high (H)”. Six main themes and their sub-themes obtained from the analysis are presented in tables in the following findings section. In order to ensure reliability of the results, the data was analysed by the researcher twice and the following formula was applied: P (Agreement Rate) = [Na (Agreement) / Na (Agreement) + Nd (Disagreement)] X 100 (Miles & Huberman, 1994). The calculation yielded a result of P = 87% and the study was considered reliable. Analysis was finalised following a revision of the codes that revealed disagreements.

RESULTS

In what follows the results for the question “What are high school students’ levels of ML self-efficacy beliefs?” will be presented in line with the presentation sequence of the research questions.

Table 1. Descriptive Statistics for Students’ Scores of ML Self-Efficacy Beliefs

Level of ML Self-Efficacy Beliefs	f	%	M	SD	Min.	Max.
Medium	23	57.5	82.56	7.55	62.00	91.00
High	17	42.5	98.29	3.53	95.00	106.00
Total	40	100	89.25	9.96	62.00	106.00

Given students’ scores of ML self-efficacy beliefs, 23 students had medium and 17 students at high level of beliefs. While mean score of the students with medium levels of ML self-efficacy beliefs was M = 57.5, that of students with high levels was M = 98.29 (See Table 1).

Table 2. Mann Whitney U Test Results of the Students’ ML Self-Efficacy Beliefs Scores

Level of ML Self-Efficacy Beliefs	f	Mean Rank	Sum of Ranks	U	Z	p
Medium	23	12.00	276.00	.000	-5.358	.000
High	17	32.00	544.00			

Scores of students’ with medium and high levels of ML self-efficacy beliefs were statistically significantly different ($U = .000$, $p < .05$). These findings indicated that there were differences between students’ ML self-efficacy beliefs scores (See Table 2). Each of the 6 themes obtained via content analysis in order to answer the second question of the study, which was *“*What are high school students’ views in relation to connections between mathematics and the real world according to their levels of ML self-efficacy beliefs?”, is presented in separate tables below (See Table 3).

Table 3. Students' Views on the Existence of a Connection between Mathematics and The Real World in Relation to their Levels of ML Self-Efficacy Beliefs

Theme	Sub-Themes	Level of ML Self-Efficacy				Total	
		Medium		High			
		f	%	f	%	f	%
Connection between mathematics and the real world	Exists	16	40.0	16	40.0	32	80.0
	Partially exists	5	12.5	-	-	5	12.5
	Doesn't exist	2	5.0	1	2.5	3	7.5
	Total					40	100

In their views in relation to whether a connection existed between mathematics and the real world, 80% of the students stated that there was, 12,5% stated that there was a partial connection, while 7,5% stated that there were not any connections. According to students' levels of ML self-efficacy beliefs, 40% of the students' with medium and high levels stated that there was a connection, 12,5% of the ones with the medium levels stated there was a partial connection, while 5% of those stated there were not any connections and 2,5% of the ones with high levels stated that there were not any connections. Some student views for this theme were as follows:

S10-H: I think mathematics is needed in all areas of life and the connection between mathematics and the real world is directly proportional, because we encounter it in all areas of life.
S21-M: Mathematics is only useful in some things in real world. But if we learn mathematics, we use more logic and can decide more quickly.
S19-H: The mathematics I am taught has no connection to real world. For example, do we say to the shop assistant "give me chocolate with 2 unknowns."

Table 4. Students' Views on the Benefits of the Efficient Use of Mathematics in The Real World According to their Levels of ML Self-Efficacy Beliefs

Theme	Sub-Themes	Level of ML Self-Efficacy				Total	
		Medium		High			
		f	%	f	%	f	%
Benefits of the Efficient Use of Mathematics in the Real World	Making life easier	9	22.5	7	17.5	16	40.0
	Being successful at exams	7	17.5	4	10.0	11	27.5
	Interpretation	-	-	1	2.5	1	2.5
	Thinking	4	10.0	1	2.5	5	12.5
	Problem solving	1	2.5	1	2.5	2	5.0
	No benefit	2	5.0	3	7.5	5	12.5
	Total					40	100

As regards students' views on the benefits of the efficient use of mathematics in the real world, 40% of the students said that it was beneficial in making life easier, 27.5% in being successful at exams, 12.5% in thinking, 5% in problem solving, and 2.5% in interpretation; while 12.5% said it had no benefits. According to students' levels of ML self-efficacy beliefs, 22.5% of the students with medium levels stated that it was beneficial in making life easier, 17.5% in being successful at exams, 10% in thinking and 2.5% in problem solving. 17.5% of the students with high levels believed that it had benefits in making life easier, 10% in being successful at exams and 2.5% in interpretation, thinking and problems solving (See Table 4). Some views of the students on this theme were as follows:

S26-M: It ensures communication among people. It makes life easier. It allows us to act more quickly.
S2-H: I can interpret an event better when I need to.
S18-M: It helps to think well.
S20-M: I see it as a way of logical thinking.
S21-M: It is necessary to understand the difficulties in our lives quicker and to solve them.

S19-H: It is of no use whatsoever, shortly they teach us mathematics only for the university entrance examination. That is why it is not useful at all.

Table 5. Students' Views on the Difficulties they Face when Connecting Mathematics to The Real World According to their Levels of ML Self-Efficacy Beliefs

Theme	Sub-Themes	Level of ML Self-Efficacy				Total	
		Medium		High			
		f	%	f	%	f	%
Difficulties faced	In the learning process	11	30.5	6	16.6	17	47.2
	Not being sufficient	7	19.4	3	8.3	10	27.7
	Teachers' approach	2	5.5	4	11.1	6	16.6
	No difficulties	2	5.5	1	2.7	3	8.3
	Total					36	100

Given the students' views on the difficulties they face when connecting mathematics and to the real world, 47.2% of the students stated difficulties due to the learning process, 27.7% due to being insufficient, 16.6% due to teachers' approach and 8.3% of the students stated that they did not have any difficulties. Moreover, 30.5% of the students with medium ML self-efficacy levels mentioned that they faced difficulties due to the learning process, 19.4% due to being insufficient and 5.5% due to teachers' approach. Among students with high ML self-efficacy levels, 16.6% stated that they faced difficulties due to the learning process, 8.3% due to being insufficient and 11.1% due to teachers' approach (See Table 5). Some student views in relation to this theme were as follows:

S10-H: When I solve a problem myself, it is usually correct but I have difficulty in explaining the solution of that problem and connection it to life.
S23-M: There are difficulties related to not knowing mathematics well, not being able to learn it completely.
S2-H: It might be better if our mathematics teachers did not challenge us this much and make exams too difficult, maybe then we can approach mathematics differently. But I still like mathematics.
S16-M: I do not have a lot of difficulties.

Table 6. Students' Views on whether they can use Mathematics in The Real World According to their Levels of ML Self-Efficacy Beliefs

Theme	Sub-Themes	Level of ML Self-Efficacy				Total	
		Medium		High			
		f	%	f	%	f	%
Level of use in the real world	I can use it.	9	23.0	5	12.8	14	35.8
	I can partially use it.	12	30.7	10	25.6	22	56.4
	I cannot use it.	2	5.1	1	2.5	3	7.6
	Total					39	100

35.8% of the students stated that they can use mathematics in the real world, while 56.4% stated that they can partially use it and 7.6% that they cannot use mathematics in the real world. According to students levels of ML self-efficacy beliefs, 23% of the students with medium levels stated that they can, 30.7% that they partially can and 5.1% that they cannot. Furthermore, 12.8% of students with high levels stated that they can use mathematics in the real world while, while 25.6% that they partially can and 2.5% that they cannot. (See Table 6) Some of the student views on this theme were as follows:

S21-M: We only use some part of mathematics in real world.
S16-M: We use mathematics a lot in life but we usually do so without noticing. There are lots of areas that mathematics can be used.
S9-M: I never use it because I do not know where to use it. The only reason for this is that the course is not connected to social life. The teacher does not connect it to life a lot, etc.

Table 7. Students' Views on the Areas in which they can use Mathematics in The Real World According to their Levels of ML Self-Efficacy Beliefs

Theme	Sub-Themes	Levels of ML Self-Efficacy				Total	
		Medium		High			
		f	%	f	%	f	%
Areas of use in the real world	Calculations	16	44.4	11	30.5	27	75.0
	Exams	3	8.3	4	11.1	7	19.4
	Other (computer, sports, measurement, …)	1	2.7	1	2.7	2	5.5
	Total					36	100

Given students' views on the areas in which they can use mathematics in the real world, 75% of the students stated that they can use it in calculations, 19.4% in examinations and 5.5% in other areas. According to students' levels of ML self-efficacy beliefs, 44.4% of students with medium levels stated that they can use it in calculations, 8.3% in examinations and 2.7% in other areas. 30.5% of students with high levels of ML self-efficacy beliefs, on the other hand, stated that they can use it in calculations, 11.1% in examinations and 2.7% in other areas (See Table 7). Some views of the students in relation to this theme are presented below:

S6-M: Our level of use is more when compared to that of other courses. Its area of use is mostly in calculations.
S25-H: I use mathematics when shopping, when calculating money and in all sorts of calculations.
S40-H: In real world I use what I learn in mathematics in the tests in the book and I believe I am successful.

Table 8. Students' Views on the Mathematical Concepts they use in The Real World According to their Levels of ML Self-Efficacy Beliefs

Theme	Sub-Themes	Levels of ML Self-Efficacy				Total	
		Medium		High			
		f	%	f	%	f	%
Mathematical concepts used in the real world	Four operations	16	44.4	11	30.5	27	75.0
	Geometric figures	2	5.5	2	5.5	4	11.1
	Permutation, combination, probability	1	2.7	2	5.5	3	8.3
	Ratio and proportion	1	2.7	1	2.7	2	5.5
	Total					36	100

Given students' views on the mathematical concepts they use in the real world, 75% of the students stated that they can use four operations (multiplication, division, addition, subtraction) 11.1% that they can use geometric figures, 8.3% that they can use permutation, combination, probability and 5.5% that they can use ratio and proportion. According to their levels of ML self-efficacy beliefs, 44.4% of the students with medium levels stated that they can use four operations, 5.5% that they can use geometric figures and 2.7% that they can use the concepts of permutation, combination, probability and ratio and proportion. Moreover, 30.5% of the students with high levels stated that they can use four operations, 5.5% that they can use geometric figures and permutation, combination, probability and 2.7% that they can use concepts of ratio and proportion (See Table 8). Some views of students in relation to this theme are presented below:

S23-M: In real world mathematics that we use most are things like multiplication, addition, and subtraction. Mathematics taught to us does not have much use in life.
S34-H: Mathematics is needed in real world. For example you do geometric figures, draw a circle well.
S13-H: We can make our life easier by using mathematical language, symbol and thinking. For example, engineers who deal with geometric figures and area calculations build houses using these.
S22-M: Very little. We use calculations at shops, probability, ratio and proportion, money calculations etc. to some extent.

DISCUSSION AND CONCLUSION

Data analysis indicated that high school students' had medium levels of ML self-efficacy beliefs in general and that students with medium levels of ML self-efficacy beliefs outnumbered others. While Yenilmez (2010) found that primary school mathematics teacher trainees' had high levels of ML self-efficacy, Ozgen and Bindak (2011) identified medium levels of ML self-efficacy beliefs among their high school participants. Results of previous studies are different from or parallel to the findings of the current study.

Other studies emphasised that students' self-efficacy increased mathematical success and performance (Chiu & Xihua, 2008; Hackett & Betz, 1989; Pietsch, Uredi & Uredi, 2005) and affected problem solving skills (Pajares & Miller, 1994). Turkish national report PISA 2006 stated that most of the students were at level two or at lower levels in terms of the ML scale (EARGED, 2007). In PISA 2003, Guzel and Berberoglu (2010) found strong relationships between students' ML and self-efficacy in mathematics. In his study conducted using the data of PISA 2003 Turkish students, Akarsu (2009) identified self-efficacy as a strong predictor of mathematical success. Moreover, it was found that students' ML self-efficacy beliefs differed significantly in terms of mathematics scores; that ML self-efficacy and mathematics scores were related and that mathematics scores were a significant predictor of ML self-efficacy beliefs (Ozgen & Bindak, 2011). Studies investigating ML self-efficacy are limited. When findings of previous research and the current study are interpreted together, the concepts of ML and ML self-efficacy are observed as important concepts for the mathematics course. That is why the aim should be to have high levels of students' ML self-efficacy beliefs.

Therefore, in PISA studies problem situations and scenarios of the real world or connected to the real world were used to measure students' ML. Given that self-efficacy beliefs are influenced by experiences, it is highly important to make mathematics more concrete that is connecting it to the real world as much as possible in order to develop high school students' ML self-efficacy beliefs. Thus, another keyword of this research was connections. Specifically, students' views on connections between mathematics and the real world were investigated.

Most of the participants stated that there were connections between mathematics and the real world, while some mentioned that the two were partially connected. According to students' ML self-efficacy beliefs, students' with medium and high levels expressed similar views. Most students with medium and high levels stated that mathematics and the real world were connected. This can be interpreted as a positive finding because students' perspective on mathematics can facilitate their approaches in the learning process. Previous studies also reported that students' believed mathematics and the real world were connected and that connection was important (Baki et al., 2009; Cankoy, 2002; Gebremichael et al., 2011). These and the findings of the current study according to students' levels of ML self-efficacy beliefs were parallel.

On the other hand, according to students' levels of ML self-efficacy beliefs, both students with medium and high levels expressed their views in relation to benefits in making life easier, being successful at exams, thinking and problem solving. Hence, their views on the purpose and benefits of connection were positive. However, some of the students stated that it was useful in being successful at exams. This was probably influenced by the education system, learning-teaching approaches and university entrance examinations. In a similar study, Gebremichael et al. (2011) found that students' perceived mathematics as an aid for their future aims, being accepted to a university and finding a job. Baki et al. (2009) reported that students believed that connections between mathematics and the real world increased their success in mathematics, influenced their course grades, ensured reasoning, made life easier and had benefits at work. Most students who participated the study by Civelek et al. (2003) stated that they were learning mathematics because it was a compulsory course, while some said they were learning mathematics because it was useful in life. While students' with medium and high levels of ML self-efficacy beliefs in the present study had partially positive views on the benefits of connections between mathematics and the real world, parallel to the findings of previous studies they were not sufficiently aware of the benefits.

Difficulties in connecting mathematics to the real world included problems arising from the learning process, not being sufficient and teachers' approaches. These views foregrounded problems specifically arising from the learning – teaching process and approaches and related difficulties, which were clearly presented in student views. Student views particularly indicated that the learning – teaching process did not include real world connections or these were not sufficient. According to students' level of ML self-efficacy beliefs, for all sub-themes except the sub-theme teachers' approach, students' with medium and high levels expressed difficulties due to the learning process and not being sufficient. Most participants of Gulten et al. (2009) stated that their teachers did not explain how the mathematics topics could be used in the real world. Moreover, according to Mousley (2002) teachers had difficulties in finding relevant content for connections between mathematics and the real world. Therefore, it is apparent that difficulties in relation to connections to the real world generally arose from the learning – teaching process and approaches.

The effects of this were also revealed in students' views on whether they could use mathematics in the real world. Most students believed that they could partially use mathematics in the real world. According to students' level of ML self-efficacy beliefs, students with medium and high levels had similar views. Students who said that they could partially use mathematics outnumbered in both groups. The reason of these findings could be the influence of students' perception of mathematics only as a school subject. Moreover, there could be reasons in relation to the learning – teaching processes and approaches. Ozgun-Koca and Sen (2002) identified below average levels of using real world in the mathematics courses in Turkey compared to that in other countries. Thus, the findings of both previous research and the present study calls for a comprehensive investigation of the reasons of students' inefficient use of their mathematical knowledge in the real world in relation to student, teacher, curriculum, family and school variables.

What is more, students' views on the areas in which they could use mathematics in the real world were extremely limited. Most students stated that they used it in calculations. According to students' levels of ML self-efficacy beliefs, students with medium and high levels both stated that they used mathematics most in calculations and in examinations. Baki et al. (2009) found that students' examples in relation to the real world contexts generally included numbers, calculations and shopping. Gulten et al. (2009), on the other hand, reported that students' had no idea how to implement what they learnt in mathematics in the real world. Considering the findings of this and other studies, it is apparent that students did not sufficiently know in which areas mathematical concepts could be used in real world.

A similar finding was obtained in students' views on the mathematical concepts used in the real world. It was found that student views were very limited and most expressed foundational concepts such as four operations (addition, subtraction, multiplication, division). According to students' levels of ML self-efficacy, most of the students with medium and high levels stated that they used four operations in the real world. Gulten et al. (2009) identified natural numbers and sets as the mathematical concepts used most in the real world by high school students. Gebremichael et al. (2011) reported that students perceived mathematics to be connected to the real world, but in relation to mathematical concepts used in the real world they were able to express some concepts they predominantly learnt in primary school or they used at work and in current contexts.

Participating students at medium and high levels were observed to have difficulties in connecting mathematics to the real world and to have partially incorrect and incomplete views and perceptions. As indicated in the findings, it is necessary for mathematics teachers and pre-service teachers equipped with knowledge, skills and attitudes in terms of ML, connection between mathematics and real world. In addition, mathematics course books and curricula with similar qualities would positively influence the learning and teaching processes.

In this study ML self-efficacy beliefs levels of a limited number of high school students and their views on connections between mathematics and the real world were identified. Further research should explore the difficulties that high school students experience in connections and the reasons for their negative perceptions thoroughly. Research into ML and connections should also investigate the relationships to and effects on students' success at mathematics. Future studies may involve primary school students, students from different high school types, mathematics teachers and teacher trainees. Furthermore, students' views on ML self-efficacy beliefs and other types of connections can also be identified.

AUTHOR INFORMATION

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