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An examination of vocational school students' self-efficacy beliefs in mathematics and of their achievement levels

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The purpose of this study is to examine vocational school students' self-efficacy beliefs in mathematics and their achievement levels. As the data collection tool, "Self-Efficacy Perception of Mathematics Scale" developed by Umay (2001) was used in the study. The sample is composed of 178 students who were attending different programs of Tatvan Vocational School of Bitlis Eren University. The research was performed in the academic year of 2014 to 2015. ANOVA and t-test were used for testing the research hypotheses. The results obtained show that there is no significant difference between students' genders and their self-efficacy beliefs; however there are statistically significant differences among their self-efficacy beliefs by their school of graduation, the school programs they attend, and their achievement levels.

Key words: Vocational school students, mathematics, academic achievement, self-efficacy beliefs.

INTRODUCTION

Rapidly-developing science and technology of today are facilitating the human life and broadening human kind's horizon. In parallel, the production of information is increasing its pace and the process is gaining speed day by day. As a result of this rapid change in information and technology, the number of behaviors which individuals need to learn so that they can adapt to the changing society and certain concepts, principles and practices to be learned by the individual undergo a transformation (Senemoğlu, 1989: 1).

For adapting to the developments experienced in science and technology, training the individuals of future and provide them with a good education, all developed or developing countries reconsider their educational systems and make the necessary adjustments from time to time. It is a reality that basic courses such as science and mathematics are of great importance in societies' effort to advance towards modernity and achieve the desired level of development. In general sense, certain elements should coexist so that individuals can be provided with mathematics education on the desired level. One of these elements is individuals' confidence.

Mathematics is a tool which is used by people in their all activities such as developing and directing their discernment needed, the acquisition of systematic, critical and logical thinking skills and exploring their surroundings, reasoning on, forecasting about and achieving the results of what they discover while it

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successfully solves the problems in life (Umay, 2002). One of the factors which have an effect on the students in learning the concepts of mathematics is their self-efficacy belief about mathematics. Self-efficacy belief is the belief "whether one can or cannot do" when they are performing an activity (Siegel, 2003). The self-efficacy belief of the students which affects their motivation and performance must be high (Günhan and Başer, 2007). Self-efficacy belief is the factor which includes the feelings of individuals, influences and develops the behavior of them in the education of mathematics (Nicalao and Philippou, 2004).

In the studies performed it is seen that the concept of self-efficacy is translated to Turkish and used in various terms such as "self-efficacy belief", "self-efficacy sense" and "competence expectation". However, the concept of "self-efficacy belief towards mathematics" is considered in our study as a research variable. Self-efficacy came to life as a concept mentioned by Bandura (1977) in his "Social Learning Theory", and according to Bandura (1997), self-efficacy is "individual's judgment on himself/herself about his/her capacity to organize, succeed in activities necessary to show a certain performance" (cited in Aşkar and Umay, 2001). Self-efficacy perception involves organizing and applying cognitive, social, emotional and behavioral skills which are needed to deliver a given task. In addition, self-efficacy perception is not just about the multitude of skills possessed by the person but also the belief in what that person can do with those skills (Bandura, 1977). Self-efficacy belief plays a very effective role in the development of human behaviors because it has an impact on behaviors (Nicalaou and Philippou, 2004). Self-efficacy belief is an efficient premise of individuals' mathematics achievements (Kiemanesh et al., 2004). Self-efficacy is about individual's belief in his/her skills rather than the skills themselves (Akkoyunlu et al., 2005). It is also possible to say that self-efficacy feeds on factors such as past experiences, indirect experiences, positive feedbacks, etc. (Yıldırım and İlhan, 2010).

Self-efficacy belief affects individuals' ways of thinking and emotional responses, too. Individuals with self-efficacy of higher levels can be more comfortable and productive when they are facing more difficult situations. Those who have lower levels of self-efficacy belief feel that the things they will do are harder than they really are. Such thinking increases anxiety and stress as well as narrowing the perspective necessary to solve any problem in the best way. Hence, self-efficacy belief has a powerful impact on individuals' achievement levels (Pajares, 2002, cited in; Üredi and Üredi, 2006).

Studies have shown that self-efficacy belief is an important determinant of students' academic achievements. In their study, Pajares and Miller (1994) found that self-efficacy belief affects mathematical achievement in a positive way, and this is a greater effect than other variables' effects on mathematical achievement. Pajares and Kranzler (1995) reported that self-efficacy belief of mathematics has a powerful influence on mathematical anxiety and problem-solving performance. In another study by Pajares and Graham (1999), they supported the idea that self-efficacy belief has a positive effect on mathematical achievement, which is also independent from other variables.

According to the literature on the self-efficacy belief of mathematics, majority of the studies have been performed on elementary school teacher candidates (Umay, 2001; Işıksal and Çakıroğlu, 2006; Can et al., 2005). On the other hand, there are almost no studies conducted on vocational school students' self-efficacy beliefs in mathematics. This makes it even more important to work with self-efficacy beliefs of students who are attending vocational school in mathematics. It was therefore aimed in this study at examining vocational school students' self-efficacy beliefs in mathematics by their genders, school of graduation, the programs they attend, and their achievement levels.

Purpose of the research

The purpose of this research is to examine self-efficacy beliefs of students who are attending different programs of the vocational school in mathematics by several variables such as gender, the type of high school of graduation, the program they attend, and mathematical achievement levels. To this end, answers to the following questions were sought for:

1. Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by their genders?
2. Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by the types of high school they were graduated from?
3. Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by the school programs they attend?
4. Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by their mathematical achievement levels?

METHODS

Research model and research group

The research aims at examining the self-efficacy beliefs of students who are attending different programs of the vocational school in mathematics and their academic achievement levels. Relational screening model was used as the descriptive screening model in the research. The screening model aims at describing a past or current situation as it was or is (Karasar, 1994).

The research sample consists of 178 students who were attending Computer Technologies, Electrical, Electronics, Surveying and Cadastre, Construction Technology, Food Technology, and Laboratory Technology at Tatvan Vocational School of Bitlis Eren

Table 1. Distribution of the participant students by the types of high school they were graduated from and their genders.

Type of High School	Female	%	Male	%	Total
General	24	49.0	25	51.0	49
Anatolian	13	44.8	16	55.2	29
Vocational	24	24.0	76	76.0	100
Total	61	34.3	117	65.7	178

Table 2. Distribution of the participant students by the programs they attend.

Name of program	With exam	%	Without exam	%	Total
Computer technologies	10	33.3	20	66.7	30
Surveying and cadastre	10	31.3	22	68.8	32
Electronics	3	27.3	8	72.7	11
Electrical	4	16.7	20	83.3	24
Construction technology	23	92.0	2	8.0	25
Food technology	23	92.0	2	8.0	25
Laboratory technology	27	87.1	4	12.9	31
Total	100	57.3	78	42.7	178

University in the academic year of 2014 to 2015. Some demographics of those students are shown in Tables 1 and 2.

According to Tables 1 and 2, 34.3% (N = 61) of the students in the study group are female, 65.7% (N = 117) of them are male. It is seen that 49 of them were graduated from a general high school, 29 graduated from an Anatolian high school, and 100 graduated from a vocational high school. In addition, 10 (33.3%) of them enrolled in the Computer Technologies program with exam, 20 (66.7%) of them enrolled in the program without exam; 10 (31.3%) of them enrolled in the Surveying and Cadastre program with exam, 22 (68.8%) of them enrolled in the program without exam; 3 (27.3%) of them enrolled in the Electronics with exam, 8 (72.7%) of them enrolled in the program without exam; 4 (16.7%) of them enrolled in the Electrical program with exam, 20 (83.3%) enrolled in the program without exam; 23 (92.0%) of them enrolled in the Construction Technologies with exam, 2 (8.0%) of them enrolled in the program without exam; 23 (92.0%) of them enrolled in the Food Technology with exam, 2 (8.0%) of them enrolled in the program without exam; and 27 (87.1%) of them enrolled in the Laboratory Technology with exam, 4 (12.9%) of them enrolled in the program without exam.

Data collection tools

The “Self-Efficacy Perception of Mathematics Scale” developed by Umay (2001) was used for determining the self-efficacy beliefs of students who are attending different programs of the vocational school in mathematics, and the personal information form developed by the researcher was used for collecting the necessary information on the students. There are questions about students' gender, the types of high school they were graduated from, the program they enrolled in, and how they enrolled in the program (with or without exam) in the information form. The scale developed by Umay (2001) which was applied to the students is composed of 14 items. Cronbach's Alpha reliability coefficient of the scale was calculated to be 0.83. 8 of the items involve positive statements whereas 6 of them comprises of negative statements in the scale. Since the scale score is the total scores of responses given to the items, each self-efficacy perception item was scored in the Likert-type scale. This scoring depends on whether the item is positive or negative. The highest self-efficacy belief score that can be obtained from the questionnaire is 70 and the lowest score is 14. Higher scores mean higher self-efficacy belief. Students' academic achievement grade points were accepted as the grade point averages of mathematics in their programs for two terms. The students were divided into three levels: Low, moderate, and high.

Analysis of data

In accordance with the general purpose of the research, SPSS 17.0 software package was utilized for the statistical analysis of the data obtained with the questionnaire form. One-Way Variance Analysis (ANOVA), Independent Single Sample t-Test, and Scheffe' test, a Post Hoc technique, were used in the analysis of the data. Significance level was taken as .05 for the statistical analyses.

FINDINGS AND INTERPRETATION

Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by their genders?

Regarding the answer sought for the first sub-problem of the research, the findings concerning the t-test applied to see whether the self-efficacy belief scores obtained by the students in the “Self-Efficacy Perception of Mathematics Scale” differ by their genders are given in Table 3.

According to Table 3, students' score averages of self-efficacy belief in mathematics do not show any significant difference by gender [$t_{(176)} = 0.96$, $p > 0.05$]. Female students' score averages of self-efficacy belief in mathematics ($\overline{x}=45.20$) are higher than male students' score averages ($\overline{x}=43.72$).Yet, it can be inferred from this

Table 3. The t-test regarding students' score averages of self-efficacy belief in mathematics by their genders.

Gender	N	$\overline{x}$	ss	sd	t	p
Female	61	45.20	9.23	176	0.96	0.335
Male	117	43.72	9.83			

Table 4. Students' score averages of self-efficacy beliefs in mathematics by the type of school they were graduated from and the standard deviation values

Type of high school	N	$\overline{x}$	ss
General	49	45.31	7.76
Anatolian	29	47.45	10.54
Vocational	100	42.34	9.26
Total	178	44.23	9.63

Table 5. ANOVA results regarding students' scores of self-efficacy belief in mathematics by the type of high school they were graduated from

Source of variance	Sum of squares	sd	Mean of squares	F	P	Significant difference
Between groups	898.787	2	449.393	5.072		
Within groups	15504.769	175	88.599		.009	2 - 3
Total	16403.556	177				

1, General high school, 2, Anatolian high school; 3, vocational high school.

finding that there is no significant relationship between self-efficacy belief in mathematics and gender.

Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by the types of high school they were graduated from?

In the second subproblem of the research, whether students' self-efficacy beliefs in mathematics differ by the type of high school they were graduated from was investigated. Students' score averages of self-efficacy belief in mathematics obtained from the “Self-Efficacy Perception of Mathematics Scale” and the results about standard deviation values are given in Table 4.

Table 4 shows students' score averages of self-efficacy beliefs in mathematics by the type of school they were graduated from. According to these results, the students graduated from an Anatolian high school have the highest score averages of self-efficacy belief in mathematics (x = 47.45). The students graduated from an Anatolian high school are followed by those who were graduated from a general high school ($\overline{x}$= 45.31) and a vocational high school (x =42.34).

According to Table 5, there is a statistically significant difference among students' score averages of self-efficacy belief in mathematics by the type of high school they were graduated from [$F_{(2\text{-}175)}$ =5.072, p< 0.05]. As a result of the Scheffe' test applied to determine between which types of school this significant difference is, it was found that the self-efficacy belief in mathematics scores of the students graduated from an Anatolian high school (x = 47.45) are higher than scores of the students graduated from a vocational high school (x = 42.34). No significant difference was found between the self-efficacy belief in mathematics scores of the students graduated from a general high school (x =45.31) and the scores of the students graduated from a vocational high school, even though the former is higher.

Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by the school programs they attend?

In the third sub problem of the research, whether students' self-efficacy beliefs in mathematics differ by the program they attend was investigated. Students' score averages of self-efficacy belief in mathematics obtained from the “Self-Efficacy Perception of Mathematics Scale” and the results about standard deviation values are given in Table 6. The table presents students' score averages of self-efficacy beliefs in mathematics by the program

Table 6. Students' score averages of self-efficacy beliefs in mathematics by the program they attend and the standard deviation values

Name of program	N	$\overline{x}$	ss
Computer technologies	30	44.50	10.40
Surveying and cadastre	32	41.87	6.83
Electronics	11	42.09	8.68
Electrical	24	40.20	10.08
Construction technology	25	46.12	10.70
Food technology	25	43.68	9.50
Laboratory technology	31	49.19	8.81
Total	178	44.23	9.62

Table 7. ANOVA results regarding students' scores of self-efficacy belief in mathematics by the program they attend.

Source of variance	Sum of squares	sd	Mean of squares	F	P	Significant difference
Between groups	1478.770	6	246,462			
Within groups	14924.786	171	87,279	2,824	0.012	7 - 4
Total	16403.556	177				

1, Computer technologies; 2, Surveying and Cadastre; 3, electronics; 4, electrical; 5, construction technology; 6, food technology; 7, laboratory technology.

they attend. According to these results, the students who attend the Laboratory Technologies program have the highest score averages of self-efficacy belief in mathematics (x =49.19). Laboratory Technology is followed by Construction Technology (x =46.12), Computer Technologies ($\overline{x}$=44.50), Food Technology (x =43.68), Electronics (x =42.09), Surveying and Cadastre (x =41.87), and Electrical (x =40.20) programs.

According to Table 7, there is a statistically significant difference among students' score averages of self-efficacy belief in mathematics by the program they attend [$F_{(6\text{-}171)}$ =2.824, p< 0.05]. As a result of the Scheffe' test applied to determine between which programs this significant difference is, it was found that the self-efficacy belief in mathematics scores of the students attending the Laboratory Technology program (x = 49.19) are higher than scores of the students attending the Electrical program (x = 40.20). No significant difference was found between the self-efficacy belief in mathematics scores of the students attending the Construction Technology program (x = 46.12) and the scores of the students graduated from a vocational high school (x =40.20), even though the former is higher.

Is there a significant difference among vocational school students' self-efficacy beliefs in mathematics by their mathematical achievement levels?

In the last sub problem of the research, whether students' self-efficacy beliefs in mathematics differ by their achievement levels was investigated. The achievement levels were divided into three: Low, moderate and high. Students' score averages of self-efficacy belief in mathematics and the standard deviation values were examined by their achievement levels, and the results are given in Table 8.

According to Table 8, the students with higher mathematical achievement levels have also higher self-efficacy beliefs in mathematics (x = 51.35). Similarly, lower score averages of self-efficacy belief are observed among with the students with lower achievement levels (x = 40.16). Below are the results of one-factor ANOVA performed to test whether these differences among students' score averages of self-efficacy belief in mathematics are statistically significant.

According to Table 9, there is a statistically significant difference among students' score averages of self-efficacy belief in mathematics by their achievement levels [$F_{(2\text{-}175)}$ =32.238, p<0.05]. As a result of the Scheffe' test applied to determine between which achievement levels this significant difference is, it was found that score averages of the self-efficacy belief in mathematics significantly differ between the students with higher achievement levels and the students with moderate and lower achievement levels (p< 0.05). These differences are in favor of the students with higher achievement levels. Furthermore, it was determined that the students with moderate achievement levels have higher self-efficacy beliefs than the students with lower achievement levels.

Table 8. Students' score averages of self-efficacy beliefs in mathematics by their achievement levels and the standard deviation values.

Achievement group	N	$\overline{x}$	ss
Low	100	40.16	8.93
Moderate	24	45.17	6.47
High	54	51.35	7.67
Total	178	44.23	9.63

Table 9. ANOVA results regarding students' scores of self-efficacy belief in mathematics by their achievement levels

Source of variance	Sum of squares	sd	Mean of squares	F	P	Significant difference
Between groups	4416.468	2	2208.234			
Within groups	11987.088	175	68.498	32,238	0.000	3-1, 3-2, 2-1
Total	16403.556	177				

1, Low; 2, moderate; 3, high.

DISCUSSION

According to the results for research's first sub-problem, there is no significant difference between the genders of the participant students and their self-efficacy beliefs in mathematics (Table 3, p > .05); however, female students' score averages of self-efficacy belief are higher than the score averages of the male students. This finding coincides with the findings of the studies performed by Baydar (2000), Üredi and Üredi (2006), Aksu (2008), Ekici (2008) and Saracaloğlu and Yenice (2009). It can be concluded that self-efficacy beliefs of both female and male students in mathematics involve similar factors such as regarding oneself as competent and trusting one's skills.

In the study, students' self-efficacy beliefs in mathematics significantly differ by the type of high schools they were graduated from (Table 5, p< 0.05). Among the type of schools, the students graduated from an Anatolian high school have higher self-efficacy beliefs in mathematics than the students graduated from other types of school. One of the reasons why the students graduated from an Anatolian high school have higher self-efficacy beliefs in mathematics is closely related to the qualities of the students graduated from those schools. This may be caused by the knowledge, skills and academic performance acquired and shown by students during their education and learning. This result is in parallel with the results obtained by Umay (2000), Terzi and Mirasyedioğlu (2009), and Taşdemir (2012). Yet, it conflicts with the studies by Baydar (2000), Yaman et al. (2004), Aydoğdu and Şensoy (2006), Alabay (2006) and Ekici (2008) in which the self-efficacy beliefs in mathematics teaching were investigated.

In the research, students' self-efficacy beliefs in mathematics significantly differ by the program they attend (Table 7, p< 0.05). As a result of the Scheffe' test applied to determine between which programs this significant difference is, it was found that the self-efficacy belief in mathematics scores of the students attending the Laboratory Technology program are higher than scores of the students attending the Electrical program. No significant difference was found between the self-efficacy belief in mathematics scores of the students attending the Construction Technology program and the scores of the students graduated from a vocational high school, even though the former is higher. One of the reasons why the students attending the Laboratory Technology program have higher self-efficacy beliefs than the students attending other programs may be higher number of students enrolled in this program with exam than other programs (Table 2). Some studies performed with the students who enrolled in the vocational schools with and without exam coincides with this finding of this study. According to the study conducted by Handen and Tunç (2005), the Open Admission System has changed the student profile of vocational schools. All of the students come from vocational high schools. Most of them belong to the group which could not score 105 or above in the university admission exam. Students pass depending on their skills as a result of the passing system applied in vocational high school. Interest in mathematics, physics, chemistry, etc. is low. Those students enrolled in vocational schools fail at the process-based and interpretation-based courses such as the abovementioned ones. Experienced instructors agree that students enrolled with exam are more eager and intrigued. They also report that they have difficulty to motivate the students enrolled without exam for the courses, therefore not enjoying the job they do. It is also reported by the instructors that the students enrolled without exam do not have the sufficient knowledge and

skills in the courses.

In the last sub-problem of the research, students' score averages of self-efficacy belief in mathematics show any significant difference by their achievement levels. It was found as a result of the Scheffe' test applied to determine between which achievement levels this significant difference is that score averages of the self-efficacy belief significantly differ between the students with higher achievement levels and the students with moderate and lower achievement levels ($p< 0.05$). These differences are in favor of the students with higher achievement levels. Furthermore, it was determined that the students with moderate achievement levels have higher self-efficacy beliefs than the students with lower achievement levels. The fact that individuals with higher self-efficacy beliefs make great effort to do a task, do not easily step back from a negative situation and are insistent and patient has been proven by certain research studies (Aşkar and Umay, 2001). In their study, Pajares and Miller (1994) found that self-efficacy perception affects mathematical achievement in a positive way, and this is a greater effect than other variables' effects on mathematical achievement. It has been determined in several studies abroad that self-efficacy belief is a significant predictor of academic achievement (Andrew and Wialle, 1998; Malpass et al., 1999; Stevens et al., 2004; Zajacova, Lynch and Espenshade, 2005; cited in Türedi and Türedi, 2006). In parallel with the results of those studies, it was found in this research that the students with higher achievement levels have higher self-efficacy beliefs in mathematics than other students.

Consequently, the findings obtained show that there is no significant difference between students' genders and their self-efficacy beliefs; however there are statistically significant differences among their self-efficacy beliefs by the high schools they were graduated from, the programs they attend, and their achievement levels.

Self-efficacy belief is an important factor which should be emphasized in the mathematics education. Based on this significant correlation between self-efficacy belief and achievement, it is scientifically clear that certain variables such as self-efficacy belief are effective so that students can be provided with the mathematics education they desire and improve their academic achievements in today's educational system. Hence, it can be recommended that necessary adjustments are made and more activities are included with an increasing importance in the educational programs in order to develop students' self-efficacy beliefs in mathematics in a positive way.

Conflict of Interests

The authors have not declared any conflict of interests.

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