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Determination of Self-Efficacy Beliefs of High School Students towards Math Literacy

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Abstract

The purpose of this study is to determine the high school students' self-efficacy beliefs about math literacy, and examine this beliefs in terms of some variables. The research was conducted on 712 high school students. A questionnaire and Math Literacy Self-Efficacy Scale were used for data collection. The data were analyzed in terms of t-test, one way anova and multiple regression analysis. According to the result of the study: it was determined that there were significant differences in math literacy self-efficacy in terms of gender, school type, class level, math degree, parents' educational status and the importance given to math classes. On the other hand, it was found that, math achievement and importance given to math classes variables were significant predictor of the math literacy self-efficacy. The findings were discussed in the light of related literature.

Key Words

Math Literacy, Self-Efficacy Belief, High School Students.

It can be seen that literacy concept is emphasized directly or indirectly, when the aims and goals of the training programs of today's education system is examined. Reading, writing, speaking and listening skills come first as the main elements of literacy. Changes have been unavoidable in the approach of raising the targeted individual according to the variable conditions of today's world. In the transition process from industry-production age to information-technology age, a literate individual is expected to have superior cognitive skills such as communication, judgment, problem solving, decision making beyond basic skills and to use them effectively in his/her life. In the PISA studies made by OECD, a new approach to literacy is being brought. Literacy is discussed to make students use the information and skills learned from basic lessons in necessary place and time, to analyze and judge the problems in different situations, and to use the obtained results in an efficient way (Organisation for Economic Co-Operation and Development [OECD], 2003, p. 24). This change in the literacy concept has spread to many areas and some literacy types have been discussed and researched.

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Math literacy (ML) concept has been created after the improvements in mathematics as a result of the changes in today's life conditions and qualifications expected from individuals. The need and the importance of competence in the mathematical content, process and situations faced in the daily lives, job-education lives of individuals can be seen as the point of origin of ML. According to Edge (2009), one has to be math literate in order to be functional in an optimal level. Besides, it has been stated that ML is a must for students in order to comply with the innovations (Pugalee & Chamblee, 1999). The ML concept has sometimes been defined as compared with mathematical efficacy, mathematical power, spatial and numeric literacy (Steen, 1999; De Lange, 2001; Kilpatrick, 2001). Whatever it is named, any individual has to have mathematical skills and abilities beyond pure mathematical content (Lengnink, 2005, p. 247).

Even if ML has not been fully described in the published standards of National Council of Teachers of Mathematics [NCTM] (1989; 2000) for school mathematics, its importance has been accepted and emphasized. The importance of ML is mentioned in today's Turkey mathematics curriculum (Milli Eğitim Bakanlığı [MEB], 2005). According to NCTM (1989, p. 5), individual's use of different mathematical methods in solving non-ordinary

problems shows his discovering, estimating and logical judgment skills. The catchword "*math for everyone*" of NCTM (2000, p. 13) has played an important role in making ML more important. Romberg (2001, p. 8) bases the meaning of being math literate on the vision of NCTM. In order to make math literacy valid and possible significant mathematical information and skills are necessary. This concept will not be considered as only reading-writing and numerical transactions.

In the PISA research made by OECD, according to many mathematics educationist; mathematics literacy includes information but not limited with that (De Lange, 2001; Matteson, 2006; OECD, 2003). When we examine the shared thoughts of PISA and NCTM about the description of ML, we see that they don't limit it with school program and mathematical contents, but beyond that they emphasize the use of mathematical information and skills in the individual's job, school and daily life functionally.

Some critiques have been made about the inadequate descriptions of ML (Amit & Fried, 2002, p. 501; Kilpatrick, 2001, p. 113). In a similar way Pugalee (1999, p. 19-20) has stated that ML is not well described, a frame or a model is necessary to discuss the meaning of it. In his model offered to overcome the complicacy of ML, some components in two circles common centered. In the outer circle, the four processes in doing math take place: representing, manipulating, judgment and problem solving. In the inner circle the elements to help make mathematics easier take place: communication, technology and values. When the components defining what ML is not we see that NCTM (2000) standards and PISA study are pathfinders.

It has been stated that the main components of ML are modeling and solving real life problems (Kaiser & Willender, 2005). ML, rather that understanding mathematical idea, includes usage of mathematical thought, building the understanding and independent skills in problem solving (Yore, Pimm, & Tuan, 2007). According to Thompson and Chappbell (2007), communication and representing are the main components in the improvement of math literacy. Lutzer (2005) says that ML means understanding the written thoughts in mathematics language and communicating. Besides, Lengnink (2005) has stated that reflecting and decision making are two important activities. And Tekin and Tekin (2004) have evaluated the mathematics literacy levels of elementary school mathematics teacher candidates in four dimensions in their study: mathematics subject field, mathematical processes, the improvement of mathematics through history and actuality.

Self-efficacy beliefs and ideas emphasize the functionality on a definite situation in the future. Individual's related status is measured before the activity happens (Zimmerman, 2000, p. 84). Individual who have ML need to develop confidence in their abilities of reasoning and verification of mathematical thinking (Western and Northern Canadian Protocol [WNCP], 2006, p. 8). Thus, self-efficacy can be said to be one of the important factors in the development of ML. According to Bandura (1977), self-efficacy feeds from four different sources: direct experiences, indirect experiences, verbal persuasion and physiological situation. And the individual uses the effect of self-efficacy by means of cognitive, motivational, emotional and choosing processes (Bandura, 1993). Students with high self-efficacy join the activities more willingly, work harder and may be insistent (Bandura, 1986; Schunk, 2009; Zimmerman, 2000).

Researches show that self-efficacy beliefs affect the students' academic successes (Chen, 2003; Pajares & Miller, 1994; Usher, 2009), their choices of the area they want to study in and their job selections (Hacket & Betz, 1989; O'Brien, Martinez-Pons, & Kopala, 1999; Waller, 2006) and their choices are related to different motivational beliefs (Chen, 2003; Cooper & Robinson,1991; Schnulz, 2005;). Besides, some meaningful relations have been observed between the students' preferences on mathematics, their interest and options with mathematics self-efficacy (Hackett & Betz, 1989; O'Brien et al., 1999).

Some researches about mathematics self efficacy beliefs in mathematical study area within different age groups have been made (Ayotola & Adedeji, 2009; Chen, 2003; Chen & Zimmerman, 2007; Goodwin, Ostrom, & Scott, 2009; Işıksal & Çakıroğlu, 2006; Liu & Koirala, 2009; O'Brien et al., 1999; Özgen & Bindak, 2008a; Özyürek, 2010; Pajares & Miller, 1994; Schnulz, 2005; Usher, 2009; Üredi & Üredi, 2005; Waller, 2006). But, in the literature it has been seen that self-efficacy beliefs of students' mathematics literacy have not been examined.

The purpose of this study is to define the self-efficacy beliefs of high school students and to analyze the students' self-efficacy beliefs in terms of gender, class, school type, mathematics degree, education of parents and the importance given to mathematics variables. Depending on this general purpose, the following research questions were addressed:

1. What are the views of high school students about ML self-efficacy?
2. Do the self-efficacy beliefs of students towards mathematics literacy vary from sex, class, school type, mathematics degree, education of parents, and the importance given to mathematics?
3. Do the mathematics degree and the importance given to mathematics affect the high school students' self-efficacy beliefs on ML?

Method

In this research descriptive survey method has been used. Survey models are research approaches aiming to describe a past or current situation as it is. The event, individual or the object subject to the research is tried to be described as it is in its own conditions (Karasar, 2005, p. 77).

Participants

The research group of this research consists of high school students located in the center of one of the metropolis cities of Turkey. The sampling of the research covers different school types (General High Schools, Anatolian-Science Schools, and Technical High Schools) and it is determined with disproportional mass sampling (Karasar, 2005, p. 115). With this purpose, 1 school from each school type has been selected and from each school 2 classes from 9th, 10th, 11th and 12th classes have been selected in order to cover all branches and the students in those classes have been added to the sampling. 712 students who have fully and truly answered the measurement tools have been sampled.

Data Analysis

"*Math Literacy Self-Efficacy Measurement*" and *"Personal Information Form"* which were improved by Özgen and Bindak (2008b) have been used. Math Literacy Self-Efficacy Measurement is a measurement in a five Likert type scale. The reliability coefficient of the scale consists of 25 items has been calculated as 0.94. Students' gender, school type, class, previous year's mathematics degree, parent's educational status and information concerning the importance given to mathematics classes have been collected.

Statistical methods like mean, frequency and percentage have been used to define the thoughts of high school students about the Math Literacy Self-Efficacy Scale. In the analysis of the obtained data t-test, variance analysis and multiple regression analysis have been used.

Results and Discussion

It has been defined that the average points of high school students who have attended the research are "*Indecisive*" and this shows that high school students have medium level belief in their Math Literate Self-Efficacy. Besides it will be useful to commentate considering the Turkish students' ML self-efficacy beliefs in PISA 2003 study. Because, remembering that students have been in the end of the world list of ML level and have got low levels in mathematics self-efficacy, we cannot say that their ML self-efficacy belief are high. In this regard, the finding obtained from the first problem of the research overlaps the findings in the previous researches on mathematics literacy and self-efficacy levels (OECD, 2004).

It has been defined that ML self-efficacy beliefs of students from different gender vary from each other and that males have more positive results than females. Some findings in researches related with the mathematics self-efficacy belief and gender have similar high result of males (Hackett & Betz, 1989; Pajares & Miller, 1994; Özyürek, 2010; Schnulz, 2005). On the other hand in some researches it has been seen that self-efficacy belief does not vary from gender (Ayotola & Adedeji, 2009; Chen, 2003; Goodwin et al., 2009). As it is seen in the related literature different research findings showing that the self-efficacy beliefs do not vary from gender have been obtained. In a similar way, in PISA 2003 study ML and self-efficacy beliefs of females are lower than males (OECD, 2004). It can be said that cultural situations affect these results on self-efficacy beliefs.

It has been defined that ML self-efficacy beliefs vary from class and 9th class students have the highest belief and 12th class students have the lowest. The thought of "as the class level increases, the ML self-efficacy beliefs rises" does not overlap with these findings. In the related literature, in PISA study, within OECD countries as the class level increases it has been defined that the ML self-efficacy belief rises too (OECD, 2004; Schnulz, 2005). In Özyürek's research (2010) it has been found that ML self-efficacy beliefs of high school students do not vary from class and it not effective in explaining the variance. Especially it is thought-provoking that 12th class student have the lowest ML self-efficacy belief level. The anxiety may cause this result because of the university exam and especially math anxiety. This result overlaps with the findings of previous (Cooper & Robinson, 1991; Jain & Dowson, 2009; Lee, 2009; OECD, 2004) researches.

Another finding of the research is that ML self-efficacy beliefs vary from school type and Anatolian High School students have a higher level of self-efficacy belief rather than General High School and Technical High School students. In his PISA 2003 research, Schnulz (2005) has found out the effect of school type in differentiating the ML points. This finding overlaps with the research's findings. The providing of necessary classes to make high school students have the basic ML level is said to be able to decrease the ML self-efficacy differentiations because of school type.

It has been found that students' ML self-efficacy beliefs vary from mathematics degree, mathematics degree and ML self-efficacy belief are related and mathematics degree highly affects the ML self-efficacy beliefs. Academic success and its different dimensions have been examined in researches on mathematics self-efficacy and in many of them academic success and mathematics self-efficacy are positively related (Chen, 2003; O'Brien et al., 1999; OECD, 2004; Pajares & Miller, 1994).

Another finding of the research is that ML self-efficacy beliefs vary from parents' education level. In a similar way, families' socio-economic status is predictive factor affecting the students' ML self-efficacy beliefs (O'Brien et al., 1999; Schnulz, 2005). Families' economical, educational etc. statuses are important to affect the students' education lives.

The final finding of the research is that ML self-efficacy beliefs vary from the importance given to mathematics classes. Students paying more attention to mathematics classes have more ML self-efficacy beliefs. When the relation of students' interest, choice and preferences with mathematics self-efficacy is observed, students with high mathematics self-efficacy are expected to pay more attention to mathematics classes.

It has been defined that high school students have a low level of ML self-efficacy belief and there are differentiations related to gender, school type, class, mathematics degree, parents' educational status, and the importance given to mathematics classes. Besides, mathematics degree and importance given to mathematics classes variables are predictions for the ML self-efficacy.

Students' current ML self-efficacy beliefs are not stable, can be changed and be improved. Especially teachers have important duties in improving the ML self-efficacy beliefs of students. Siegle and McCoach (2007) have defined that using right education strategies it is possible to increase the ML self-efficacy beliefs of students. These strategies are, helping students building learning aims, ensuring on-time and full feedback, encouraging him to work hard, and using successful students as model.

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