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Factors affecting the Mathematics achievement of Turkish students in PISA 2012

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This study aims to analyze the effect of variables determining mathematics interest, mathematics self-concept, mathematics anxiety, teacher-student relation, classroom management and sense of belonging on the Mathematics achievement of Turkish students in the Programme for International Student Assessment (PISA) 2012. Structural equation modeling (SEM) was employed in this research study. The research population is represented by 15 year 3 month and 16 year 2 month old students receiving education in Turkey. The research sample, on the other hand, is composed of 4848 students randomly selected from 170 schools in 12 geographical regions where PISA is implemented. When the Mathematical structural equation model is analyzed, it has been seen that there is a medium and positive relationship between mathematics achievement and mathematics interest of students with mathematics self-concept. It has also been determined that the variable mathematics anxiety has a negative and medium effect on mathematics achievement. According to the results of the research study there is no meaningful relationship between variables of teacher-student relation, classroom management, sense of belonging and mathematics achievement of Turkish students.

Key words: PISA 2012, Mathematics literacy, structural equation model.

INTRODUCTION

In the aftermath of the OECD (2013) report, the Programme for International Student Assessment (PISA 2012) examination has initiated a debate in the media, among academics and practitioners on the causes of the results and the consequences. The average performance of Turkish students was relatively poor when it is compared to other OECD countries in the three literacy areas (reading, mathematics and science). PISA, the most reliable index assessing the performance of educational systems, aims to evaluate the knowledge and skills of 15 year old students in reading, mathematics and science literacy. PISA assesses that the educational systems in terms of quality, equity and efficiency and analyses how students participate in modern societies using the acquired knowledge and skills. This approach reflects the fact that modern societies evaluate individuals not only by the knowledge they acquired but also what they can do with it (OECD, 2013a). Besides this, PISA collects “rich” data from both students, parents, teachers and schools in order to establish a model showing all related variables and processes influence. In other words, it supplies the data related to factors

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supposed to effect the achievement of students including family resources, learning environment and student belief and motivation. PISA student questionnaire includes six main titles; personal information, family and home, mathematics experiences, school, learning mathematics and problem solving experiences (OECD, 2013b).

PISA in 2012 focused on mathematics literacy. Mathematics literacy is the ability of an individual to formulate, employ and interpret in different contexts. In other words, an individual is able to use mathematics knowledge sources and tools for reasoning and predicting the formulation deeply. There are many potential factors affecting achievement differences in large scale testing. Joshi (1998) proposed an academic achievement model to explain for mathematics learning and achievement in Nepal. The model includes two basic parts. One of them is personal factors (gender, age, prior knowledge, motivation) and the other is environmental factors (learning environment at school, at home and among peers). Besides this, Carroll (1982) focused on students intrinsic abilities to learn. According to Coleman et al.'s model, school policy matters are directly affecting the achievement of students. Walberg's educational productivity theory (1981) suggested nine variables (motivation, classroom environment, quality of instruction, home environment…) that have positive effects on academic achievement. In 2007, Adeyemo and Adetona stated several detrimental factors (self-efficacy, anxiety, self-concept) for academic achievement (Lai, 2008).

Reviewing the literature on mathematics achievement, the potential factors affecting the performance of students can be put into a range of list. For Zhao (2011), stated factors could be classified as individual variables, such as mathematics anxiety (Meece et al., 1990); background variables, such as family socio-economic status (Sirin, 2005); learning environment variables, such as teacher quality and time investment (Stigler et al., 1999). Student personal attitudes towards mathematics, classroom climate, mathematics anxiety (Lewis and Aiken, 1970; Engelhard, 2001), teaching methods (Matt and et al., 2011), self-concept (Marsh and Hau, 2004), sense of belonging (Goodenow, 1993; Voekl, 1995), teacher-students relation (Smith et al., 1978) and interest (Heinze et al., 2005) are the factors mostly stated and implied in research studies. In this research study individual variables (mathematics self-concept, mathematics interest, mathematics anxiety), teacher student relation, classroom management and sense of belonging are included as latent variables.

Academic self- concept can be described as individuals' knowledge and perceptions about their academic achievement on a particular area (Wigfield and Karpathian, 1991). Students with positive self-concept have a higher motivation and can perform better (Stipek, 1998). Some researchers stated that there is a positive relationship between self- concept and mathematics achievement depending on the results of the studies carried at different schools in different countries (Dermitzaki et al., 2009). Bandura (1997) implied that self-concept of individuals influences their choices, because individuals prefer the areas in which they believe they succeed with a high level of self-confidence. In addition, the higher the self-concept is the higher the effort and persistence is. Many students have difficulties in learning at school not because they have not got the capacity but they think they are incapable and cannot succeed (Obilor, 2011).

Another variable taken into account for students in PISA 2012 is mathematics interest. It is clear that students' interest or academic motivation increases their performance. Students who like or find mathematics interesting are likely to excel in it (Deci and Ryan, 2002). Students' mathematics interest and motivation to learn affects each other mutually in a positive way. Therefore, it is crucial to support and develop their positive attitudes towards any academic subject (Pintrich, 1999).

Krapp (1992) and Prenzel (1988) stated that a concept of interest and motivation can be described as a relationship between an individual (learner) and an object (learning topic). In this theoretical context, it has to be differentiated between a current situational relation to an object and the interest in an object. Lewalter et al. (1998) implied that conditions of school instruction are fostering individual interest and motivation. This depends on the particular teacher who is responsible for organizing teaching and learning in the classroom. Moreover, interest and motivation can lead to the development of an orientation of interest towards a school subject (Heinze et al., 2005:213).

Mathematics anxiety is one of the factors that affect individual's performance. The relationship between anxiety and performance is analyzed in different titles, such as test anxiety (Bodas and Ollendick, 2005) or mathematics anxiety (Engelhard, 2001). Mathematics anxiety can be defined as a fear that has a negative relationship with performance (Whyte, 2009). Studies point out that mathematics anxiety is associated with several factors ranging from environmental factors such as family pressure for higher achievement, to intellectual factors as learning styles or to personality factors such as low self- esteem (Uusimaki and Nason, 2004; Woodard, 2004). Negative school experiences such as teachers' threatening and authoritarian attitudes might also contribute to the development of mathematics anxiety (Bursal and Paznokas, 2006). The research studies about mathematics anxiety reveal the fact that while the mathematics life and experiences increases the level of anxiety decreases (Ruffell, Mason and Barbara, 1998). For Lee (2009), the statistically analysis of PISA 2003 data states that mathematics anxiety is distinguishable from mathematics self-concept and mathematics self-efficacy. He added that in New Zealand, students with high mathematics achievement have a lower mathematics anxiety.

Previous studies that employed cross-cultural data have documented moderate sizes of correlations in the relationship between math performance and math self-concept, math interest and math anxiety. Marsh et al. (2006) carried out a study in 25 countries and found that cross-cultural invariant correlations between mathematics self concept and mathematics achievement is moderate and in a positive way. In a meta-analysis by Ma (1999), a similar size (but negative) is reported as the population correlation on the relationship between mathematics performance and mathematics anxiety. Another meta-analysis on mathematics anxiety (Hembree, 1990) shows slightly stronger correlations for students.

For years, international student assessment projects, PISA and TIMMS have supplied a rich data for national and international comparative analyses of student performances. By this way, it is possible to see strengths and weaknesses of educational systems. This paper contributes to the related literature by providing a detailed analysis of Turkish students' individual achievement in the mathematics literacy of PISA 2012 examining the various factors which influenced it. Turkish students' achievement in PISA is considerably lower than other countries. It is thought to be crucial to supply findings to take precautions needed for better academic achievement. The author also postulates the results to be informative for other countries. It is aimed to analyze the effect of variables determining students' mathematics interest, mathematics self-concept, mathematics anxiety, teacher-student relation, classroom management and sense of belonging on the mathematics achievement of Turkish students in the Programme for International Student Assessment (PISA) 2012.

METHOD

Structural equation modeling (SEM) was employed in this research study. Structural equation modeling is a comprehensive statistical approach to test hypotheses about relations among observed and latent variables (Hoyle, 1995). For MacCallum and Austin (2000) SEM tests hypothesized patterns of directional and non-directional relationships among a set of observed (measured) and unobserved (latent) variables. SEM has got two goals; to understand the patterns of correlation/covariance among a set of variables and to explain as much of their variance as possible with the model specified. SEM includes variation, co-variation, confirmatory factor analyses and regression in order to analyse the relationship between variables (Kleine, 2005).

Data and Sampling of the Research

The data are sourced from PISA 2012 in which all 34 OECD member countries and 31 partner countries and economies participated, representing more than 80% of the world economy. Around 510 000 students between the ages of 15 years 3 months and 16 years 2 months completed the assessment in 2012, representing about 28 million 15-year-olds in the schools of the 65 participating countries and economies. The research population is represented by 15 year 3 month and 16 year 2 month old students receiving education in Turkey. The research sample, on the other hand, is composed of 4848 students randomly selected from 170 schools in 12 geographical regions where PISA is implemented. PISA is an assessment of domains such as reading, mathematical, and scientific literacy. In addition to content assessments, PISA includes student, parents, and school surveys that have questions related to students' and parents' background, students' attitude towards reading and information and communication technologies. The data were obtained from both the mathematics literacy test and students surveys of PISA 2012.

The analysis of the data

In the proposed structural model (Figure 1), the variables of mathematics interest, mathematics self- concept, mathematics anxiety, teacher-student relation, classroom management and sense of belonging are hypothesized to have direct effects on mathematics achievement in PISA. To reduce the length of the test, PISA applied matrix sampling, which splits one long test booklet into several short test booklets. Therefore, each student works on one booklet only. Because students complete different tests, mathematics achievement cannot be obtained using traditional test scores, but instead by using plausible values. For Ma et al. (2008, 59-110).

Plausible values are multiple imputations of unobservable latent achievement for each student. Simply put, plausible values are some kind of student ability estimates. Instead of obtaining a point-estimate for student ability, which is a traditional test score for each student, an estimated probability distribution was derived empirically from the observed values on students' tests and their background variables. Plausible values then are drawn at random from this probability distribution for each student.

Plausible values are multiple estimates of individual student performance that enable group-level estimates of performance. Plausible values are used because PISA sample members did not take the full battery of assessment items (each student was given a subset of items). In the case of PISA 2013, five plausible values were computed for each student respondent, indicating possible "true" values of the student's score on the underlying conceptual dimension. Plausible values for Mathematics literacy were coded as PV1 Mathematics, PV2 Mathematics, PV3 Mathematics, PV4 Mathematics and PV5 Mathematics.

Initially the questions in the questionnaire were determined through basic components paraphrasing factors analysis so as to determine the factors influential over mathematics achievement. Prior to the analysis of the data, reverse coding was observed in some data and the data were rearranged by the researcher through recoding, and the data were checked for suitability for factors analysis via Kaiser- Meyer- Olkin (KMO) coefficient in addition to Barlett Sphericity test. The factor loads of the questions formed for this purpose and the specific values of the factors were then studied on SPSS 15.0 package program. The coefficient of internal consistency Croanbach Alpha Value calculated for latent variables. Then the structural equation model was established.

Prior to Exploratory factor analysis (EFA), the Kaiser- Meyer-Olkin measure of sampling (KMO-test) was applied. The value of KMO was calculated as 0.92. The sample is adequate if the value of KMO is greater than 0.5 (Field, 2000: 446). For these data Barlett's test is significant ($p<0.01$) and therefore factor analysis is appropriate. Not all of the questions in the questionnaire were taken into consideration in the research and only those questions with the most factor load were included in the research. The most significant

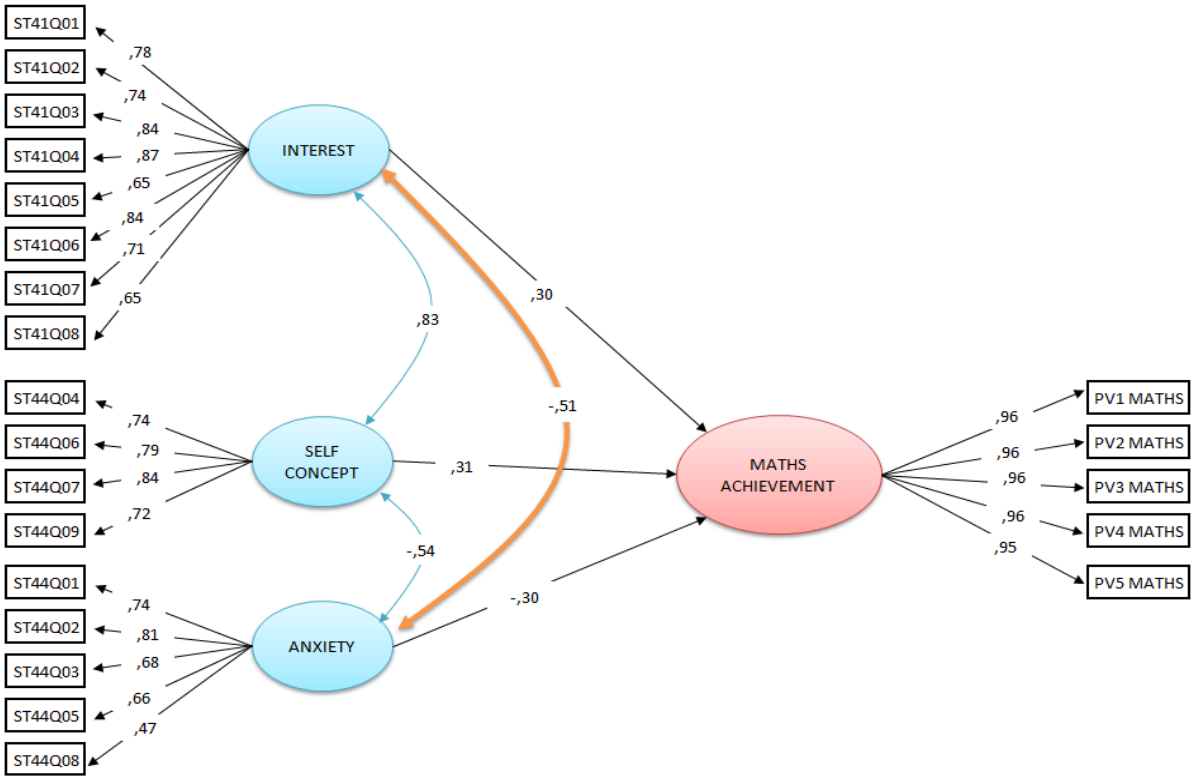

Figure 1. Structural equation model (SEM).

criterion here was use of at least three questions for each dimension (Schumacher and Lomax, 1996). After the analysis, the items were collected under 6 factors. The total variant value these six factors could explain was 61.28. The results of EFA are stated in Table 1. The value for factor loading cut-off is determined as 0.50 and the value for the double-loading item is determined as 0.10. ST35Q04 of which factor loading was less than factor loading cut-off (0.50) and ST37Q08 which has double loading were extracted (Çokluk et al., 2001). Categories of PISA overlap factors of the EFA to a large extent. The communalities were found in the range of 0.34 and 0.79. The highest loading on the factor is 0.85 while the smallest is 0.53.

The coefficient of internal consistency Croanbach Alpha value calculated for entire independent variables is 0.82, suggesting that the items have relatively high internal consistency (Note that a reliability coefficient of 0.70 or higher is considered "acceptable" in most social science research situations) (Table 2). For each factor the coefficient of internal consistency Croanbach Alpha value was calculated for mathematics interest as 0.92; for mathematics self-concept as 0.85; for mathematics anxiety as 0.84; for sense of belonging as 0.80; for teacher-student relation as 0.84 and for classroom management as 0.78 (Table 3). As a result of two consistency analysis, upper 27% and lower 27% of the group point have shown that there is a significant difference for all items (*p<.01*).

FINDINGS

The findings made out of the analysis of the data have been stated in this section of the research. In the proposed model one dependent latent variable (mathematics literacy/achievement) and three independent latent variables (mathematics interest, mathematics self-concept, mathematics anxiety) were used. In Figure 1 the proposed structural equation model (SEM) was stated.

The standardized regression analysis of structural equation model was stated (Figure 1). Prior to SEM, ST44Q02 was excluded because of the high covariance error (T44Q02 following the analysis of the table of standardized covariance variables (Tabachnick and Fidel, 2001). For Kline (2005) standardized coefficients around 0.30 are considered medium. When the Mathematical structural equation modeling is analyzed, it has been determined that the variables ‘mathematics interest’ and ‘mathematics self-concept’ have a medium and positive effect on mathematics achievement (β=0.30, p<.01; β=0.31, p<0.01). Besides this, the variable ‘mathematics anxiety’ has a negative and medium effect on mathematics achievement (β=-0.30, p<0.01). The negative value of the standardized regression coefficient of the regression equation means that 1.00 unit increase in students’ ‘mathematics anxiety’ level causes 30 unit decrease in students’ mathematics achievement scores. On the other hand, there is no meaningful relationship between variables of ‘teacher-student relationship (t=0.71, p>0.05)’, ‘classroom management (t=0.47, p>0.05)’, ‘sense of belongings’ (t=0.12, p>0.05) and students’ mathematics achievement, that’s why they were not stated in the model.

Table 1. Exploratory factor analysis (EFA).

	Factor loading					
	1	**2**	**3**	**4**	**5**	**6**
ST41Q07	.81	-.11	.03	.04	.11	.09
ST41Q02	.81	-.13	.05	.10	.12	.03
ST41Q05	.80	-.04	.08	.09	.05	.05
ST41Q08	.78	-.03	.07	.06	.08	.07
ST41Q06	.71	-.19	.02	.09	.37	.08
ST41Q04	.65	-.28	.01	.12	.47	.10
ST41Q03	.63	-.24	.03	.15	.43	.13
ST41Q01	.62	-.19	.00	.07	.42	.05
ST44Q03	-.16	.76	-.01	-.04	-.21	.00
ST44Q01	-.11	.73	-.01	-.01	-.28	.01
ST44Q08	-.15	.73	-.06	-.05	-.02	-.02
ST44Q02	-.25	.72	-.02	-.01	-.33	-.02
ST44Q05	-.15	.72	.00	-.09	.02	-.03
ST44Q10	.00	.58	-.00	.00	-.08	-.01
ST37Q06	.01	-.23	.71	.00	-.20	-.03
ST37Q03	.09	.07	.69	.10	.11	.08
ST37Q01	-.05	-.24	.68	-.00	-.15	-.02
ST37Q07	.17	.10	.65	.11	.08	.06
ST37Q05	-.03	.09	.65	.04	.24	.03
ST37Q02	-.04	.09	.64	.09	.22	.07
ST37Q04	.02	-.28	.59	.06	-.30	-.06
ST37Q09	.14	.04	.53	.25	-.04	.16
ST28Q03	.10	-.04	.09	.79	.01	.13
ST28Q04	.05	-.05	.13	.78	.06	.17
ST28Q01	.05	-.01	.05	.75	.11	.16
ST28Q05	.131	-.07	.14	.73	.00	.10
ST28Q02	.091	-.03	.07	.72	.05	.06
ST44Q09	.269	-.16	.02	.07	.71	.03
ST44Q06	.343	-.27	.05	.05	.66	.07
ST44Q04	.325	-.27	.06	.07	.64	.09
ST44Q05	.492	-.23	.00	.06	.63	.05
ST35Q02	.104	-.01	.08	.21	.09	.85
ST35Q01	.101	-.04	.03	.20	.12	.81

The goodness of fit statistics used in the evaluation of model suitability and the values calculated are stated in Table 4. The consistency index results of the structural equation modeling have been analyzed using x2/sd, GFI, AGFI, NFI, CFI and RMSEA values in order to evaluate the suitability between the model and the data. At the end of the analysis x2/sd, GFI, AGFI, NFI, CFI and RMSEA values were calculated as 3.69, 0.96, 0.90, 0.95, 0.95 and 0.04 respectively. Kleine (2005) stated that x2/sd rate being 3 and less shows a good suitability while the value of 5 and less is evaluated as quite sufficient (Sümer, 2000; Şimşek, 2007). For Hooper et al. (2008) the GFI and AGFI consistency index values which are higher than 0.90 show a good suitability. Jöreskog and Sorbon (1993) stated that RMSEA value being 0.05 and lower shows a perfect model data suitability. Hu and Bentler (1999) specified that NFI AND CFI consistency index values over 0.95 show a perfect suitability. In this research study CFI consistency index value of the model which is 0.95 shows a perfect suitability.

DISCUSSION

In this study it was aimed to analyze Turkish students' individual achievement in mathematics literacy of PISA 2012 examining six independent latent variables (mathematics interest, mathematics anxiety, self-concept, sense of belongings, teacher-student relation and classroom management). For this purpose, a structural equation model was established.

When the Mathematical structural equation model is analyzed, it has been seen that there is a medium and positive relationship between mathematics achievement and mathematics interest of students. This result is similar to some findings stated in the literature. There are some studies that give a correlation between Mathematics achievement and interest. Schiefele et al. (1993) stated an average correlation (0.30) between them (Heinze et al., 2005). High interest in mathematics was shown to correlate with mathematics achievement in Taiwan, Japan and the United States (Evans et al., 2002). Similarly, there is a positive and medium correlation (between 0.25-0.35) between academic achievement and interest according to some other research results (Eccles et al., 1993; Marsh et al., 2005). On the other hand, Köller et al. (2001) showed that subject interest in mathematics had no significant influence on achievement. It is important to discuss what shapes students' interest. Brophy (2000) states that teachers' expectations play a crucial role in students' achievement because it predicts the level of interest (Wentzel, 2002). It is possible to tell that mathematics interest behaving as a crucial and internal motivator increases mathematics achievement. Therefore, it could be concluded that teaching behaviors which encourage students to learn more and motivate their mathematics interest will increase their achievement at mathematics.

The other result of the research study is that the independent latent variable 'mathematics self- concept' has a medium and positive effect on mathematics achievement. According to Bandura (1977), people's belief of personal efficacy affects almost everything they do (p.19). Much of the early literature investigating the relation between academic self-concept and academic achievement demonstrated that higher levels of academic

Table 2. Survey items and latent variables.

Observed variables – item coding at PISA database	Scales	Latent variables
ST41Q01 I enjoy reading about mathematics. ST41Q02 Making an effort in mathematics is worth it because it will help me in the work that I want to do later on. ST41Q03 I look forward to my mathematics lessons. ST41Q04 I do mathematics because I enjoy it. ST41Q05Learning mathematics is worthwhile for me because it will improve my career prospects chances. ST41Q06 I am interested in the things I learn in mathematics. ST41Q07 Mathematics is an important subject for me because I need it for what I want to study later on. ST41Q08 I will learn many things in mathematics that will help me get a job.	Strongly Agree (1) Agree (2) Disagree (3) Strongly Disagree (4)	Mathematics Interest
ST44Q04 I get good grades in mathematics. ST44Q06 I learn mathematics quickly. ST44Q07 I have always believed that mathematics is one of my best subjects. ST44Q09 In my mathematics class I understand even the most difficult work.	Strongly Agree (1) Agree (2) Disagree (3) Strongly Disagree (4)	Mathematics Self-Concept
ST44Q01 I often worry that it will be difficult for me in mathematics classes. ST44Q02 I am just not good at mathematics. ST44Q03 I get very tense when I have to do mathematics homework. ST44Q05 I get very nervous doing mathematics problems. ST44Q08 I feel helpless when doing a mathematics problem. ST44Q10 I worry that I will get poor grades in mathematics.	Strongly Agree (1) Agree (2) Disagree (3) Strongly Disagree (4)	Mathematics Anxiety
ST28Q01 The teacher shows an interest in every student's learning. ST28Q02 The teacher gives extra help when students need it. ST2803 The teacher helps students with their learning. ST2804 The teacher continues teaching until the students understand. ST28Q05 The teacher gives students an opportunity to express opinions.	Every Lesson (1) Most Lessons (2) Some Lessons (3) Never Or Hardly Ever (4)	Teacher Student Relation
ST35Q01My teacher gets students to listen to him or her. ST35Q02 My teacher keeps the class orderly. ST35Q03 My teacher starts lessons on time.	Strongly Agree (1) Agree (2) Disagree (3) Strongly Disagree (4)	Classroom Management
ST37Q01I feel like an outsider (or left out of things) at school. ST37Q02 I make friends easily at school. ST37Q03 I feel like I belong at school. ST37Q04 I feel awkward and out of place in my school. ST37Q05 Other students seem to like me. ST37Q06 I feel lonely at school. ST37Q07 I feel happy at school. ST37Q09 I am satisfied with my school.	Strongly Agree (1) Agree (2) Disagree (3) Strongly Disagree (4)	Sense Of Belonging; Students Attitudes Towards School

Source: Student Questionnaire, PISA 2012.

self-concept were associated with higher levels of achievement (Marsh and Craven, 1997). In their meta-analysis, Hansford and Hattie (1982) reported that the average correlation between measures of general self-

Table 3. Croanbach alpha coefficient for Independent latent variables.

Latent variables	Cronbach alpha value
Mathematics interest	0.92
Mathematics self-concept	0.85
Mathematics anxiety	0.84
Sense of belongings	0.80
Teacher student relationship	0.84
Classroom management	0.78

Table 4. The consistency index values of the model.

x2/sd	GFI	AGFI	NFI	CFI	RMSEA
3.69	0.96	0.90	0.95	0.95	0.04

concept and academic achievement was moderately low but positive (0.21). Furthermore, Kiamanesh and Kheirieh (2011) implied that Iranian students who have high level of mathematics self-concept could do better at mathematics. They added that the correlation between them is positive and significant. Törnross et al. (2006) studied on PISA and reported that self-concept had a stronger effect on mathematics achievement than motivation and anxiety in mathematics. Some studies showed that academic self-concept was called as a distinctive factor across cultures (Corbiere et al., 2006; Marsh and Byrne, 1993; Chong and Michael, 2000). Briefly, self-concept may play important roles in learning because they provide the foundation for motivation and influence the level of effort and persistence a student applies to performing a task and reaching a particular outcome.

It has been also determined that the variable 'mathematics anxiety' has a negative and medium effect on mathematics achievement. In a meta-analysis by Ma (1999), a similar size of correlation (−0.27) is reported as the population correlation on the relationship between math performance and math anxiety. Lafferty (1996) and Miller (1991) worked with elementary school students and found that those with higher achievement in mathematics had lower degrees of anxiety for mathematics. Townsend et al. (1998) reason that low achievement increases students fear and anxiety about mathematics which in turn negatively impacts achievement. Studies show that group work and collaborative learning strategies alleviate mathematics anxiety and have positive impact on students cognitively, emotional and socially (Gresham et al., 1997; Townsend et al., 1998). In addition, students with anxiety in mathematics may develop negative attitudes and negative self-concept which causes lower academic achievement (Fennema, 1989). Subsequently, students may feel helpless and this, in turn, can affect their motivation and success in mathematics. Remembering the fact that examination and failure anxiety causes low academic achievement, it is possible to propose an evaluation based on students' performance homework, projects and participation in class rather than strict ruled written examinations. It is clear that all these factors stated above are also interrelated- for example, failure related anxiety may reduce interest and motivation, but can also reinforce motivation allowing a person to invest more work to avoid failure (Pekrun et al., 2002). As reported by Macher et al. (2012), students with higher levels of interest in a subject invest more time and effort in learning, apply more effective learning strategies, and achieve better results.

According to the results of the research study there is no meaningful relationship between variables of 'teacher-student relation', 'classroom management', 'sense of belonging' and mathematics achievement of Turkish students. Previous studies have found that the correlation between academic achievement and sense of belonging is moderate – generally between 0.25 and 0.30 (Goodenow, 1993; Voelkl, 1995). In some respects this result is surprising. It is indisputable that teachers play a crucial role in a effective and qualified education. Well classroom management is a perquisite for effective teaching and learning. For some researchers a safe and orderly classroom atmosphere is a necessity (Marzano, 2003). According to Marzano (2003), a qualified teacher uses effective classroom management strategies.

PISA is a tool for monitoring and evaluating a country's education performance and equity. Yüksel –Şahin (2008) stated that Turkish students having difficulty with problem solving in PISA 2003 reported higher mathematics anxiety compared to other OECD countries. In 2007 these findings were thought to be alarming in Turkey and decided to revise the curriculum. The ministry of Education is to take precautions to live up to demands of the global competition. Policymakers, academics and researchers are the stakeholders of education. Policymakers should be wise to draw conclusions from the results of scientific researches using international test score reports. It is possible to propose a partnership model of decision making regarding curriculum and assessment including teachers. Reimers and Reimers (2014.4) state that the highest performing countries allocate resources equitably across schools, give teachers and principals autonomy over curriculum and assessment, and engage all stakeholders in education including students-e.g. Japan and Portugal have reformed curriculum to align it with students interests.

Besides this, teachers need to develop skills that help students have higher interest and lower academic anxiety. The general idea is that teacher attitudes motivate or demotivate students. It is crucial to discuss to what extent teacher competences that contribute to

student achievement and how to create programs for teachers supporting their professional development. Similarly, Sami (2013) implied that the principal factor explaining Korean students' success is equity in educational opportunities. She added that Korean teacher training programs followed by continuous teacher support and professional development is another key factor in the same area. For Simola (2005), the most efficient factor explaining the success of Finland at PISA is teacher; hence teacher training policies.

In summary, some of the results of this study have been surprising and somewhat contradictory to that of previous research results. The present study offers a general conclusion of the three closely related independent variables (mathematics interest, mathematics anxiety, self-concept) while there is no meaningful relationship between variables of 'teacher-student relation', 'classroom management', 'sense of belonging' and mathematics achievement of Turkish students. It is possible to tell that teachers are closely related to learning outcomes, which suggest that teacher training should include not only instructional knowledge but also how to create a good atmosphere supporting students' academic achievement. The problem of teacher quality and the impact of it on students' achievement with teacher training policies are discussed among academics, educators and practitioners. Due to Turkish students' poor mathematics achievement at PISA, further researches are needed to analyze the role of teachers. Further conceptualization and knowledge looking into the matter in different ways are essential to determine the factors that have the greatest impact on student achievement. The ministry of education may cooperate with universities to understand the reasons behind the success of top countries at PISA and apply different efforts made to develop mathematics education in Turkey. Application of projects keeping the level teacher education qualification high and being able to recruit motivation of students may offer an opportunity to develop the performance of students.

Conflict of Interests

The author has not declared any conflict of interests.

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