Education and Science

Vol 40 (2015) No 179 45-55

Examination of Factors Affecting PISA 2012 Mathematical Literacy through Mediation Model

Hakan Koğar [1]

Abstract

The purpose of this survey is to identify the direct and indirect factors affecting the PISA 2012 mathematical literacy. This research has been conducted in relational screening model. All of the 4848 students included in Turkey sample took part in this survey. Learning mathematics, mathematics experiences and problem solving experiences mediation variables consisting of the 17 indexes and gender, economic, social and cultural status and time allocated for learning mathematics independent variables included for analysis. The significance of the indirect influences in the mediation models were tested by using Sobel, Aroian and Goodman tests. Gender, economic, social and cultural status index and time allocated for learning mathematics independent variables have a significant influence on mathematical literacy. The independent variables explain 11 mediation variables in a significant way. Seven indexes from learning mathematics mediation variable, 4 indexes from mathematics experiences variable and 2 indexes from problem solving mediation variable explain the values in mathematical literacy in a significant manner. The mediation variable explaining the mathematical literacy at the maximum level is mathematics self-efficacy. The significance of the mediation effects were tested by using Sobel, Aroian and Goodman tests. According to the test results, 10 index values out of 17 index values are seen to have a mediator effect.

Keywords

Mediation Model

Mathematical Literacy

PISA 2012

Article Info

Received: 02.17.2015

Accepted: 04.22.2015

Online Published: 05.20.2015

DOI: 10.15390/EB.2015.4445

Introduction

Program for International Student Assessment (PISA) is a project applied for pupils at the age of 15 and having undertaken minimum 7 years of education and aiming at identifying the success of countries in raising the human capital they need for economic development. 510 pupils from 65 countries participated in PISA 2012 application. PISA application is repeated every 3 years in one of the main fields of reading, mathematics and science. The dominant field in PISA 2012 application is mathematics (MEB, 2013).

In the PISA application, student parent and school questionnaires are also applied besides the tests assessing the academic success of students. The factors affecting the academic success can also be identified through these questionnaires (Özer & Anıl, 2011). Among the PISA applications when the national and international surveys where the factors affecting the academic success are examined, it is

[1] Başkent University, Faculty of Education, Department of Primary Education, Turkey, hkogar@gmail.com

seen that variable directly affecting the academic success are tried to be identified (Yılmaz, 2009; Lin, Tzou, Shyu, Hung & Huang, 2008; Ovayolu, 2010; Özer & Anıl, 2011; Özer & Özberk, 2011; Stacey, 2011; Uysal & Yenilmez, 2011; Gürsakal, 2012).However, the presence of variables can also be emphasized which indirectly affect the mathematical literacy variable indicating the success in mathematics which was the dominant field in PISA 2012 application. The studies about PISA 2012 mathematics literacy examined in Turkey. In a consequence of research, six articles found in peer-reviewed journal. In five articles, only descriptive statistics done.

In PISA 2012 applications and this research, mathematics literacy means the capacity of individuals to formulate, employ and interpret mathematics in a variety of contexts. Mathematics literacy is not an attribute that an individual either has or does not have; rather, it is a skill that can be developed over a lifetime (OECD, 2013a). For examined the mathematics literacy, PISA 2012 database is been used. Comparing the performance of education systems across countries adds more layers of complexity and because the social, economic and cultural context of the countries that are being compared are often very different. The best way for these purposes, PISA 2012 applications are used. It has been identified that mathematical literacy is influenced by such variables as gender (Ovayolu, 2010; Özer & Özberk, 2011; Stacey, 2011; Uysal & Yenilmez, 2011; Gürsakal, 2012), economic, social and cultural status (Lin, et al.., 2008; Yılmaz, 2009; Stacey, 2011) and time allocated for learning mathematics(Anderson, 1995; Fisher, 1995; Dursun & Dede, 2004; Seidel & Shavelson, 2007; Savaş, Taş & Duru, 2010; Özer & Anıl, 2011). These variables have direct effects, bacause of this, these variables taken as independent. The findings belonging to Turkey sample among these variables that are identified in the PISA 2012 application has been reported by testing three mediator variables (learning mathematics, mathematics experiences and problem solving experiences) obtained from 17 index values reported by OECD (2013b) and identified to influence the mathematical literacy.

The mediation variables of learning mathematics consisting of the indexes like the familiarity with mathematical concepts (FAMCON) with sections of algebra and geometry, experience with pure mathematics tasks at school (EXPUREM), mathematics self-efficacy (MATHEFF) with sef-confidence of a known number of tasks, mathematics self-concepts (SCMAT) with what their think about working mathematics, mathematics interest (INTMAT), instrumental motivations for mathematics (INSTMOT) with to think about their views on mathematics, mathematics work ethics (MATWKETH) with ethical questions, mathematics behavior (MATBEH), subjective norms in mathematics (SUBNORM), mathematics anxiety (ANXMAT) and attributions to failure in mathematics (FAILMAT), mathematics experiences mediation variable consisting of the indexes like mathematics teacher's classroom management (CLSMAN), cognitive action in mathematics lessons (COGACT) with the mathematics teacher that taught them their last mathematics class, mathematics teacher's support (MTSUP) and disciplinary climate (DISCLIMA) and problem solving experiences mediation variable consisting of the indexes like perseverance (PERSEV) with the perseverance to difficult problems and openness for problem solving (OPENPS) influence the mathematical literacy

Mediation Model is a statistical model aiming at finding out the direct and indirect influences of the dependent variable. Especially in the behavioral sciences, it is capable of identifying the indirect influences; therefore, it has been a popular statistical technique. These analyse method are not only researched maximum effect of independent variables to dependent variable; but also researched the reproductivity of mediator variables (Baron & Kenny, 1986; Iacobucci, 2008). Mediation Model is described in Figure 1.

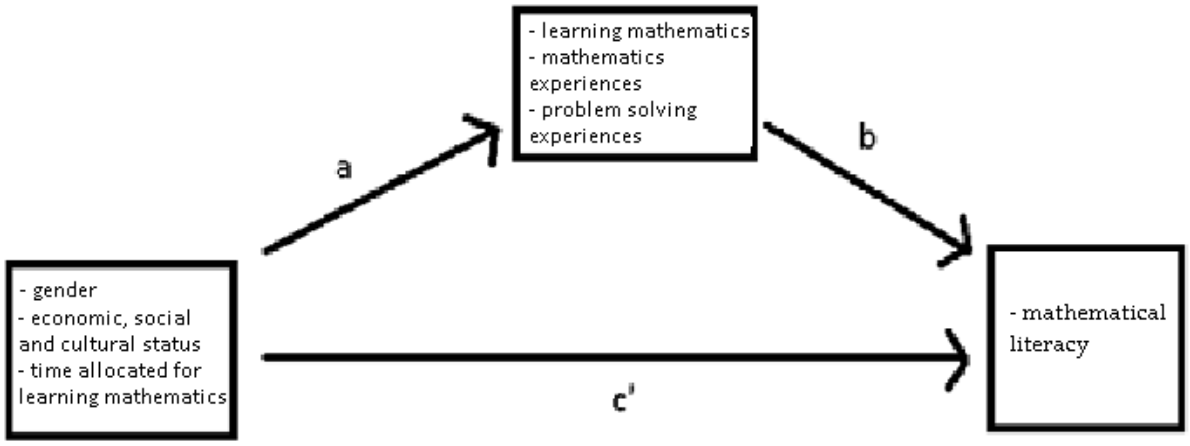

Figure 1. Mediation Model

In testing the Mediation Model, several statistical techniques such as path analysis, structural equation modeling and regression analysis are used (Burmaoğlu, Polat & Meydan, 2013). Using multiple regression analysis has been identified to give the best performance even if the dependent variable is measured in categorical terms (Cohen, Cohen, West & Aiken, 2003).

The purpose of this survey is to identify the direct and indirect factors affecting the PISA 2012 mathematical literacy. For this purpose, the following questions will be researched:

1. How do the independent variables of gender, economic, social and cultural index (ESCS) and time allocated for learning mathematics (MMIN) influence the mathematical literacy?
2. How do the independent variables of gender, economic, social and cultural index (ESCS) and time allocated for learning mathematics (MMIN) influence the mediation variables?
3. How do the mediation variables of learning mathematics consisting of the indexes like the familiarity with mathematical concepts (FAMCON), experience with pure mathematics tasks at school (EXPUREM), mathematics self-efficacy (MATHEFF), mathematics self-concepts (SCMAT), mathematics interest (INTMAT), instrumental motivations for mathematics (INSTMOT), mathematics work ethics (MATWKETH), mathematics behavior (MATBEH), subjective norms in mathematics (SUBNORM), mathematics anxiety (ANXMAT) and attributions to failure in mathematics (FAILMAT), mathematics experiences mediation variable consisting of the indexes like mathematics teacher's classroom management (CLSMAN), cognitive action in mathematics lessons (COGACT), mathematics teacher's support (MTSUP) and disciplinary climate (DISCLIMA) and problem solving experiences mediation variable consisting of the indexes like perseverance (PERSEV) and openness for problem solving (OPENPS) influence the mathematical literacy?
4. Are the indirect factors of Mediation Model meaningful?

This survey is considered to be a significant as it is going to increase the limited number of publications relevant to mathematical literacy in Turkey sample of PISA 2012 and identify the indirect factors influencing the mathematical literacy, hence contributing to the development of the Turkish education system. In addition, this study is the first of its type in the field in the sense that it aim is at finding the mediator variables affecting the academic performance in PISA Turkey applications.

Method

This survey targeting at identifying the factors influencing the mathematical literacy performance of PISA 2012 Turkey sample has been conducted in relational screening model.

Population and Sample

In the Turkey population of PISA 2012, 1.266.638 students are included in total who are at the age of 15. The target population consists of 965.736 students going to school at the 7th grade and the upper grades. In the Turkish sample, 4848 students took part in the application. Firstly, the schools and then the students were randomly selected through two-stage stratified sampling (OECD, 2013c). All of the 4848 students included in Turkey sample took part in this survey.

Data Collection Tool

Written examination and student questionnaires were administered to the students in PISA 2012. In the written examination, there are 110 mathematics questions in total. As different question sets are administered to different students in PISA, the students only answer one part of the questions. Each student is given two hours to answer the questions. The points for mathematical literacy is obtained by graduating the general average of mathematical literacy points of OECD countries having attended to PISA 2012 application as 500 and the standard deviation as 100 (OECD, 2013c).

The PISA 2012 students' questionnaire consists of three different forms, Form A, B and C. There are questions related to the age, gender, education level and profession of parents in addition to the questions about mathematics anxiety and mathematics self-efficacy. The data obtained from student questionnaires are indexed and assessed. For this purpose, simple and scale indexes have been developed. The simple indexes are obtained by the arithmetical transformation or repeated encoding of a single matter. The scale indexes consist of scaling more than one matter with weighted likelihood estimate by using a parameter logistics model (OECD, 2013c). The average of scale index points is 0, and the standard deviation is 1 (OECD, 2013b). All of the independent and mediator variables included in this study have been obtained through scale indexing method.

Analysis of Data

In order to examine the factors influencing the mathematical literacy performance of 4848 students included in the PISA 2012 Turkey sample through Mediation Model, the assumptions belonging to this model were examined in the first place. Lost data analysis was performed at the beginning. The lost data belonging to the independent variables of economic, social and cultural status index and time allocated for learning mathematics and all of the mediation variables were estimated through multiple imputations. Among the multiple imputation techniques, Markov Chain Monte Carlo (MCMC) technique, which was an iterative technique, was used and 5 datasets were identified via 100 iterations. In this way, analyses were performed by assigning plausible values like in the mathematical literacy, which was the dependent variable. For this purpose, the data sets consisting of 5 different plausible values were separately assessed and the averages of the analysis findings were obtained and reported (OECD, 2009).

In the Mediation Model, 4 conditions need to be met in order to establish the mediation relations (Baron & Kenny, 1986):

1. The influence of the independent variables on the dependent variable should be significant (Model-1).
2. The influence of the independent variables on the mediation variables should be significant (Model-2).
3. When the influences of the independent variables are controlled, the mediation variables predict the dependent variable in a meaningful way (Model-3).
4. When the influences of the mediation variables are controlled, there should be a meaningful reduction in the relation between the independent variables and the dependent variable or the relation is no longer significant.

The Mediation Model consists of Model-1, model-2 and model-3. The direct and indirect influences of independent variables like the gender, economic, social and cultural status (ESCS), time allocated for Learning mathematics (MMIN) and the mediation variables Learning mathematics, consisting of indexes like familiarity with mathematical concepts (FAMCON), experience obtained at school through Mathematic tasks (EXPUREM), mathematics self-efficacy (MATHEFF), mathematics self-concepts (SCMAT), mathematics interest (INTMAT), instrumental motivations for mathematics (INSTMOT), mathematics work ethics (MATWKETH), mathematics behavior (MATBEH), subjective norms in mathematics (SUBNORM), mathematics anxiety (ANXMAT) and attributions to failure in mathematics (FAILMAT), mathematics experiences mediation variable consisting of the indexes like mathematics teacher's classroom management (CLSMAN), cognitive action in mathematics lessons (COGACT), mathematics teacher's support (MTSUP) and disciplinary climate (DISCLIMA) and problem solving experiences mediation variable consisting of the indexes like perseverance (PERSEV) and openness for problem solving experiences (OPENPS) on mathematical literacy were examined by multiple regression analysis. These 17 index values selected as the mediation variable were chosen among the index values influencing the mathematical literacy given in OECD report about the results of PISA 2012 (OECD, 2013b, 191-207). The significance of the indirect influences in the mediation models were tested by using Sobel, Aroian and Goodman tests. As the results of these tests are statistically significant, it can be said that a third variable (mediation variable) indirectly affects the relation between the dependent variable and the independent variable (Sobel, 1986).

In the Mediation Model, a significant relation is needed between the independent variables and the mediation variables and dependent variable and between the mediation variables and dependent variable. However, very high values of these relation (,80 and over) will be an indicator for the multiple connection problem (Iacobucci, Neela & Xiaoyan, 2008). The relations between the independent variables and the mediator variable range from -,166 to ,291. 40 out of 51 relations are significant at the level of ,05. The relations between the independent variables and the dependent variable range from ,075 to ,391. All of these relations are significant at ,05 level. The relations between the mediation variables and the dependent variable range from -,247 to ,438. 16 out of 17 relations are significant at ,05 level. These values indicate that a mediation model can be established between the variables and there is not a multiple connection problem.

Results

The findings of multiple regression analysis performed in order to examine the influence of the independent variables on the dependent variable are given in Table 1.

Table 1. The Influence of the Independent Variables on the Dependent Variable

	B	**SH$_B$**	***β***	**R**	**R^2**	**t**	**p**
Constant	450,07	4,51		0,45	0,20	99,93	,000
Gender			-0,07			3,03	,000
ESCS			0,35			27,08	,000
MMIN			0,22			13,10	,000

When Table 1 is examined, it is seen that the independent variables of gender, economic, social and cultural status index (ESCS) and Time allocated for learning mathematics (MMIN) explain 20 % of the variance in mathematical literacy. The influence of the independent variables on the dependent variable is seen to be significant at ,001 level. The variable having the maximum influence on mathematical literacy has been identified to be the economic, social and cultural status index. When the explanation percentage of the independent variables on the variance of mathematical literacy is examined one by one using the stratified multiple regression analysis, the value of economic, social and cultural status index is 15 %, time allocated for learning mathematics is 4% and gender is 1 % and all of these values are significant at the level of ,001.

The findings of multiple regression analysis performed in order to examine the influence of the independent variables on the mediation variables are given in Table 2.

Table 2. The Influence of the Independent Variables on the Mediation Variables

Mediation variables	Index values	B	SH_B	R	R^2	t	p
Learning mathematics	FAMCON	,22	,06	,26	,06	3,82	,002
	EXPUREM	-,69	,07	,30	,09	9,90	,000
	MATHEFF	-,41	,08	,35	,12	5,25	,001
	SCMAT	-,31	,06	,17	,03	4,92	,000
	INTMAT	,07	,09	,14	,02	,78	,461
	INSTMOT	-,30	,07	,13	,02	4,33	,001
	MATWKETH	-,04	,09	,11	,01	,44	,672
	MATBEH	,51	,11	,13	,02	4,69	,004
	SUBNORM	,10	,07	,13	,02	1,32	,206
	ANXMAT	,55	,07	,16	,02	7,84	,000
	FAILMAT	,35	,14	,06	,00	2,45	,056
Mathematics experiences	CLSMAN	-,05	,08	,14	,02	,67	,523
	COGACT	,00	,08	,08	,01	,03	,977
	MTSUP	,22	,07	,06	,00	3,00	,011
	DISCLIMA	-,32	,06	,15	,02	5,21	,000
Problem solving experiences	PERSEV	,43	,08	,09	,01	5,16	,000
	OPENPS	,13	,06	,15	,02	2,14	,046

According to Table 2, the independent variables of gender, economic, social and cultural status index (ESCS) and Time allocated for learning mathematics (MMIN) are significant predictors for the primary mediator variable - Learning mathematics consisting of familiarity with mathematical concepts (FAMCON), experience with pure mathematics tasks at school (EXPUREM), mathematics self-efficacy (MATHEFF), mathematics self-concepts (SCMAT), instrumental motivations for mathematics (INSTMOT), mathematics behavior (MATBEH), mathematics anxiety (ANXMAT) indexes at the level of ,01. The other index values mathematics interest (INTMAT), mathematics work ethics (MATWKETH), subjective norms in mathematics (SUBNORM) and attributions to failure in mathematics (FAILMAT) variables could not be predicted as significant. The percentage of the explanation of the independent variables on the variance of the mediator variable, that is, learning mathematics, ranges from 0% (attributions to failure in mathematics) to 12 % (mathematics self-efficacy).

The independent variables Gender, economic, social and cultural status index (ESCS) and Time allocated for learning mathematics (MMIN) predict the secondary mediation variable mathematics experiences consisting of the indexes mathematics teachers' support (MTSUP) and disciplinary climate (DISCLIMA) as statistically significant at the level of ,05. The other index values being the mathematics teacher's classroom management (CLSMAN) and cognitive action in mathematics lessons (COGACT) variables could not be predicted as significant. The percentage of the explanation of the independent variables on the variance of the mediator variable, that is mathematics experiences ranges from 0 % (mathematics teacher's support) to 2 % (mathematics teacher's class management and disciplinary climate).

The independent variables Gender, economic, social and cultural status index (ESCS) and Time allocated for learning mathematics (MMIN) predict the tertiary mediator variable Problem solving experience consisting of perseverance (PERSEV) and openness for problem solving (OPENPS) as significant at the level of ,05. The percentage of the explanation of the independent variables on the variance of the mediator variable, that is, problem solving experience is 1 % for the perseverance index and 2 % for openness for problem solving.

The higher values for the independent variables in explaining the variance for mathematical literacy compared to the mediation variables indicate that there is a mediation relation between these variables and a Mediation Model can be established.

The findings of multiple regression analysis performed in order to examine the influence of the mediation variables on the dependent variable are given in Table 3.

Table 3. The Influence of the Mediation Variables on the Dependent Variable

Mediation variables	Index values	B	SH_B	β	R	R^2	t	p
Learning mathematics	*Constant*	457,45	1,99		0,49	0,24	230,25	,000
	FAMCON			0,13			7,30	,000
	EXPUREM			0,13			7,49	,000
	MATHEFF			0,34			18,25	,000
	SCMAT			0,06			2,51	,014
	INTMAT			-0,04			1,41	,173
	INSTMOT			-0,02			0,84	,418
	MATWKETH			-0,12			5,83	,000
	MATBEH			-0,07			4,00	,000
	SUBNORM			-0,02			1,37	,175
	ANXMAT			-0,13			6,28	,000
	FAILMAT			-0,02			1,43	,166
Mathematics experiences	*Constant*	451,72	1,51		0,23	0,05	298,69	,000
	CLSMAN			0,13			5,33	,000
	COGACT			0,06			2,78	,011
	MTSUP			-0,09			5,05	,000
	DISCLIMA			0,16			7,93	,000
Problem solving experiences	*Constant*	442,86	1,47		0,20	0,04	300,60	,000
	PERSEV			0,10			4,67	,000
	OPENPS			0,13			7,43	,000

When Table 3 is examined, the indexes familiarity with mathematical concepts (FAMCON), experience with pure mathematics tasks at school (EXPUREM), mathematics self-efficacy (MATHEFF), mathematics self-concepts (SCMAT), mathematics work ethics (MATWKETH), mathematics behavior (MATBEH) and mathematics anxiety (ANXMAT) making up the learning mathematics mediation variable explain the mathematical literacy as statistically significant. The indexes mathematics work ethics (MATWKETH), mathematics behavior (MATBEH) and mathematics anxiety (ANXMAT) predict the dependent variable in a negative way. Learning mathematics mediation variable explain 24 % of the variance in mathematical literacy. The index explaining the mathematical literacy at the maximum level is mathematics self-efficacy (MATHEFF).

All of the indexes making up the Mathematics experiences mediation variable were identified to predict the mathematical literacy as statistically significant. Mathematics teacher's support (MTSUP) index predicts the dependent variable negatively. Mathematics experiences mediation variable explains 5 % of the variance in mathematical literacy. The index explaining the mathematical literacy at the maximum level is disciplinary climate (DISCLIMA).

All of the indexes making up the problem solving experience mediation variable were identified to predict the mathematical literacy as statistically significant. This mediation variable explains 4 % of the variance in mathematical literacy. The index explaining the mathematical literacy at the maximum level is openness for problem solving (OPENPS).

The significance of the mediation effects were tested by using Sobel, Aroian and Goodman tests. The findings are given in table 4.

Table 4. The Significance of the Mediation Effect

Mediation variables	Index values	Sobel		Aroian		Goodman	
		Value	p	Value	p	Value	p
Learning mathematics	FAMCON	3,38	,001	3,36	,001	3,41	,001
	EXPUREM	5,97	,000	5,95	,000	5,99	,000
	MATHEFF	5,05	,000	5,04	,000	5,05	,000
	SCMAT	2,24	,025	2,20	,027	2,27	,023
	INTMAT	0.68	,495	0,58	,562	0,87	,384
	INSTMOT	0,82	,410	0,80	,421	0,85	,397
	MATWKETH	0,44	,661	0,43	,665	0,46	,656
	MATBEH	3,04	,002	3,00	,003	3,08	,002
	SUBNORM	0,95	,342	0,84	,400	1,12	,264
	ANXMAT	4,90	,000	4,88	,000	4,93	,000
	FAILMAT	1,24	,217	1,16	,244	1,32	,187
Mathematics experiences	CLSMAN	0,66	,506	0,65	,513	0,68	,499
	COGACT	0,03	,976	0,03	,977	0,03	,974
	MTSUP	2,58	,010	2,54	,011	2,62	,009
	DISCLIMA	4.35	,000	4.33	,000	4.38	,000
Problem solving experiences	PERSEV	3,46	,001	3,43	,001	3,50	,000
	OPENPS	2,06	,040	2,04	,041	2,07	,038

When Table 4 is examined, the indexes affecting the Learning mathematics mediation variable as a mediator are seen to be familiarity with mathematical concepts (FAMCON), experience with pure mathematics tasks at school (EXPUREM), mathematics self-efficacy (MATHEFF), mathematics self-concepts (SCMAT), mathematics behavior (MATBEH) and mathematics anxiety (ANXMAT). The indexes affecting the mathematics experiences mediation variable as a mediator are mathematics teacher's support (MTSUP) and disciplinary climate (DISCLIMA). The indexes affecting the Problem solving experience mediation variable as a mediator are perseverance (PERSEV) and openness for problem solving (OPENPS).

In this case, it is concluded that 10 index values out of 17 selected among the index values influencing the mathematical literacy for all the countries participated in PISA 2012 affect the Turkey sample as a mediator.

Discussion, Conclusion and Suggestions

In this survey aiming at identifying the direct and indirect factors influencing the PISA 2012 mathematical literacy, it has been concluded from the first question that gender, economic, social and cultural status index and Time allocated for learning mathematics independent variables have a significant influence on mathematical literacy. These three independent variables explain 20 % of the variance in mathematical literacy while the economic, social and cultural status index has the maximum impact. These findings coincide with the results of the surveys indicating that the variables of gender (Ovayolu, 2010; Özer & Özberk, 2011; Stacey, 2011; Uysal & Yenilmez, 2011; Gürsakal, 2012), economic, social and cultural status (Lin, et al., 2008; Yılmaz, 2009; Stacey, 2011) and time allocated for learning mathematics(Anderson, 1995; Fisher, 1995; Dursun & Dede, 2004; Seidel & Shavelson, 2007; Savaş, Taş & Duru, 2010; Özer & Anıl, 2011) influence the mathematical literacy.

The independent variables explain 11 mediation variables in a significant way. The explained variance ranges from 0 % to 12 %. The mediation variable having the maximum percentage for explaining the variance is mathematics self-efficacy.

Seven indexes from Learning mathematics mediation variable, 4 indexes from Mathematics experiences variable and 2 indexes from problem solving mediation variable explain the values in mathematical literacy in a significant manner. The mediation variable explaining the mathematical literacy at the maximum level is mathematics self-efficacy. The mediation variables of mathematics self-efficacy, mathematics anxiety and experience obtained through mathematics tasks at school are among the mediation variables influencing the mathematical literacy at the maximum level.

The significance of the mediation effects were tested by using Sobel, Aroian and Goodman tests. According to the test results, the indexes affecting the Learning mathematics mediation variable as a mediator are seen to be familiarity with mathematical concepts (FAMCON), experience with pure mathematics tasks at school (EXPUREM), mathematics self-efficacy (MATHEFF), mathematics self-concepts (SCMAT), mathematics behavior (MATBEH), and mathematics anxiety (ANXMAT); the indexes affecting the mathematics experiences mediation variable as a mediator are mathematics teacher's support (MTSUP) and disciplinary climate (DISCLIMA); and the indexes affecting the problem solving experience mediation variable as a mediator are perseverance (PERSEV) and openness for problem solving (OPENPS). 10 index values out of 17 index values are seen to have a mediator effect.

Three independent variables identified to influence the mathematical literacy directly and 10 mediation variables having a mediator effect are recommended to be examined by the education directors and policy makers and the needed activities to be performed. With these mediator effects, some conclusions have agreed: with more practice in lessons, mathematics concepts can be teach; with home works, students can get more experience; mathematics anxiety low and mathematics self-efficacy high students can be teach; correct mathematics guiding; perseverance for difficult problems and open for problem solving students are effects mathematics literacy. If attention should be paid, İt's have a key importance for Turkey in order to be more successful at mathematical literacy at the PISA applications in the future. The aim of to get a higher level of competence of mathematics literacy is lighter through this research. The questions of higher levels have mathematical modelling in the flesh. To teach competent students, these three independent and 10 mediator variables effects must be considered.

In this survey, where the mediation effects have been tested, the direct impact of the mediation variables used on the mathematical literacy can be tested through structural equation modeling. Using different independent and mediator variables considered to affect the mathematical literacy, various surveys can be conducted. Mediation Model can be re-tested with methods other than multiple regression analysis.

References

Anderson, L. W. (1995). Time: Allocated and instructional. In L. W. Anderson (Ed.), *International encyclopedia of teaching and teacher education* (pp. 204-207). Oxford: Pergamon.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Burmaoğlu, S., Polat, M., & Meydan, C. H. (2013). Örgütsel davranış alanında ilişkisel analiz yöntemleri ve türkçe yazında aracılık modeli kullanımı üzerine bir inceleme. *Anadolu Üniversitesi Sosyal Bilimler Dergisi, 13*(1), 13-26.

Cohen J., Cohen P., West S. G., & Aiken L. S. (2003). *Applied Multiple Regression / Correlation Analysis for the Behavioral Sciences (3rd Edition)* Mahwaj, NJ: Erlbaum.

Dursun, Ş., & Dede, Y. (2004). Öğrencilerin matematikte başarısını etkileyen faktörler: Matematik öğretmenlerinin görüşleri bakımından. *Gazi Eğitim Fakültesi Dergisi, 24*(2), 217-230.

Fisher, C. W. (1995). Academic learning time. In L. W. Anderson (Ed.), *International encyclopedia of teaching and teacher education* (pp. 430-434). Oxford: Pergamon.

Lin, C., Tzou, H., Shyu, C., Hung, P., & Huang, H. *Comparison of effect size of social and cultural status (escs) on literacy in various subject areas and different grades at school and student levels--multilevel analysis of 2006 pısa data for taiwan*. PISA Taiwan National Center Publication.

Gürsakal, S. (2012). PISA 2009 Öğrenci başarı düzeylerini etkileyen faktörlerin değerlendirilmesi. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 17*(1), 441-452.

Iacobucci, D., Neela S., & Xiaoyan D. (2007). A meditation on mediation: evidence that structural equations models perform better than regressions. *Journal of Consumer Psychology*, *17* (2), 139-153.

Iacobucci, D. (2008), *Mediation Analysis*, Thousand Oaks, CA: Sage.

MEB (2013). *PISA 2012 ulusal ön raporu.* Ankara: MEB.

OECD (2009). *PISA data analysis manual. SPSS SECOND EDITION*. Paris: OECD.

OECD (2013a). *PISA 2012 results: what students know and can do (volume I): student performance in mathematics, reading and science*. OECD publishing.

OECD (2013b). *PISA 2012 results: excellence through equity (volume II): Giving every student the chance to succeed.* OECD publishing.

OECD (2013c). *PISA 2012 results: ready to learn (volume III): Students' engagement, drive and self-beliefs*. OECD publishing.

Ovayolu, Ö. (2010). *Türkiye'deki öğrencilerin PISA 2006 matematik alt testindeki düşünme süreçlerine ilişkin puan dağılımları.* Unpublished Master Dissertation, Ankara University, Ankara.

Özer, Y., & Anıl, D. (2011). Öğrencilerin fen ve matematik başarılarını etkileyen faktörlerin yapısal eşitlik modeli ile incelenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 41,* 313-324.

Saidel, T., & Shavelson, R. J. (2007). Teaching effectiveness research in the past decade: The role of theory and research design in disentangling meta-analysis results. *Review of Educational Research*, *77*(4), 454-499.

Savaş, E., Taş, S., & Duru, A. (2010). Factors Affecting Students' Achievement in Mathematical. *İnonu University Journal of the Faculty of Education, 11*(1), 113-132.

Stacey, K. (2011). The PISA view of matehematical literacy in indonesia. *Journal on Mathematical Education, 2*(2), 95-126.

Özer, Y., & Özberk, E. H. (2011). *PISA 2009: Türk öğrencilerin okuma becerileri, fen ve matematik okuryazarlığının bazı değişkenler açısından incelenmesi*. 20. National Congress of Educational Sciences, Burdur.

Sobel, M. E. (1986). Some New Results on Indirect Effects and Their Standard Errors in Covariance Structure. *Sociological Methodology*, *16*, 159-186.

Uysal, E., & Yenilmez, K. (2011). Sekizinci sınıf öğrencilerinin matematik okuryazarlığı düzeyi. *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi, 12*(2), 1-15.

Yılmaz, H. B. (2009). *Turkish students' scientific literacy scores: a multilevel analysis of data from program for international student assessment.* Unpublished Master Dissertation, The Ohio State University, Ohio.