Levels of Visual Mathematics Literacy Self-Efficacy Perception of the Secondary School Students

Omer F. Tutkun[1]

Duygu Gur Erdogan[2]

Betül Ozturk[3]

Abstract

The aim of this study is to determine levels of visual mathematics literacy self-efficacy perception of the secondary school students. In addition to this basic problem, levels of visual mathematics literacy self-efficacy perception of the students have been examined through gender, levels of perceived mathematics achievement, grade level, levels of perceived income and educational levels of the parents. As the method of the research, descriptive survey model has been used."A visual mathematics literacy self-efficacy perception scale" developed by Bekdemir and Duran (2012) has been used as the data collection tool in this research. The sample of the study consists of a total of 342secondary school students including 160 female and 182 male students. Research findings are the followings: 1- Levels of visual mathematics literacy self-efficacy perception of the students have been found in a high level. 2- Levels of visual mathematics literacy self-efficacy perception have differentiated in terms of gender, levels of perceived mathematics achievement, levels of perceived income and educational level of father. 3-Levels of visual mathematics literacy self-efficacy perception have not differentiated in terms of grade level and educational level of mother.

Key Words

Mathematics, Mathematics Achievement, Visual Mathematics Literacy, Self-Efficacy.

Introduction

Literacy(Kellner, 1995), can be defined as qualifyabout in fluently using of communicative symbols that the community has given the meaning to. According to Anderson (2002), literacyis renewed and

*This paper was presented as oral presentation at 2nd International Eurasian Conference on Mathematical Sciences and Applications, 26-29 August, Sarajevo, Bosnia and Herzegovina.
[1]Sakarya University, Faculty of Education, Sakarya Turkey, otutkun@sakarya.edu.tr
[2]Sakarya University, Faculty of Education, Sakarya Turkey, dgur@sakarya.edu.tr
[3]Mathematics Teacher, Ministry of Education, Sakarya, Turkey, betul_zngldk@hotmail.com

given meaning continuously with the cooperation of the individuals who consist of the community. Alpan (2008) indicates that edition or article literacy skills that consist of oral communication are not enough to improve the quality of life and fit into the age (period).According to the different definitions in literature, it is seen that different kinds of literacy can be. And we can say (Kellner, 2001; Cited in Alpan, 2008) that these might change for surroundings the tools used and/or desired aim.Within this framework, new literacy concepts have ensued such as media literacy, computer literacy, cultural literacy, social literacy, environmental literacy, auditory literacy and visual literacy.

In this context, it is necessary that visual literacy (Sanalan, Sülün and Çoban, 2007), the topic of this study, should be seen and given meaning as the supplement of the traditional literacy, not the alternatives of it. Visual literacy, defined by Hoffmann (2000) as " it is a necessary skill in terms of its embodying thoughts, mind's remembering easily and occurring mental process in a short time"is a phenomenon taking part among the aims of many education systems in the world.Visual literacy has been defined as the power of giving meaning to visual messages and composing message in a similar way (Alpan, 2008).There is a necessity to be visual literate for understanding both visual materials such as map and schema used in education process and traffic signals, photographs and PC software that individuals come across in daily life (Günay, 2008).

Mathematics literacy, however, can be dealt as a dimension of literacy skill. Karunaratne (2000) indicates this within literacy definition as " the individual's being able to maintain his life in his society, having enough literacy ability to communicate with society and being able to transact basic mathematical operation (Cited inDuran, 2013).Mathematical literacy (The Ministry of Education, 2011: 1), has been defined as " the individual's realizing and understanding the role of mathematics in the World, reaching justice based on valid principles, using mathematics by means of providing his own needs as a sensitive citizen". An individual(Harms, 2003), who has mathematical literacy capacity, can bear in mind mathematical concepts, reflect mathematical skills to daily life and use mathematical knowledge in the case of analysis-synthesis. But, the principle to be considered is that other literacies such as visual and mathematical literacy is not an alternative of general literacy, but a supporter of it, should not be forgotten. (Tuman, 1994).

Visual mathematical literacy can be described as " the individual's being able to understand, interpret, evaluate and use in his life of problems come across in his daily life as visual or spatial, in contrast to, visual or spatial knowledge as mathematical (Bekdemirand Duran, 2012).When the literature having been examined: Burtness (2006), "in the level of primary school students, it was studied on visual learning in that numbers and arithmetical operations represented by animal figures. Sobanski (2002) has made a study, aimed at occurring fast and easy learning based on visual mathematical literacy and the problems' being served by the help of diagram and such like visuals. At the national level, the studies on this topic are in a limited number. All of these are (Şengül, Katrancı andGülbağcı 2012;Bekdemir and Duran, 2012; Duran, 2013), the studies on which visual mathematical literacy self- efficacy perception of secondary school students.

Visual mathematical literacy sufficiency has an indispensable position both in Daily life and in mathematics education. Because, mathematical objects' being visualized in structure provide the understanding of the relations between them easily. For some students, visual displays are definitely essential to learn mathematics. The reason for the failure of these students in mathematics is because of visuality deficiency. Visual settings for these students provide the success of the student as well as the student's interest and participation to the lessons (Goldenberg and Couco,

1998, Cited in Zengin andKutluca, 2011).For this reason, instruction practiced by developing materials in order to make mathematics more visual has evidence that it provides positive effects for the students' motivation, participation desire to the lesson and success (Gürbüz, 2007; Kutluca, 2009; Sahaet al., 2010; Reis andÖzdemir, 2010, Zengin andKutluca, 2011).Accordingly, in the World, it is observed that the objectives of mathematics, science and technology are mentioned mainly in the running of formal and non-formal education institutions (Ersoy, 2002).

Method

Descriptive survey model was used as the method of the research. "A visual mathematics literacy self-efficacy perception scale (VMLSPS)" developed by Bekdemir and Duran (2012) was used as the data collection tool. The sample of the study consists of a total of 342secondary school students including 160 female and 182 male students. Demographic characteristics relating to working group is given Table 1.

Table 1: Demographic Characteristics Relating To Working Group

Mathematics success perception level	Class level	Gender		Total
		Girl	Boy	
Low	5	4	8	12
	6	9	14	23
	7	5	23	28
	8	10	14	24
Medium	5	28	59	87
	6	11	20	31
	7	20	15	35
	8	23	17	40
High	5	22	18	40
	6	76	70	146
	7	16	16	32
	8	16	14	30
Total	5	31	44	75
	6	45	43	88
	7	43	54	97
	8	41	41	82
	Total	160	182	342

Findings

Level of visual mathematics literacy self-efficacy perception of the students and findings of this level related to gender, levels ofperceivedmathematics achievement, grade level, levels of perceived income and educational levels of the parents variables are given below.

Table 2: Frequency Results Relating To Level of Visual Mathematics Literacy Self-Efficacy Perception of the Students

Self-Efficacy Perception Level	f	%
Low (1)	43	12,6
Medium (2)	141	41,2
High (3)	158	46,2

When frequency table relating to the level of visual mathematics literacy self-efficacy perception of the students are examined, according to the visual mathematics literacy self-efficacy scale, it has been observed that %46.2 of the students are in high group, %41.2 of them are in medium group and %12.6 of them are in low group.

Table3: T-test Analysis Results of the level of Visual Mathematics Literacy Self-Efficacy Perception of the Students according To Gender Variation

Variable		N	$\bar{x}$	SS	Sd	t	P
Gender	Female	160	140,0188	32,47204	337,044	4,225	.000*
	Male	182	123,3022	40,62158			

As seen in Table 3, the level of visual mathematics literacy self-efficacy perception of the students has a significant difference according to the gender variable[$t_{(337,044)}$= 4.225; P<0.05]. When the arithmetic averages are examined, it is specified that the level of visual mathematics literacy self-efficacy perception of girls are ($\bar{x}$=140.0188) higher than the level of visual mathematics literacy self-efficacy perception of boys ($\bar{x}$=123.3022).

Table 4: Anova Results of the Level of Visual Mathematics Literacy Self-Efficacy Perception of the Students according To Perceived Mathematics Success Level

Variable		N	$\bar{x}$	SS	sd	F	P (Scheffe)
Perceived Mathematics Success Level	Low	87	80.32	19.74	2-339	531.148	.000* 1-2,1-3, 2-3
	Medium	146	134.09	22.62			
	High	109	167.68	9.99			
	Total	342	131.12	37.91			

According to Table 4, the level of visual mathematics literacy self-efficacy perception of the students has a significant difference according to the perceived mathematics success level [$F_{(2-339)}$ = 531.148; P<0.05]. According to the perceived mathematics success level, according to Scheffe results made on the purpose of determining in which groups thereare differences, the views of the students whose perceived mathematics success level is low ($\overline{X}$=80.32), the views of the students whose perceived mathematics success level is medium ($\overline{X}$=134.09) and the views of the students whose perceived mathematics success level is high ($\overline{X}$=167.68) are different from each other. In other words, as perceived mathematics success level increases, visual mathematics literacy self-efficacy perception level increases.

Table 5: Anova Results of the Levels of Visual Mathematics Literacy Self-Efficacy Perception of the Students according To Perceived Income Level

Variable		N	$\overline{X}$	SS	sd	F	P (Scheffe)
Perceived Income Level	Low	44	90.65	31.48	2-339	42.215	.000* 1-2,1-3, 2-3
	Medium	259	134.33	35.43			
	High	39	155.41	26.01			
	Total	342	131.12	37.91			

According to Table5, the level of visual mathematics literacy self-efficacy perception of the students has a significant difference according to the perceived income level [$F_{(2-339)}$ = 42.215; P<0.05]. According to the perceived income level, according to Scheffe results made on the purpose of determining in which groups there are differences, the views of the students whose perceived income level is low ($\overline{X}$=90.65), the views of the students whose perceivedincome level is medium ($\overline{X}$=134.33) and the views of the students whose perceivedincome level is high ($\overline{X}$=131.12) are different from each other. In other words, the level of visual mathematics literacy self-efficacy of the students whose perceived levels are medium is higher.

Table 6: Anova results of the Levels of Visual Mathematics Literacy Self-Efficacy Perception of the Students according To Father's Education Level

Variable		N	$\overline{X}$	SS	sd	F	P (Scheffe)
Father's Education Level	Primary school	117	121.11	37.60	2-339	21.377	.000*1-3,2-3
	Secondary school	121	124.42	38.00			
	High school	104	150.17	30.82			
	Total	342	131.12	37.91			

According to Table 6, the level of visual mathematics literacy self-efficacy perception of the students has a significant difference according to father's education level [$F_{(2-339)} = 21.377$; $P<0.05$]. According to the father's education level variable, according to Scheffe results made on the purpose of determining in which groups there are differences, the views of the students whose fathers' education level is primary ($\overline{X}$=121.11), the views of the students whose fathers' education level is secondary ($\overline{X}$=124.42) and the views of the students whose fathers' education level is high school ($\overline{X}$=150.17) are different from each other. In other words, as the father's education level increases, visual mathematics literacy self-efficacy perception level increases.

Table 7: Anova results of the levels of visual mathematics literacy self-efficacy perception of the students according to mother's education level

Variable		N	$\overline{X}$	SS	sd	F	P
Mother's Education Level	Primary school	158	130.89	37.42	2-339	2.378	.094
	Secondary school	124	127.09	39.27			
	High school	60	140.03	35.35			
	Total	342	131.12	37.91			

According to Table7, the level of visual mathematics literacy self-efficacy perception of the students does not have a significant difference according to mother's education level [$F_{(2-339)} = 2.378$; $P>0.05$]. It can be said that the level of visual mathematics literacy self-efficacy perception of the students does not change according to mother's education level.

Table 8: Anova results of the Levels of Visual Mathematics Literacy Self-Efficacy Perception of the Students according To Class Level

Variable		N	$\overline{X}$	SS	sd	F	P
Class level	5. grade	75	139,96	35,00	3-338	1.833	.141
	6. grade	88	129,69	39,19			
	7. grade	97	127,15	38,92			
	8. grade	82	129,26	37,26			
	Total	342	131,12	37,91			

When Table 8is examined, the level of visual mathematics literacy self-efficacy perception of the students does not have a significant difference according to class level [$F_{(3-338)} = 1.833$; $P>0.05$]. It can be said that the level of visual mathematics literacy self-efficacy perception of the students does not change according to class level.

Results Discussion and Suggestions

At the end of the study, it can be said that the level of visual mathematics literacy self-efficacy perception of the students is - %46.2 in high group, %41.2 in medium group and %12.6 in low group. Gender is a factor in the visual mathematics literacy self-efficacy perception level. The visual mathematics literacy self-efficacy perception level of girls is higher than boys. This result matches up with the findings of Uysal (2009). In his study, has been done by basing on PISA 2013 mathematics exam questions and their evaluations of the 8th grade primary school students. Uysalhas theorized that mathematics literacy level shows significant differences in terms of gender variable. But, in the study made by Duran (2011), it is proved that there is not a significant difference according to gender when visual mathematics literacy self-efficacy perception points are not restrained.

According to the perceived mathematics success level variable, as long as the level of perceived mathematics success increases, the level of visual mathematics literacy self-efficacy increases. In his study, Duran (2011)proved that there is a positive medium level relation between the visual mathematics literacy self-efficacy perception and the visual mathematics success of 8th grade primary school students. It has been seen that there is a significant difference between visual mathematics literacy self-efficacy perception level and the perceived income level. It has been seen that visual mathematics literacy self-efficacy perception level of the students, whose perceived income level is medium, is higher. It is seen that in the study of Duran (2011),when the visual mathematics literacy self-efficacy perception points are not restrained,visual mathematics success points have significant differences according to socio-economic level where the school is and in the study of Uysal, (2009) which has been done by basing on PISA 2013 mathematics exam questions and their evaluations of the 8th grade primary school students, mathematics literacy levels of the students have significant differences in terms of the parents' income level variable.

The levels of visual mathematics literacy self-efficacy perception become different according to the father's education level. Visual mathematics literacy self-efficacy perception level of the students whose fathers have high education grade is higher. But, a significant difference has not seen in the level of visual mathematics literacy self-efficacy perception according to the mother's education level. In the study of Uysal, (2009) which has been done by basing on PISA 2013 mathematics exam questions and their evaluations of the 8th grade primary school students, it has been seen that the level of mathematics literacy has become different according to father and mother's education level variable. In terms of class level variable, visual mathematics literacy self-efficacy levels has not become different.

According to the research outcomes, these are suggestions: 1- visual items should be used more effectively in mathematics lesson content, books, equipment, materials, teaching-learning methods.

Suggestions for future researches: 1- theoretical information should be brought into Turkish literature by the way of translations relating to mathematics literacy. 2- The studies should be done with different level student groups about this subject. 3- Awareness raising programs about the subject should be practiced to mathematics teachers.

References

Alpan, G (2008).Visual Literacy and Education Technology.YüzüncüYılUniversity, Faculty of Education Journal, V(II), 74-102.

Bekdemir, M., & Duran, M. (2012).Development of a visual math literacy self efficacy Perception scale (vmlseps) for elementary students.OndokuzMayısUniversity, Faculty of Education Journal, 31(1), 89-115.

Burtness, J.L. (2006).Visual math teaching method.Retrieved July 27 2013 from http://www.google.com/patents/US7077654.

Duran, M. (2011).Relationship between visual math literacy self-efficacy perceptions with visual mathematics achievements of elementary 7th grade students.(UnpublishedMaster thesis).ErzincanUniversity, Institute of Science, Erzincan.

Duran, M. (2013).Opinions of Primary 7th Grade Students About Visual Mathematics Literacy. Mehmet AkifErsoyUniversityJournal of the Institute of Education Sciences, 2, (2), 38-51.

Ersoy, Y. (2002) Information Technology And Mathematics Education-II:Radical Innovations And The Effects Of Cognitive Tools. Mathematics Symposium Proceedings. (Compiletion: O. Çelebi, Y. Ersoy, G. Öner). Ankara: Publications of the Association of Mathematicians.

Kutluca, T., (2009).Evaluation Of A Computer Assisted Learning Environment Designed For The Subject Of Quadratic Functions.(Unpublished Doctoral Dissertation).KaradenizTeknikUniversity, Institute of Science, Trabzon.

Ministry of Education.[MEB]. (2011). PISA Bulletin II.Retrieved July 19 2013 fromhttp://earged.meb.gov.tr.

Reis, Z. A. andÖzdemir, Ş. (2010). Using Geogebra as an Information Technology Tool: Parabola Teaching.Procedia Social and Behavioral Sciences 9, 565-572.

Saha, R. A., Ayub, A. F. M., &Tarmizi, R. A. (2010). The Effect of GeoGebra on Mathematics Achievement: Enlightening Coordinate Geometry Learning. Procedia Social and Behavioral Sciences,8, 686-693.

Sanalan,A.V, Sülün, A, &Çoban,T.A (2007).Visual literacy.ErzincanUniversity, Faculty of Education Journal, 9, 2, 33-47.

Sobanski, J. (2002). Visual math: See how math make sense. New York: Learning Express.

Şengül, S., Katrancı, Y., &Gülbağcı, H. (2012).Middle school students' self-efficacy perceptions of the visual examination of mathematical literacy.21.Ulusal Congress of Educational Sciences, Marmara University/ İstanbul.

Uysal, E. (2009). The Mathematics Literacy Level of Primary School 8th Grade Students.Unpublished Master thesis.EskişehirOsmangaziUniversityInstitute of Social Sciences,Eskişehir.

Zengin,YveKutluca,T (2011) Prospective Mathematics Teachers' Views On The Use Of Geogebra In Secondary Mathematics Curriculum. 5th International Computer & Instructional Technologies Symposium/Fırat University, Elazığ.

Zengin,YveKutluca,T (2011) Evaluation of Views of Students about Using GeoGebra in Teaching of Mathematics.DicleUniversityZiyaGökalpFaculty of Education Journal, 17, 160-172.

Gürbüz, R. (2007). Students' and Theır Teachers' Opınıons About The Instructıon Based On The Materıals On Probabılıty Subject. KastamonuUniversityKastamonuFaculty of Education Journal, 15 (1), 259-270.