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Use of Tangible Materials and Computer in Mathematics Teaching: Opinions of School Principals

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ABSTRACT

School principals, who are responsible for all kinds of activities, should make necessary efforts in order to provide an effective learning environment. It is known that students usually have difficulties in visualizing abstract concepts in their minds and these difficulties are most often observed when teaching mathematics. Activating lessons for students by using tangible materials rather than abstract concepts will facilitate the teaching process considerably. The sample group of this study consisted of 184 school principals selected by the random sampling method from the school principals working in three provinces in the 2016-2017 academic year. All population lists of this study were accessed from the 2015-2019 Strategic Plans on the official website of Aksaray, Kahramanmaras and Mersin Provincial Directorates for National Education. The data collection tool of the study was the scale developed by the researchers of this study. The collected data were analyzed in line with the sub-problems of this study. The school principals reported that tangible materials should always be used and computers should be frequently used in mathematics lessons. It was concluded that the school principals would always support the purchase of tangible materials and they would often provide support for the programs and equipment required for computer use.

Keywords: tangible teaching object, mathematics teaching, mathematics and computers, school principals

INTRODUCTION

It can be said that taking advantage of the advancing technology with tangible materials and visuals in education activities is an important practice. Mathematics and mathematics teaching exist independently of the individuals whether created or discovered by mankind (Post, 1981). Galileo (1564-1642) stated that "the universe is always open for our observations, but it cannot be understood without knowing and comprehending its letters and language. The universe was written in the language of mathematics; its letters are triangles, circles, and other geometric figures. Without them, even a single word cannot be understood; it is like wandering in a dark labyrinth without them." As Galileo further stated, "Philosophy is written in this grand book, which stands continually open before our eyes (I say the 'Universe'), but cannot be understood without first learning to comprehend the language and know the characters as it is written. It is written in mathematical language, and its characters are triangles, circles, and other geometric figures, without which it is impossible to humanly understand a word; without this, one is wandering in a dark labyrinth." (As cited in Burtt, 2003). As can be understood from the statement of Galileo, mathematics is included within the universe. In this regard, learning mathematics, which is found in everything in life, will be the same as learning life. As mathematics, which originates from the existing, has reached up to quite advanced levels in our age, it is believed that it has become difficult to understand. However, when we turn our heads, we can see that the language of the universe is probably the most easily understandable science. One of the biggest mistakes made in this education field and mathematics is providing this language without making sense of it by means of tangible data. In fact, the mathematics can be internalized more easily if the vital tangible counterparts of all information are known by the learners and these become meaningful whenever encountered.

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Contribution of this paper to the literature

- There are a few studies conducted on the use of tangible materials in mathematics lessons within the context of Turkey, especially regarding the opinions of school principals.
- There are a few studies assessing the use of tangible materials and computer in lessons together within the context of Turkey and international context.
- The teachers with high seniority levels are reluctant to use tangible materials in mathematics lessons. In this regard, this paper can contribute to the literature and increase their use of tangible materials.
- The use of tangible materials in mathematics lessons is less, especially within the context of Turkey. The use of tangible materials can be increased due to the findings and recommendations of this study.

This is why many studies have been conducted and are being conducted in this field. The use of mathematics as required by our time and use of tangible materials for learning mathematics with its vital counterparts may be possible by means of computer-assisted education. Tangible materials within mathematics teaching are described as follows: Tangible materials include specifically designed tools (equipment) and real objects such as pictures and objects that materialize mathematical concepts (Van de Walle, 2007). Tangible materials are regarded as the objects that can be touched and moved (Haciomeroglu & Apaydin, 2009). These materials make it easier for the students and learners to understand mathematical concepts more clearly and concretely (Moyer, 2001). It can be said that one of most significant outputs of these studies is "Movement for Increasing Opportunities and Improving Technology", or the FATİH project, carried out by the Ministry of National Education and Ministry of Transportation in November 2010. In fact, as can be understood from this project, a great deal of importance is placed on the use of computers in mathematics teaching in Turkey. In addition to this, the use of tangible materials during lessons is emphasized in the new mathematics teaching program implemented since 2005 and developed by the Ministry of National Education (MoNE) by adopting a constructivist teaching philosophy. Considering the vision of this mathematics teaching program, it is emphasized that the concepts in mathematics are abstract by nature, it is difficult for children to perceive these abstract concepts when their developmental characteristics are examined and it is necessary to support the teaching of mathematical concepts with tangible materials. Based on the fact that the students must be active participants in the mathematics teaching process, this program emphasizes that students will create their own thoughts from their interactions with the environment, tangible objects and their peers (Aydogdu Iskenderoglu, Turk, & Iskenderoglu, 2016; MoNE, 2013). In addition to this, in recent years, many studies have been conducted for determining the opinions of mathematics teachers on computer-assisted mathematics teaching (Fuson & Briars, 1990; Yenilmez & Karakus, 2007) and determining the opinions of mathematics teacher candidates on the use of teaching materials in mathematics teaching (Tooke, 2001; Unlu, 2017; Valverde, Bianchi, & Wolfe, 2002; Van de Walle, 2007) and determining the knowledge levels of mathematics teacher candidates for using tangible teaching objects (Tutak et al., 2012). In a declaration published by the American National Council of Teachers of Mathematics in September 1987, it was stated that the teachers could use computers as a tool in mathematics lessons when teaching concepts, developing tangible mathematical ideas from tangible experiences and teaching problem-solving processes (Aktumen, 2002; Daghan, Kibar, Akkoyunlu, & Atanur-Baskan, 2015; NIER, 1987).

Some studies have been conducted on the use of computer technologies in mathematics lessons and the following results have been revealed: (1) the lessons become more interesting and productive for teachers, (2) the attention and motivations of students are increased when lessons are supported with computers and tools are used, and (3) it has become easier to interact through the use of text, audio, video and graphic elements of technology (Adiguzel, Gurbulak, & Saricayir, 2011; Akdemir, 2009; Smith, Higgins, Wall, & Miller, 2005).

In terms of the teaching-learning process, school principals have emphasized that the process has become more enjoyable and the interests of teachers and students in lessons have increased. The school principals mentioned here and all through this article are described in the MoNE regulations as the school principals and deputy principals should provide the tasks for teachers (MoNE, 2013). In accordance with the Regulation on Secondary Education Institutions published by the MoNE in 2013, the duty of school principals is to provide the classroom, information technology classroom, laboratory, workshop and library with tools and equipment for teaching and training in line with health and safety requirements. In addition to this, they are to bring technological advancements to the school. They determine the requirements of the school and complete the necessary procedures to meet these requirements by purchasing, donation or in similar ways according to the budget. They notify the relevant departments about the requirements of training tools and equipment. Therefore, all possibilities are in the school principals' power. These data can be shown as a reason why the opinions of school principals on the use of tangible materials and computers in mathematics lessons are important. The studies conducted and previous experiences show that it will be impossible to successfully use technology without the support of school principals (Akinci, Kurtoglu, & Seferoglu, 2012; Dursun et al., 2013). The study conducted by Arikan, Aydogdu, Dogru, and Usak (2006) on computer-assisted education can be given as an example in this regard. In this study, it was seen that the sample group learning with computers was more successful than the sample group learning using traditional methods and, therefore, their learning was more permanent.

It has also been revealed that the tangible materials used in mathematics lessons, have many benefits such as embodying the abstract mathematical concepts (Moyer, 2001), making it easier to understand mathematical concepts (Kennedy & Tipps, 1994) and allowing for conceptual learning (Dienes, 1967). However, in some of the studies conducted in Turkey, it has been revealed that the levels of teachers' use of materials in mathematical lessons are not high (Piskin, 2010; Toptas, Celik & Karaca, 2012). In fact, the teachers in Turkey, have suggested that our students can understand very abstract mathematical topics and they learn mathematics in a more enjoyable and permanent way due to the tangible materials. Despite these positive opinions, it was stated that teachers and students were not able to procure materials for a variety of reasons and, therefore, they could not use these materials (Akbayir, 2016).

In line with the results of the studies in the literature, the following information can be obtained: (1) mathematics includes abstract concepts, (2) the teachings are based entirely on these concepts and (3) there is an excessive increase in the amount of knowledge that must be given in lessons due to the ever-advancing science. Therefore, it has been concluded that the way the lessons are taught needs to be changed in order for information to be reproduced, to be understood and to be permanent. From the studies conducted so far, it is seen that this is possible by means of the use of tangible materials and computer-assisted education. However, the opinions and possibilities of school principals on issues such as how these auxiliary objects will be procured, how they will be used in learning environments and whether they are allowed or not are also important. Therefore, the opinions of school principals on issues such as the possibilities of mathematics lessons, teaching mathematics and how to answer the demands of teachers were referred to and the results obtained were shared in this study.

RESEARCH QUESTIONS

The research questions of this study were:

- What is the level of school principals' opinions on the use of tangible materials and computers in mathematics lessons?'

In this regard, the sub-problems were:

- What are the opinions of school principals on providing tangible materials and computer-aided teaching in mathematics lessons?
- Are there any differences in the opinions of school principals according to their gender?
- Do the opinions of school principals differ according to the number of students in school?
- Do the opinions of school principals differ according to the number of mathematics teachers in school?
- Do the opinions of school principals differ according to the number of managers in school?

METHOD

Research Model

The research model of this study was a general screening model from quantitative research designs. In general, the whole population is analyzed or a sample group is chosen from this population in order to reach a general conclusion about the population consisting of a lot of elements, and the main purpose is to describe the current situation as it is (Balci, 2005; Karasar, 2014). This study is a descriptive screening study as it aims at explaining the current situation as it is without any manipulation.

Population and Sample Group

The population of this study included the primary, secondary and high school principals working in Aksaray, Kahramanmaras and Mersin provinces of Turkey. Considering the breadth of the population, it was determined that the selection of a sample group was necessary and, therefore, the sample group was selected by the random sampling technique. Simple random sampling technique was employed when selecting the sample group. In the simple random sampling technique, the sample group is selected randomly and objectively considering the possibility of being equal and independent for each unit (Balci, 2005; Buyukozturk, 2005). In this study, this principle was followed and the individuals to be included in the sample group were selected randomly. The study group consisted of 184 individuals randomly selected among the school principals working in these provinces in the 2016-2017 academic year. All population lists of this study were accessed from the 2015-2019 Strategic Plans on the official website of the Aksaray, Kahramanmaras and Mersin Provincial Directorates for National Education.

Online forms were randomly sent to the school principals included in the sample group until the total number reached up to a level that reflected the whole population. The purpose here was to create a small sample and to reflect the diversity of individuals that could be a party to the problem studied in the sample at a maximum degree (Yildirim & Simsek, 2013). The participation in this study was based on the principle of volunteerism.

Data Collection Tool

The scale used in this study consisted of two parts: The first part of the scale consisted of personal information and the second part consisted of 21 items about the opinions of school principals on the use of tangible materials and computers in mathematics lessons. The school principals in schools affiliated to the MoNE in Turkey were assigned according to the total number of students in primary, secondary and high schools as follows: (1) school principals for schools with 100-601 students, (2) school principals for schools with 601-1201 students, (3) school principals for schools with 1201-1501 students, (4) school principals for schools with 1501-2001 students and (5) school principals for schools with 2001 and more students (MoNE, 2014). The items in the second part were obtained as a result of the literature review and consisted of 36 items (18 positives, 18 negatives). After receiving the opinions of experts, the number of items decreased to 21 (18 positives, 3 negative items) as a total of 15 items was found to be inappropriate. The scale consisting of 21 items was changed into a 5-point Likert-type scale. These items were created in five degrees of participation as follows: (1) Always, (2) Often, (3) Sometimes, (4) Rarely and (5) Never. In order to interpret and compare the mean values in the analysis of sub-dimensions, a standard interval criterion was determined and the arithmetic average score interval coefficient was obtained with the following formula: (highest score – lowest score) / (number of options) = (5-1)/5=.80. The boundary values were determined for the options such as Never, Rarely, Sometimes, Often and Always respectively as 1.00-1.80, 1.81-2.60, 2.61-3.40, 3.41-4.20 and 4.21-5 (Aydin, 2012). The scale used in this study provided the opinions of school principals on the use of tangible materials and computers in mathematics lessons in terms of sub-dimensions scores and total scores. The opinions of 3 academic members, 4 mathematics teachers with 5-12 years of experience and one assessment and measuring expert were taken in order to ensure the content validity of the measuring tool. The school principals were assessed according to the opinions they expressed. The item analysis, difficulty and discrimination indices of the data obtained from the scale were performed in SPSS software and KR-20 values were calculated. As a result of the pilot study, the total 27 questions in scale were reduced to 21 questions. In line with the data obtained from the school principals as a result of the assessment of the prepared scale, the reliability (KR-20) was found to be 0.86. This shows that the measuring tool is very reliable. As the total number obtained from the scale increases, the negative attitudes of individuals towards the measured structure increase. In other words, the high scores obtained from the scale show high negative attitudes. The highest and lowest scores that can be obtained from the scale are 105 and 21, respectively. When conducting the study, the personal information of the participants such as gender, seniority, educational institutions they work in and their educational levels were also requested in line with the aims of this study. The participants were informed and the aim of the study was explained during the implementation.

Data Analysis

The obtained data were resolved under the sub-problems of this study. The data were analyzed using SPSS 22 (Statistical Package for Social Science) software. The items of scale were graded and the data set was reviewed for lost and extreme values before analyzing. No lost value was found in the dataset. During extreme data review, some data entries were corrected. In addition to this, the possible negative effects of some extreme values that can disrupt normality were removed by changing them to their closest values. The normality of the research data was analyzed using the Kolmogorov-Smirnov Test. The analyses were performed after ensuring that the distribution was normal. T-test (Independent - Samples T-Test) was used in order to test whether school principals' attitudes towards reporting child sexual abuse showed a statistically significant difference in terms of gender variable or not. On the other hand, One-Way Analysis of Variance – ANOVA - was used in order to test whether the attitudes of school principals towards expressing their opinions on the use of tangible materials and computers in mathematics lessons showed a statistically significant difference in terms of seniority, educational status, educational background and educational institutions or not.

FINDINGS

The degree of participation of all opinions provided by the participant school principals on all items was found to be "Sometimes" (mean= 2.74). The Distribution of the Opinions of School principals on the Use of Tangible Materials and Computers in Mathematics Lessons According to Each Item of the Scale is shown in **Table 1**.

Table 1. The distribution of the opinions of school principals on the use of tangible materials and computers in mathematics lessons according to each item of the scale

Items	N	X	SS	Degree of Participation
1. The mathematics teachers should also use resources apart from the guidebooks	184	1.71	.815	Always
2. I shall provide support for subscribing to scientific mathematics magazines in line with the demands of mathematics teachers	184	2.69	1.29	Sometimes
3. I shall procure resources for mathematics teachers apart from the guidebooks	184	2.90	1.395	Often
4. I think it would be good to have a mathematics corner in our school (such as books, tangible materials, and posters)	184	1.59	.906	Always
5. I shall refer to the opinions of mathematics teachers on the use of tangible materials during lessons	184	2.04	.942	Often
6. The teachers should use tangible materials in mathematics lessons	184	1.78	.878	Always
7. I shall support the procurement of tangible materials when mathematics teachers demand	184	2.16	1.212	Always
8. I think the duration of the lesson is enough for mathematics teachers to use tangible materials during lesson	184	2.92	1.184	Sometimes
9. I think the use of tangible materials in mathematics lessons will distract the students and the lessons will not be healthy	184	4.27	1.077	Never
10. I think the use of tangible materials in mathematics lessons will not make a positive contribution to the students (such as increasing their success or comprehension levels)	184	3.94	1.353	Never
11. I think the mathematics teachers have skills for using tangible materials in mathematics lessons	184	2.50	1.086	Sometimes
12. The mathematics teachers request my help for the procurement and use of tangible materials	184	3.17	1.113	Sometimes
13. I refer to the opinions of mathematics teachers on the use of computers in lessons	184	2.82	1.183	Often
14. The mathematics teachers should take advantage of computers during lessons	184	2.14	1.087	Often
15. I shall provide support for the procurement of the software related to mathematics and graphics drawing that mathematics teachers need	184	2.49	1.164	Often
16. I immediately interfere with the procurement and maintenance of computers and projectors	184	2.15	1.003	Often
17. I think the mathematics teachers have skills for using computers in mathematics lessons	184	2.16	.833	Often
18. I think the duration of the lesson is enough for mathematics teachers to use computers during lesson	184	2.80	1.320	Often
19. I think the use of computers in mathematics lessons will distract the students and the lessons will not be healthy	184	4.15	1.051	Never
20. I think computer-aided mathematics lessons will not make a positive contribution to the students (such as increasing their success or comprehension levels)	184	4.04	1.206	Never
21. The mathematics teachers request my help for the procurement and use of computer equipment necessary for computers and presentations	184	3.05	1.213	Sometimes

In this study, the opinions of the school principals were provided without making any changes. As can be seen in **Table 1**, "I shall support the procurement of tangible materials when mathematics teachers demand" the item had one of the highest means (X=2.16). This item was followed by "The teachers should use tangible materials in mathematics lessons" (X=1.78), "The mathematics teachers should also use resources apart from the guidebooks" (X=1.71) and "I think it would be good to have a mathematics corner in our school (such as books, tangible materials, and posters)" (X=1.59). Considering the degree of participation, the qualitative equivalents of the opinions related to these three items are 'Always'.

As can be seen in **Table 1**, the item "I shall procure resources for mathematics teachers apart from the guidebooks" had one of the highest means (X=2.90) among the items related to the opinions of school principals on the use of tangible materials and computers in mathematics lessons. This item was followed by "I refer to the opinions of mathematics teachers on the use of computers in lessons" (X=2.82), "I think the duration of the lesson is enough for mathematics teachers to use computers during lesson" (X=2.80), "I shall provide support for the procurement of the software related to mathematics and graphic drawing that mathematics teachers need" (X=2.49), "I think the mathematics teachers have skills for using computers in mathematics lessons" (X=2.16), "I immediately interfere in the procurement and maintenance of computers and projectors" (X=2.15), "The mathematics teachers should take advantage of computers during lessons" (X=2.14) and "I shall refer to the opinions of mathematics teachers on the use of tangible materials during lessons" (X=2.04). Considering the degree of participation, the qualitative equivalents of the opinions related to these items are 'Often'.

Table 2. T-test results of the opinions of school principals on the use of tangible materials and computers in mathematics lessons in terms of gender variable

Gender	N	Mean	Sd	df	t	p
Female	25	55.68	10.83	182	0.979	.329
Male	159	77.87	7.02			

Table 3. One-Way ANOVA results of the opinions of school principals in terms of the number of students in school

Variables	N	Mean	S	Sd	f	p	Resource of Difference
a. 100-601	44	57.22	10.60	4; 184	4.72	0.03	901-1300 More than 1701
b. 601-1201	55	59.36	12.37				
c. 1201-1501	30	52.47	8.59				
d. 1501-2001	20	54.35	6.55				
e. More than 2001	35	61.42	7.86				
Total	184	57.58	10.41				

As can be seen in **Table 1**, "The mathematics teachers request my help for the procurement and use of tangible materials" item had one of the highest means (X=3.17) among the items related to the opinions of school principals on the use of tangible materials and computers in mathematics lessons. This item was followed by "The mathematics teachers request my help for the procurement and use of computer equipment necessary for computers and presentations" (X=3.05), "I think the duration of the lesson is enough for mathematics teachers to use tangible materials during lesson" (X=2.92), "I shall provide support for subscribing scientific mathematics magazines in line with the demands of mathematics teachers" (X=2.69) and "I think the mathematics teachers have skills for using tangible materials in mathematics lessons" (X=2.50). Considering the degree of participation, the qualitative equivalents of the opinions related to these items are 'Sometimes'.

As can be seen in **Table 1**, "I think the use of tangible materials in mathematics lessons will distract the students and the lessons will not be healthy" item had one of the highest means (X=4.27) among the items related to the opinions of school principals on the use of tangible materials and computers in mathematics lessons. This item was followed by "I think the use of computers in mathematics lessons will distract the students and the lessons will not be healthy" (X=4.15), "I think computer-aided mathematics lessons will not make a positive contribution to the students (such as increasing their success or comprehension levels)" (X=4.04) and "I think the use of tangible materials in mathematics lessons will not make a positive contribution to the students (such as increasing their success or comprehension levels)" (X=3.94). Considering the degree of participation, the qualitative equivalents of the opinions related to these items are 'Never'.

In line with the information in **Table 2**, it was determined that the scores of the opinions of school principals on the use of tangible materials and computers in mathematics lessons didn't show any statistically significant difference in terms of gender. One-Way ANOVA results of the opinions of school principals on the use of tangible materials and computers in mathematics lessons in terms of the number of students in the school are shown in **Table 3**.

As a result of the One-Way ANOVA performed, it was determined that the opinions of school principals on the use of tangible materials and computers in mathematics lessons showed a statistically significant difference in terms of the number of students in school [$F(4, 184)=4.72$, $p<.05$]. In this regard, it can be said that the opinions of school principals on the use of tangible materials and computers in mathematics lessons show a statistically significant difference. The Scheffe test from multiple comparison tests was used in order to determine which means are different. According to the results of the Scheffe test (as high scores show high levels of negative attitudes), when the opinions of school principals who had 901-1300 students in their school (X=1.4738) and the opinions of school principals who had both 16-20 years of seniority and more than 1701 students in their school (X=52.47) were compared, it was determined that the opinions of school principals on the use of tangible materials and computers in mathematics lessons showed a statistically significant difference.

The opinions of school principals on the use of tangible materials and computers in mathematics lessons show the statistically significant difference in terms of the number of students in school. In this regard, it can be said that the use of tangible materials and computers in mathematics lessons in schools with 901-1300 students and more than 1701 students are more effective. When the data obtained from the school principals with up to 20 seniority years and the data obtained from the school principals with fewer seniority years are compared, it can be determined that the school principals exhibit more negative attitudes towards reporting child sexual abuse. However, it can be also said that after this seniority year the school principals exhibit more positive attitudes.

One-Way ANOVA results of the opinions of school principals on the use of tangible materials and computers in mathematics lessons in terms of the number of teachers in the school are shown in **Table 4**.

Table 4. ANOVA Results in terms of the number of teachers in school

Variables	N	Means	S	Sd	f	*p*	Resource of Difference
1-3	90	57.92	9.67	4; 184	4.77	0.010	1-3 More than 6
4-5	44	51.42	10.36				
6 and more	50	51.96	10.99				
Total	184	56.06	10.41				

Table 5. ANOVA Results in terms of the number of managers in school

Variables	N	Means	S	Sd	f	*p*	Resource of Difference
1-3	99	58.05	11.61	4; 184	.459	.633	No difference
4-5	59	57.54	9.25				
6 and more	26	55.84	7.86				
Total	184	57.57	10.41				

As a result of the One-Way ANOVA performed, it was determined that the opinions of school principals on the use of tangible materials and computers in mathematics lessons showed a statistically significant difference in terms of the number of teachers in school [$F(3, 184)= 4.77$ $p>.05$]. In this regard, it can be said that the opinions of school principals on the use of tangible materials and computers in mathematics lessons show a statistically significant difference in terms of the total number of mathematics teachers working in a related school. The Scheffe test from multiple comparison tests was used in order to determine which means are different. According to the results of the Scheffe test (as high scores show high levels of negative attitudes), when the opinions of school principals who had 1-3 mathematics teachers in their school (X=57.92), the opinions of school principals who had 6 and more mathematics teachers in their school (X=51.96) and the opinions of school principals who had 4-5 mathematics teachers in their schools (X=51.42) were compared, it was determined that the opinions of school principals on the use of tangible materials and computers in mathematics lessons showed a statistically significant difference. The opinions of school principals on the use of tangible materials and computer in mathematics lessons show the statistically significant difference in terms of the number of mathematics teachers in school. In this regard, it can be said that the use of tangible materials and computers in mathematics lessons in schools with 1-3 and 4-5 mathematics teachers are more effective than the use of tangible materials and computers in mathematics lessons in schools with 6 or more mathematics teachers.

One-Way ANOVA results of the opinions of school principals on the use of tangible materials and computers in mathematics lessons in terms of the number of managers in school are shown in **Table 5**.

As a result of the One-Way ANOVA performed, it was determined that the opinions of school principals on the use of tangible materials and computers in mathematics lessons didn't show any statistically significant difference in terms of the number of managers in school [$F(3, 184)= .459$, $p>.05$]. In this regard, it can be said that the number of managers in school does not have a statistically significant effect on the opinions of school principals regarding the use of tangible materials and computers in mathematics lessons.

DISCUSSION AND CONCLUSIONS

Mathematics is of great importance in our lives especially for describing and predicting the events happening around the world. It can be said that it is an abstraction in its pure sense as it exists independently of mankind and the world around us. Mathematics creates abstract structures of real-world counterparts with similar features and properties (Post, 1981).

As stated in studies conducted by Akinci et al. (2012), Dursun et al. (2013), and Ibarra, Santillán, Salazar, and Leyva (2017), past experiences and studies conducted so far show that technology cannot be used successfully in schools without the support of school principals. Therefore, the idea of determining the attitudes of school principals formed the basis of this study. In this study, various questions were addressed to the school principals about the use of tangible materials and computers by teachers in mathematics lessons and the following data were obtained as a result of the survey:

First, the school principals reported that tangible materials should always be used and computers should frequently be used in mathematics lessons. In fact, the same conclusion was made in an announcement published by the National Council of Teachers of Mathematics and it was reported that tangible materials and computers should be used in mathematics lessons.

It was concluded that school principals would always support the procurement of tangible materials upon the demand of teachers and they would often provide support for the procurement of the software and equipment related to the use of computers. The school principals reported that the mathematics teachers should use resources apart from the guidebooks and there should be a mathematics corner in schools. However, the school principals also reported that they were not keen in subscribing to scientific mathematics magazines, but they would provide support for the procurement of resources apart from the guidebooks. In addition to these, it was concluded that the school principals often referred to the opinions of mathematics teachers on the use of tangible materials and computers in mathematics lessons. The school principals reported that the use of tangible materials and computers in mathematics lessons would not cause any troubles, but they were not sure whether the duration of the lesson was enough for mathematics teachers to use tangible materials during a lesson or not. However, they reported that the use tangible materials and computers would not distract the students and it would not have a negative effect on the success of students.

The FATİH project (Movement for Increasing Opportunities and Improving Technology), which is in parallel with the results of this study, shows that the senior management institutions (Ministry of National Education and Ministry of Transportation, Turkey) have been supporting the use of tangible materials and computers in lessons and have been procuring required materials since 2010. Thus, it can be said that these efforts are in parallel with the results obtained from this study. It was also expressed that the teachers, who sometimes demanded the procurement and use of tangible materials and computers, were better at using the computers during the lesson than using tangible materials.

In conclusion, the opinions of school principals on the use of tangible materials and computers didn't o show a statistically significant difference in terms of gender and the total number of managers in school, but showed a statistically significant difference in terms of the total number of students and mathematics teachers in school.

Considering both the results of this study and the data obtained from the previously published studies (the ones reviewed in this study with examples), it can be concluded that there is a consensus that additional materials should be used in mathematics lessons. As stated in the studies conducted by Nan (1994), Adigüzel et al. (2011), Akdemir (2009), Smith et al. (2005), Arikan et al. (2006), Akinci et al. (2012), Dursun et al. (2013), and Asnake, Kassahun, and Halgeyo (2017), a considerable amount of importance should be placed on the opinions of school principals in this regard. It was found in this study that the school principals supported the procurement and use of tangible materials and computers and they found it necessary to use tangible materials and computers in mathematics lessons.

RECOMMENDATIONS

In line with the findings of this study, the following recommendations can be made:

1. The school principals are interested in the procurement or maintenance/repair of materials in line with the demands of mathematics teachers. However, this should be represented by the teachers more clearly. Thus, the perception that these demands will be met can be created.
2. The mathematics teachers can arrange testing lessons regarding the use of computers and tangible materials with school principals during in-service training. Developments can be achieved for the use of these materials in lessons.
3. School principals can determine the problems related to the materials and the use of these materials by holding regular meetings with mathematics teachers. These meetings will be more permanent if they are supervised and are aimed at submitting a final report. These meetings can be made compulsory at the beginning and, then, they can be maintained on the basis of habit and utility principles.
4. The school principals can observe the mathematics lessons in which these materials are used. At the end of these lessons, they can share the results with teachers. Thus, the use of materials in lessons can be increased and the individuals can be encouraged based on the positive feedbacks.
5. Book corners, mathematics material exhibitions or presentations including mathematics symbols arranged by the cooperation of both teachers and school principals can lead every student in the school to an interest in mathematics. A communication opportunity can be created for mathematics teachers and school principals based on these kinds of efforts. In addition to these, the teachers can be motivated and encouraged to use these materials in lessons. If a library is built, the use of additional resources can become easier for teachers.

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