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The Evaluation of Inquiry Learning Skills towards Math of Middle School Students in terms of Inquiring, Evaluating, Reasoning, and Reflective-Thinking Skills for Problem-Solving

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Abstract

The purpose of the study was to develop a scale to determine inquiry learning skills perception towards math of middle school students, to test the developed scale, and to evaluate their inquiry learning skills towards math in terms of inquiring, evaluating, reasoning, and reflective thinking skills for problem-solving. For this purpose, the study was carried out within two stages. In the first stage, the availability of the scale was presented by analysing the reliability and validity of the scale. In the second stage, the relationships between inquiry learning skills towards math and inquiring, evaluating, reasoning, and reflective thinking skills for problem-solving were analysed by considering various variables. The second stage which was prepared according to relational scanning model was carried out with the participation of 217 middle school students. The following scales were used as data collection instruments; "Inquiry Learning Skills Scale towards Math" and "A Reflective Thinking Skill Scale towards Problem-Solving". While middle school students had advance level of inquiry learning skills towards math, evaluating, reasoning, and reflecting thinking skills for problem-solving, and their inquiry skills were at intermediate level. There was a significant relationship between inquiry learning skills towards math and inquiring, evaluating, reasoning, and reflective thinking skills for problem-solving. Inquiry learning skills towards math differred significantly by students' gender, grade-levels, math achievement scores, and watching a science program for kids, but they did not differ by following a scientific magazine.

Keywords

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Introduction

One of the key factors that enable societies to advance is to have well-educated individuals. Developing and changing life conditions increases opportunities to access information anywhere you want as well as they need individuals who search, inquiry the relationships of cause and effect, and think. This period is not only limited to the schools in the information age but also it continues lifelong. In order to adopt the changes occurred in life conditions, people should have the following skills; learning to learn, thinking critically, creatively and flexibly, using technology, and reflecting what you think, working in groups, solving problems, searching, inquiring, and producing information (Şen & Erişen, 2002).

Ministry of Education (MoNE, 2013) also aims to raise students who have advanced skills of inquiring, understanding the problem by asking proper and meaningful questions, planning what to do where and when to solve the problem, predicting and testing results, and suggesting ideas. In order to reach these objectives, students are expected to have inquiry skills such as determining and checking variables, planning the process, and interpreting samples regarding evidence. According to John Dewey inquiry skills are expressed as asking questions about the topic which is being learned, searching for the answers, producing and creating the latest information while collecting information about any topic as well as reflecting the experiences (Taşkoyan, 2008). Raising the students who have such skills requires them being in a close relationship to inquiry-based learning (Howe, 2002).

Inquiry-based learning was adopted by many teachers in 1970s and it began to emerge. However; utilizing it during higher education and sustainable implementation cannot be ensured although it has to be an indispensable part of the curriculum (Sproken Smith & Walker, 2010). Perry and Richardson (2001) define inquiry-based learning as solving problems by asking questions, searching and analyzing information, and the process of converting learned information into useful knowledge. Inquiry-based learning can be mentioned as a process in which students pose problems and they try to solve problems during their classes (Wood, 2003). Inquiry-based learning generally points out student-centered learning in which students pose their own problems and they develop solution methods for them (Maaß & Artigue, 2013). In this student-centered process, students can do the developing both their learning outcomes and their high-level skills (Justice, Warry, & Rice, 2009; Prince & Felder, 2006; Spronken Smith, Bullard, Ray, Roberts, & Keiffer, 2008; Wagner, Speer, & Rossa, 2007). This learning is expressed as an example of the experiential learning approach (Sproken Smith & Walker, 2010). Inquiry-based learning is a practical way to establish connections between previous knowledge and the definitions of the natural world (Nuangchalerm & Thammasena, 2009). It can be said that inquiry-based learning will improve students' mathematical understanding, and this will make mathematical knowledge more necessary and functional than usual school tasks in contextual diversity. According to Fibonacci (2012), inquiry learning skills will help students' mathematical and scientific curiosity and creativity, their critical thinking, logic and analysis potentials, and their independent thinking levels. Inquiry-based learning approaches encourage students to discover mathematical problems, predict and test the hypothesis, develop the solutions, and express their opinions (Rasmussen & Kwon, 2007). Zimmerman and Schunk (2001) also state similarly that inquiry learning approaches can promote continuity, independence, and creative usage of mathematical knowledge. In addition to this, inquiry-based learning presents opportunities for students to discover and understand the natural world (Panasan & Nuangchalerm, 2010). The main components of the inquiry-based learning which as accepted by many researchers (Justice et al., 2007; Kahn & O'Rourke, 2004) are as follows;

1. Learning is increased by inquiry,
2. Learning is based on information and the process of building new insights,
3. It is an active approach including learning by experiencing,
4. It is a student-centered approach in which teachers act as facilitators,
5. It is a transition to self-regulated learning in which students take the responsibility of their own learning.

Healey (2005) advocated more use research-based learning by using inquiry-based learning. Because after a five-year study Justice et al. (2007) concluded that inquiring is a powerful pedagogical tool which encourages students to become self-learners who actively participates in the learning process. When we analyzed the literature, it was seen that the effect of inquiry-based learning on various variables was searched. It was revealed that inquiry-based learning has positive effects on variables such as academic achievement, attitude for lessons, scientific process skills, scientific operations skills, etc. (Akben, 2011; Aydoğdu, 2009; Balım, İnel, & Evrekli, 2008; Budak Bayır, 2008; Chin & Osborne, 2008; Çeliksöz, 2012; Davies, Collier, & Howe, 2012; Duban, 2008; Erdoğan, 2005; Gençtürk, 2004; Gül, 2011; Güngör Seyhan, 2008; İnel Ekici, 2017; Kara, 2008; Köksal, 2008; Küçük, 2012; Sağlam, 2012; Sözen, 2010; Şen, 2010; Taşkoyan, 2008; Tatar, 2006; Timur, 2005; Van Zee, Iwasyk, Kurose, Simpson, & Wild, 2001). Yaşar and Duban (2009) examined students' opinions on inquiry-based learning. Bayır and Köseoğlu (2013) analyzed the understanding developed by pre-service chemistry teachers and teachers about inquiry-based teaching which was prepared to support inquiry and research-based teaching applications. The conceptual understanding of teachers about inquiry-based learning was also analyzed in a study which was carried out by Dutrow (2005). Chabalengula and Mumba (2012) identified the type of inquiry skills and tasks in national high school science curriculum in Zambia in their study.

Some of the studies are related to developing the instruments to test inquiry-based skills. For example; Wu and Hsieh (2006) developed an inquiry skills test to evaluate students' inquiry skills and they used this test as a pre-post test in their studies. Balım and Taşkoyan (2007) developed an inquiry skills scale. This developed scale can be used by science and technology teachers to determine the perceptions of the students about inquiry skills towards science. Besides, it is also stated that this scale can also be used for 6th, 7th, and 8th grade students. Akben (2011) developed a survey to evaluate scientific inquiry-based laboratory activities developed by pre-service teachers. The purpose of this survey was to test to what extent these activities reflect scientific inquiry-based approach and to determine the availability of experiments to the students' levels. In addition, in this scale, there are items regarding how teachers give importance to the rules to be obeyed in labs. Aldan Karademir and Saracaloğlu (2013) developed inquiry skills scale for pre-service teachers. It is stated that pre-service teachers' inquiry skills can be determined by this developed scale. Under the light of analysis, it is understood that most of the studies are about science education and a scale which is developed for determining inquiry skills of middle school students within the scope of math lessons have not been noticed yet. For this reason, it was thought that a study in math is necessary. In this context, it was aimed to develop an inquiry learning skills scale towards math in the first stage of the study. It was thought that developing an inquiry learning skills scale towards math could support future studies and could fill out a scientific gap in math education. This developed scale could also be used in experimental studies about the effectiveness of inquiry-based learning in math. The effective factors on inquiry learning skills towards math could be determined by using this scale.

Schwab and Brandwein (1962) explained scientific inquiry in three phases. These are as follows; 1) a problem and solution methods are given to the students. Questions are used to help students to create correlations to the topics that they have not learned yet, 2) the problem is given to the students. The student determines his/her own solution methods and reaches a solution, 3) the stages of the scientific inquiry (problem, method, and solution) are determined by the student. Herron (1971) expressed scientific inquiry in four phases. These phases are; 0: Problem, solution method, and result are given. 1: Problem and solution methods are given; student finds the solution on his/her own. 2: Only the problem is given. 3: Problem, solution, and method are not provided. When the scientific inquiry levels provided by Schwab and Brandwein (1962) and Herron (1971) are analyzed, the similarities to problem-solving and the stages of problem-solving attract attention. It is thought that scientific inquiry is within the essence of math. Within this context, the aim of the second stage was to present correlations between inquiry learning skills towards math and inquiring, evaluating, reasoning, and reflective thinking skills for problem-solving, and also to analyze these relationships in terms of various variables.

These various variables are as follows; gender, grade-levels, math achievement, watching any science program for kids and following a scientific magazine. In inquiry-based learning, students are expected to develop a conceptual understanding of scientific content and understand the nature of science (Chin & Chia, 2006). Besides, inquiry learning helps them to construct their own knowledge (Zion & Sadeh, 2007). It is thought that watching science programs and following a scientific magazine will help them to develop the skills mentioned here and also to create inquiry-based learning environments. In addition to this, students direct their research activities individually by actively participating in the scientific inquiry process (Dedić, 2014; Pappas, 2006). It is predicted that a student will direct his own inquiry process by watching a TV program that he wants or by following a magazine. Students can find opportunities to discover and express their own concepts and strategies in inquiry learning (Gijlers & Jong, 2013). It is thought that watching a program or following a magazine is important in this discovery period. In this sense, the answers of the following questions were searched in the second stage.

1. What are the levels of inquiry learning skills towards math of middle school students and the levels of the skills of inquiring, evaluating, reasoning, and reflective thinking for problem-solving?

2. Is there a relationship between the inquiry learning skills towards math of middle school students and the skills of inquiring, evaluating, reasoning, and reflective thinking for problem-solving?

3. Is there a relationship between the inquiry learning skills towards math of middle school students and their gender, grade levels, their math achievements, watching a science program for kids and following a scientific magazine?

Method

This study was carried out in two stages. The methods and findings about the first and the second stages of the study are presented separately below.

The First Stage

Research Model and Study Group

The first stage of the study was designed according to the general scanning model. Convenience sampling was preferred among purposeful sampling methods in order to determine the study group. In convenience sampling, the researchers create their samples by starting from the most accessible respondents until they reach the size of the group that they need and they work on this sample (Ravid, 1994). In this sense, the study was carried out in a public middle school from the Anatolian side of Istanbul. The study group was composed of 745 middle school students. The distributions of the students are shown in Table 1.

Table 1. The Distribution of the Study Group

	5th-Grade	6th-Grade	7th-Grade	8th-Grade	Total
Female (F)	70	75	95	87	327 (%43.89)
Male (M)	112	103	104	99	418 (%56.11)
Total	182 (%24.43)	178 (%23.89)	199 (%43.89)	186 (%24.97)	745

The study group of 745 students was divided randomly into two groups for the explanatory factor analysis of the scale, reliability studies, and the confirmatory factor analysis. The student distributions in the first and the second groups are as follows:

Table 2. The Distributions of Students into the First and the Second Groups

Groups	Grades	Female (F)	Male (M)	Total
The First Group	5	43	74	117 (%29.03)
	6	45	49	94 (%23.33)
	7	49	49	98 (%24.32)
	8	44	50	94 (%23.33)
	Total	181 (%44.91)	222 (%55.09)	403
The Second Group	5	27	38	65 (%18.71)
	6	30	54	84 (%24.56)
	7	46	55	101 (%29.53)
	8	43	49	92 (%26.90)
	Total	146 (%42.69)	196 (%57.31)	342

The data obtained from the first group composed of 403 students were used in explanatory factor analyses and reliability analyses. The data obtained from the second group composed of 342 students were used for confirmatory factor analyses.

Process: The Development of the Scale

The Study of the Reliability and Validity: Inquiry Learning Skills Scale towards Math (ILSSM)

As a result of scanning the related literature, it was seen that inquiry learning is mostly used in science education studies (Balım & Taşkoyan, 2007; Balım et al., 2008; Bayır & Köseoğlu, 2013; Celep Havuz & Karamustafaoğlu, 2016; Chin & Osborne, 2008; Davies et al., 2012). It was seen that inquiry learning skills towards science were frequently searched and the scales of inquiry learning skills towards sciences were used in the studies. In this sense, "Scale of Inquiry Learning Skills Perception Devise" was developed by Balım and Taşkoyan (2007) and "Inquiry Skills Scale".was developed by Aldan Karademir and Saracaloğlu (2013) were accepted as a reference.

The inquiry includes some actions. These actions are; observating, creating questions, reviewing books, looking at information sources which are already known, planning researches, and reviewing existing knowledge in the light of experimental evidence. A scientific inquiry is for students to increase their knowledge through experiences and to understand how scientists study on natural life (National Research Council (NRC), 1996; Ketelhut & Dede, 2006; Taşkoyan, 2008). It is stated that it is necessary that students who have the ability of scientific inquiry to be able to ask questions, plan and maintain simple researches, obtain data by using simple tools and instruments, and implement reasonable results (Ediger, 2001). In this regard, while writing the items of the scale, the internal dynamics of the math, concepts about inquiry, and scientific inquiry were also taken into consideration. An item pool composed of 32 expressions was created by paying attention to the number of positive and negative items.

After creating the item pool, the opinions of the experts were asked for the items in the pool. At this point, it was decided to consult the experts in science education due to the inquiry learning is frequently used in science education. In this context, the opinions of two science education experts and three math education experts were asked. For this, three-graded expert opinon form was prepared. They were asked to determine whether the items of the scale are appropriate or not by choosing one of the items stated as "not suitable", "partly suitable", and "suitable", and to point out their ideas in the comment section. First of all, the comments written by the experts as a warning were taken into consideration. At this point, it appeared that four of the items (in twos) which were expressed by using different structures had the same meaning. Two of these four items were eliminated. Later on, for the remaining items, the opinions of the experts were combined in a single form and the number of approvals by the experts for each item was determined. In this sense, the content validity of the items was calculated by using the following formula of *"(The number of experts giving a positive answer/The total number of experts)-1"* developed by Veneziano and Hooper (1997). The obtained results were assessed by considering the necessity to exclude items whose validity rate is below 0.80. It was decided to exclude two more items from the scale according to the validity rates. Two items were edited to make them more meaningful. Here, we finally had 27 items for the scale. It appeared after the first analysis of the forms that there were also five items which were suggested to be added in the experts' forms. From this point, we finalized the draft/trial scale with 32 items after adding these five items suggested by the experts. 15 of the 32 items in the draft/trial scale were negative and 17 of them were positive. The responding style for the items in the scale was determined as five-point Likert as in the following (*"strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4)* and *strongly agree (5)"*).

The draft/trial form which became available to use was carried out to 92 students who were studying at a public middle school in Körfez, Kocaeli to check whether there were spelling mistakes, there were items which students cannot understand and to determine the length of time which will be given students to fill in the form. Among these students, there were 19 5th-grade students, 23 6th-grade students, 29 7th-grade students, and 21 8th-grade students. While filling in the form, students were asked to read the items carefully and to note parts that they did not understand. According to the data, it appeared that there were not any incomprehensible items. 5th-grade students filled in the form in 26 minutes, 6th and 7th-grade students in 25 minutes, and 8th-grade students in 15 minutes. In this sense, the time allocated for filling in the form was decided as 25 minutes. The draft/trial scale was carried out to the study group. The average time for the study group to fill in the form was 23 minutes. However, one needs to consider the fact that when the study groups change, this time may increase or decrease. Generally, the average time for filling in the form should be considered as 25 minutes.

Data Analysis

While developing scales, factor analysis is used in order to get evidence for the construct validity of scales. Before starting this process, it is necessary to prove some basic concepts and probable situations. First of them is the size of the sample (Çokluk, Şekercioğlu, & Büyüköztürk, 2010). In this analysis, there is a general rule saying that there should be at least 300 samples (Tabachnick & Fidell, 2001). Comrey and Lee (1992) state that for sufficient sample size, 50 is very weak, 100 is weak, 200 is average, 300 is good, 500 is very good, and 1000 is excellent. In addition to these, it is suggested to have a sample group which is ten times bigger than the number of the items (Kline, 1994). Bryman and Cramer (2001) advocate that you can find the sufficient sample size by multiplying the number of items with five or ten. When we consider these points, the explanatory factor analysis of this study was conducted with 403 data. In this sense, it can be said that the size of the sample is sufficient.

The availability of the sample size in terms of factor analysis can be assessed by using the Kaiser-Meyer-Olkin (KMO) test which compares the size of the observed correlation coefficients and the size of the partial correlation coefficients (Kalaycı, 2005). After conducting this test, having a result between 0.80-0.90 can be interpreted as the sample size is good in terms of factor analysis and having a result as 0.90 or over can be interpreted as the sample size in terms of factor analysis is perfect (Leech, Barrett, & Morgan, 2005). In this study, the result of the KMO test was calculated as 0.884. According to this result, the sample size was considered as good.

The other point which should be proved is to test the normality of the data set. Whether the data comes from normal distribution or not can be presented by using Bartlett's Test of Sphericity (Tavşancıl, 2005). In this test, chi-square value is assigned and then the significance value is analysed and if this value is smaller than 0.05, it is decided that it is impossible to conduct a factor analysis (Şencan, 2005). However, as the size of the sample becomes bigger, chi-square value also becomes bigger and the possibility of getting a significant chi-square will be higher. For this reason, we should be proactive while interpreting the results of this test (Çokluk et al., 2010). The result of the Bartlett's test obtained in our study also showed that ($X^2 = 3411.23; p < .01$) factor analysis can be conducted.

After explanatory factor analysis, confirmatory factor analysis was conducted to reveal the construct validity of the scale. Cronbach Alpha reliability analysis was used for internal consistency. It was decided to use item analysis based on correlations for item analysis.

Results

Explanatory Factor Analysis of ILSSM (ILSSM-EFA)

Explanatory factor analysis was done and the obtained results were evaluated. At this point, we preferred basic components analysis in order to present the factor design of the scale. Varimax technique among right rotating methods was preferred. In determining the number of factors, eigenvalue statistics and scree plots were considered (Büyüköztürk, 2012). In factor analysis, only factors whose eigenvalue is calculated as one and over one is accepted as decisive factors (Köklü, 2002). In this study, first of all, factors whose eigenvalue was calculated as one or over were taken into consideration. In this sense, it was seen that there were eight factors. In addition to this, scree plots decrease the number of factors more successfully than eigenvalues and serve the fundamental purpose of the factor analysis (Thompson, 2004). In this sense, when we analysed the scree plot obtained in our study, it was decided to have two factors.

What we need to consider while analyzing is the values regarding factor loads. Factor loads are the coefficients explaining the correlation between items and factors (Kline, 1994). Having a low factor load in an item shows that there is not a significant correlation between item and related factor. It is advocated in the related literature that the minimum size of the factor load has to be 0.30 (Şencan, 2005). According to Tabachnick and Fidell (2001), one has to assess factor load value when it is 0.32 and over.

In addition to them, the size of the sample is also important when deciding on the factor load. The size of the sample for an item whose factor load is 0.30 has to be minimum 350, for an item with 0.40 factor load it has to be at least 200 (Kim Yin, 2004, as cited in Şencan, 2005). It is stated that when a factor load is 0.32, an evaluation is "weak" and when it is 0.45, it is an "average" evaluation and when it is 0.55, then it becomes a "good" evaluation (Comrey & Lee, 1992). When we considered all the information stated above, it was decided to have a factor load calculated as 0.45.

After having this decision, we repeated the analysis as having the number of factors as two and factor load values as 0.45. The results were analysed in terms of having overlapping data and then seven items were removed from the scales. Finally, we had 25 items remaining in the scale. The factor load groups of the remaining items and the meaning of the items were evaluated. According to this evaluation, first factor was called as "Positive Perceptions" and the second factor as "Negative Perceptions". The items about the Positive Perceptions were: 1, 2, 5, 7, 11, 13, 14, 16, 17, 21, 23, 25, 27, 29, and 31, the items about the Negative Perceptions were: 3, 10, 12, 17, 22, 24, 26, 28, 30, and 32. Whereas the final version of the scale is provided in Appendix 1, the results of the factor analysis are presented below.

Table 3. The Factor Analysis Results of ILSSM

Positive Perceptions		Negative Perceptions	
Item No	**Factor Loads**	**Item No**	**Factor Loads**
1	.559	3	.506
2	.486	10	.561
5	.490	12	.504
7	.532	17	.487**
11	.509	22	.624
13	.677*	24	.731*
14	.578	26	.695
16	.583	28	.681
17	.468**	30	.649
21	.498	32	.566
23	.580		
25	.503		
27	.589		
29	.508		
31	.546		
Explained variance: %18.720		%16.482	
Explained total variance: %35.202		*Max	**Min

When we analyze Table 3, it was seen that there are 15 items related to "Positive Perceptions" and their factor loads differ between 0.677 and 0.468. Similarly, there were 10 items related to "Negative Perceptions" and their factor loads differ between 0.731 and 0.487.

Item-Remainder (IRC) and Item-Total (ITC) Correlations

Item-remainder corerelations and item-total correlations were calculated in order to determine the reliability coefficient of the items. The results of the analysis were presented below in Table 4.

Table 4. Item Analysis Results of ILSSM

Positive Perceptions			Negative Perceptions		
Item No	**IRC**	**ITC**	**Item No**	**IRC**	**ITC**
1	.402	.460	3	.439	.505
2	.371	.440	10	.401	.472
5	.480	.533	12	.429	.497
7	.406	.464	17	.394	.464
11	.392	.459	22	.463	.527
13	.575	.619	24	.584	.638
14	.496	.545	26	.502	.565
16	.457	.504	28	.514	.576
18	.331	.398	30	.461	.526
21	.431	.492	32	.409	.478
23	.490	.545			
25	.451	.513			
27	.568	.618			
29	.394	.463			
31	.404	.475			

p* < ,01

The results presented in Table 4 were evaluated as evidence that the reliabilities of the remaining items of the scale are high, they are discriminative, and they test the same structure. We presented below the correlations related to ILSSM and its sub-factors and correlations between factor scores related to both the whole scale and the factor scores among each other.

Table 5. Correlations between ILSSM Factor Scores

Factors	Correlations		
	Positive Perceptions	**Negative Perceptions**	**ILSSM**
Positive Perceptions	1		
Negative Perceptions	.504*	1	
ILSSM	.890*	.842*	1

p* < .01

When we analyze Table 5, it was seen that there was a high-level correlation between sub-factors and the whole scale. Because having a correlation coefficient between 0.70-1.00 is defined as a high correlation (Büyüköztürk, 2012). The correlation among sub-factors was a middle-level. Because having a correlation coefficient between 0.30-0.70 is interpreted as a middle level correlation (Büyüköztürk, 2012). This level of correlation between sub-factors is an intended situation. It is known that having a high correlation among factors (0.60 and over) means that factors are dependent on each other and it is not true to assume them as single sub-scales (Engs, 1996). In this sense, this middle-level correlation that was obtained can be accepted as evidence for the independence of the factors from each other.

Confirmatory Factor Analysis of ILSSM (ILSSM-CFA)

The data which was obtained from the second group was used for the confirmatory factor analysis. However, these data were not used for the explanatory factor analysis. After explanatory factor analysis, confirmatory factor analysis was carried out for the scale whose 25-item structure was exposed in order to test the validity of the scale. The findings obtained as a result of the analysis were presented in Table 6 below.

Table 6. The Results of CFA of ILSSM

Indexes	X^2/sd	**NFI**	**NNFI**	**CFI**	**GFI**	**RMR**	**SRMR**	**RMSEA**
Value	1.79	0.94	0.97	0.97	0.90	0.07	0.04	0.04

When X^2/sd ratio equals to two or less, it shows perfect fit (Tabachnick & Fidell, 2001). When NFI and GFI values equal to 0.90 or more, they show good fit (Hooper, Coughlan, & Mullen, 2008; Thompson, 2004) and when NNFI and CFI values equal to 0.95 or more, they show perfect fit (Sümer, 2000; Thompson, 2004). Having RMR value equal to 0.08 or less expresses good fit (Brown, 2006). Having SRMR and RMSEA values equal to 0.05 or less states perfect fit (Brown, 2006; Raykov & Marcoulides, 2008). In this context, when Table 6 is analyzed, it is seen that all fit indexes regarding ILSSM show either perfect or a good fit.

Internal Consistency of ILSSM

Cronbach Alpha internal consistency calculations were made in order to identify the reliability of the scores obtained from ILSSM. Cronbach Alpha value calculated for the initial form of the 32-item scale was as 0.884. The reliability coefficients calculated for 25 items after removing seven items as a result of factor and item analysis were presented below.

Table 7. Internal Consistency Values of ILSSM

	Cronbach Alpha	**p**
Positive Perceptions	.843	p < .05
Negative Perceptions	.825	p < .05
ILSSM	.880	p < .05

According to Table 7, Cronbach Alpha value regarding for the whole scale consisted of 25 items was calculated as 0.880, Cronbach Alpha value was calculated for positive perception factor as 0.843, and Cronbach Alpha value was calculated for negative perception factor as 0.825. It can be said that having all the calculated reliability coefficients over 0.80 shows that the scale is reliable (Kayış, 2009).

The Second Stage

Research Model and Study Group

The research model of the second stage is correlational research in which the correlations between two or more variables are analyzed without making any interventions (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2012). The study group of the second stage was determined according to convenience sampling from purposeful sampling methods. In this sense, the second stage was carried out in a public middle school in Çatalca, Istanbul. 217 middle school students participated in the study. 91 of the students (41.94%) were female and 126 of them were male (58.06%). There were 67 5^{th}-grade students (30.86%), 41 6^{th}-grade students (18.89%), 52 7^{th}-grade students (23.96%), and 57 8^{th}-grade students (26.64%) in the study group.

Data Collection Instruments

Every kind of data collection instrument can be used in correlational studies to collect qualitative data eventually. However, we should pay attention to provide high-level reliability and validity for these instruments (Büyüköztürk et al., 2012). For this reason, both reliability analysis and confirmatory factor analysis were conducted for the scales explained below and used in the second stage of the study.

Inquiry Learning Skills Scale towards Math (ILSSM): First of all, reliability analyses of the developed scale were repeated for the second stage. According to these analyses, Cronbach Alpha internal consistency coefficient regarding the whole scale was found as 0.880 and the alpha coefficient for the positive perceptions factor was found as 0.905 and for the negative perceptions factor as 0.858. It was seen that the developed scale also displayed similar results in the second stage suitable to the first study. Then confirmatory factor analysis was repeated. According to this analysis, the following data were obtained; X^2/sd: 1.62; RMSEA: 0.05; NFI: 0.92; NNFI: 0.96, CFI: 0.96; RMR: 0.11, and GFI: 0.86. It was seen that all the fit indexes were both sufficient and parallel to the first study (Brown, 2006; Hooper et al., 2008; Kline, 2005; Sümer, 2000; Tabachnick & Fidell, 2001; Thompson, 2004).

A Reflective Thinking Skill Scale towards Problem-Solving (ARTSSPS): The scale which was developed by Kızılkaya and Aşkar (2009) to determine students' reflective thinking skills towards problem-solving is composed of three sub-factors and 14 items. The Cronbach Alpha coefficient was calculated as 0.83 for the whole scale; as 0.73 for the questioning sub-factor; as 0.71 for the reasoning sub-factor, and as 0.69 for the evaluation sub-factor. According to the results of the confirmatory factor analysis, fit indexes are as in the following; GFI: 0.92; AGFI: 0.89; NNFI: 0.93; CFI: 0.95, and RMSEA: 0.71.

For this study, first, the Cronbach Alpha internal coefficient was calculated for both the whole scale and the sub-factors of the scale to present evidence regarding the reliability of the scale. According to this calculation, the alpha coefficient regarding the whole scale was calculated as 0.85, for questioning sub-factor as 0.68, for the evaluation sub-factor as 0.66, for reasoning sub-factor as 0.62. Later on, confirmatory factor analysis regarding the scale was repeated. The results are as in the following; X^2/sd: 0.01; RMSEA: 0.05; NFI: 0.93; NNFI: 0.96; CFI: 0.97; RMR: 0.08, and GFI: 0.93. It was seen that all the fit indexes are sufficient (Brown, 2006; Sümer, 2000; Tabachnick & Fidell, 2001; Thompson, 2004).

Data Analysis

The participants about whom we do not conduct any test about any variable during the data collection process in correlational studies should be excluded from the data set (Büyüköztürk et al., 2012). For this reason, each and every data obtained in this study was examined carefully by the researchers. We did not observe anything missing in the data set after examining whether there was a test about any variable regarding the data obtained. Upon this, we entered the data into computer and prepared the data set for the analyses.

We calculated the arithmetic mean of the scores obtained from data collection in order to get the answer to the first research problem in the second stage. As the data collection instruments were composed of four even intervals and five options, it was determined that the evaluation interval of the averages with "4/5=0.8" as in the following: *"1.00-1.80: Very Poor; 1.81-2.60: Poor; 2.61-3.40: Average; 3.41-4.20: High, and 4.21-5.00: Excellent"*. We presented the averages we calculated according to specified evaluation intervals in the results section.

In order to pursue conducting analysis, it is necessary to determine whether the data set has a normal distribution or not. For this, the size of the group from which obtained the data set is important. Since we need to use the Kolmogorov-Smirnov (K-S) test for the group sizes which are bigger than 50 (Büyüköztürk, Çokluk, & Köklü, 2010). We made this analysis and it was seen that all the scores obtained from both the scales and sub-factors of the scales do not have a normal distribution. Upon this, it was decided to test data set by using non-parametric tests. The findings obtained here were given in Table 8.

Table 8. The Findings Obtained from K-S Normality Test

The Scales and Their Sub-Factors	K-S	p
Reflective Thinking towards Problem-Solving	.08	.00
Questioning	.07	.01
Reasoning	.10	.00
Evaluation	.11	.00
Inquiry Learning towards Math	.13	.00
Positive Perceptions	.10	.00
Negative Perceptions	.05	.00

Having p-values bigger than 0.05 as a result of K-S shows that the data is suitable to a normal distrubution (Büyüköztürk, 2012). In this regard, it was decided to analyse data set by using non-parametric tests according to the data in Table 8. After having this decision, it was decided to use Spearman's rank-order correlation which is used while the data set does not have a normal distribution in order to have the answers of the second research problem. Mann-Whitney U (MW-U) test was used in terms of gender, watching a scientific program, and following a scientific magazine variables and Kruskal-Wallis (KW) test was used in terms of grade-levels and math achievement scores variables in order to have the answer to the third research problem.

When a significant difference appeared as a result of KW tests, we used MW-U test which is based on paired comparisons to determine which groups are different from each other. According to MW-U test, while the magnitude of the impact can be evaluated by using the following formula; $r = Z/\sqrt{n}$ (Field, 2009), as interpreting the results, when r=0.1 is, low breakpoints are considered, when r=0.3 is, middle breakpoints are considered and when r=0.5 is, big breakpoints are considered (Cohen, 1988, as cited in Kilmen, 2015). In order to determine the direction of the results of the KW test analysis, Std. J-T value is calculated and having a negative value is interpreted as when the level of the variable is increased, there is a decrease in the dependent variable. In addition to this, this situation was also checked by using the Jonckheere-Terpstra test (Kilmen, 2015).

The Second Stage Results

Within the scope of the second stage, the findings obtained as a result of the analysis carried out for finding the answer of the first research problem stated as *"What are the levels of inquiry learning skills towards math of middle school students and the levels of the skills of inquiring, evaluating, reasoning, and reflective thinking for problem-solving?"* are as in the following.

Table 9. Levels of Skills

Skills		**N**	$\bar{X}$	**ss**
Inquiry Learning towards Math		217	3.55	.69
For Problem-Solving	Questioning	217	3.38	.84
	Evaluation	217	3.56	.84
	Reasoning	217	3.60	.88
	Reflective Thinking	217	3.51	.74

According to Table 9, the average score of inquiry learning skills towards math of middle school students is 3.55. The average score of their reflective thinking skills towards problem-solving is 3.51. In addition to them, their average score for their inquiry skills is 3.38, their average score of their evaluation skills is 3.56 and average score of reasoning skills is 3.60. It was seen that while the level of the skills of inquiry learning, evaluation, reasoning, and reflective thinking towards problem-solving are high, the level of the skill of questioning is average.

The findings obtained as a result of the analysis carried out for finding the answers of the second research problem stated as *"Is there a relationship between the inquiry learning skills towards math of middle school students and the skills of inquiring, evaluating, reasoning, and reflective thinking for problem-solving?"*are as in the following.

Table 10. The Relationships between Inquiry Learning Skills towards Math and Inquiring, Evaluating, Reasoning, and Reflective Thinking Skills for Problem-Solving

		For Problem Solving			
		Inquiring	**Evaluating**	**Reasoning**	**Reflective Thinking**
Inquiry Learning towards Math	Spearman's rho	.499	.587	.507	.613
	p	.000	.000	.000	.000
	r^2	.249	.345	.257	.376

According to Table 10, there is a mid-level positive correlation between inquiry learning skills of middle school students and their inquiring, evaluating, reasoning, and reflective thinking skills for problem-solving. When the determination coefficients were examined, it could be said that 24.90% of the students' inquiry learning skills towards math was explained by their inquiry skills, 34.50% of them by evaluation skills, and its 25.70% of them by reasoning skills, and 37.60% of them by reflective thinking skills for problem-solving.

The findings obtained according to the analysis carried out for finding the answers of the third research problem stated as in the following *"Is there a relationship between the inquiry learning skills towards math of middle school students and their gender, grade-levels, their math achievements, watching a science program for kids and following a scientific magazine?"* are as follows. According to this;

Table 11. The Relationships between Inquiry Learning Skills towards Math and Gender

Gender	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**Z**	**p**
Female	91	128.70	11711.50	3940.5	-3.929	.000
Male	126	94.77	11941.50			

According to Table 11, it was seen that inquiry learning skills towards math of middle school students differ significantly by gender [U=3940.5, z= -3.929, p< .05, r= 0.267]. The inquiry learning skills towards math of female students were higher than male students' skills. It could be said that the calculated magnitude of the impact was at the middle-level.

Table 12. The Relationships between Inquiry Learning Skills towards Math and Grade-Levels

Grade-Levels	N	Mean Rank	df	X^2	p	Significant Difference
5	67	130.88	3	26.96	.000	5; 7-8 6; 7-8
6	41	131.52				
7	52	83.97				
8	57	89.91				

As a result of the analysis, it was determined that inquiry learning skills towards math of middle school students differ significantly by students' grade-levels [H_3= 26.96; p< .05]. In paired comparisons carried out by using MW-U test, it was found that the inquiry learning skills of 5th and 6th-grade students differed significantly when compared with 7th and 8th-grade students. According to Jonckheere-Terpstra test, it could be said that as the grade-level of the students is increased, their inquiry learning skills are decreasing [J= 6451.50, z= -4.442, p< .05, r= .302].

Table 13. The Relationships between Inquiry Learning Skills towards Math and Math Achievement Scores

Math Achievement Scores	N	Mean Rank	df	X^2	p	Significant Difference
1	3	17.00	4	45.492	.000	1; 2, 3, 4, 5 2; 4, 5 3; 5 4; 5
2	28	69.55				
3	59	90.07				
4	60	109.91				
5	67	145.46				

As a result of the analysis, it was determined that inquiry learning skills of middle school students differed significantly by their math achievement [H_4= 45.492; p< .05]. In paired comparisons carried out by using MW-U test, it was seen that inquiry learning skills towards math of the students whose math achievement scores are higher than the other students' skills. According to Jonckheere-Terpstra test, it could be said that as the math achievement scores are increased, the inquiry learning skills towards math are also increased [J= 12159.50, z= 6.763, p< .05, r= .459].

Table 14. The Relationship between Inquiry Learning Skills towards Math and Watching a Science Program (WS-P) for Kids

WS-P	N	Mean Rank	Sum of Ranks	U	Z	p
Yes	95	122.33	11621.50	4528.50	-2.761	.006
No	122	98.62	12031.50			

According to the analysis, it was determined that inquiry learning skills towards math of middle school students differed significantly according to watching a science program for kids [U=4528.50, z= -2.761, p< .05, r= 0.187]. It was seen that inquiry learning skills of kids who follow any TV programs for kids about science are higher than kids who do not follow any TV program. The magnitude of the impact is low.

Table 15. The Relationships between Inquiry Learning Skills towards Math and Following A Scientific Magazine (FASM)

FASM	N	Mean Rank	Sum of Ranks	U	Z	p
Yes	70	120.90	8463.00	4312.00	-1.927	.054
No	147	103.33	1519.00			

According to the analysis, it was determined that inquiry learning skills towards math of middle school students did not differ by their situation about following a scientific magazine or not [U=4312.00, z= -1.927, p> .05]. However, when we considered their mean rank, it was seen that the mean score of the students who are following any scientific magazine is higher than the ones who do not.

Conclusion, Discussion and Suggestions

This study was carried out in two stages. Within the scope of the first stage, the aim was to develop a scale for inquiry learning skills towards math for middle school students. The aim of the second stage was to analyze the practicability of the scale and to determine relationships between inquiry learning skills towards math and inquiring, evaluating, reasoning, and reflective thinking skills for problem-solving, and to examine those relationships in terms of various variables. In this sense, discussion, conclusion, and suggestions regarding our study were presented below, respectively.

The First Stage

In this stage, first of all, we tried to develop an inquiry learning skills scale towards math. Since inquiry learning is used frequently in science education, it was decided to consult experts from science education. For this, an item pool was created about students' inquiry learning skills towards math by asking the opinions of the two experts from science education and three experts from math education. Then, the following operations were performed respectively.

1. Corrections about the items were made. The scale was ready for the pre-application.
2. The draft/trial scale was applied to the study group.
3. An exploratory factor analysis was executed to determine the factor structure of the scale.
4. A confirmatory factor analysis was done to test the structure of the scale.
5. The reliability studies were performed.

As a result of the explanatory factor analysis, it was seen that the scale consisted of two factors as "positive perceptions" and "negative perceptions". It was seen that factor load values regarding positive perceptions change between 0.677 and 0.468, for negative perceptions, they change between 0.731 and 0.487. The other results obtained are as follows:

1. The total variance explained by ILSSM was 35.202%.
2. Item-total correlation and item-remaining correlation values were found to be sufficient.
3. The X^2/df ratio of ILSSM according to CFA results is 1.79. This value was accepted as evidence that the scale is compatible with the real data.
4. The other fit indexes were also within the acceptance values (see Table 6).

As a result, it could be said that ILSSM is a practicable and valid model.

Cronbach Alpha value for the whole scale was calculated as 0.880. It was calculated as 0.843 for positive perceptions factor and 0.825 for negative perceptions factor as a result of the reliability analysis. Having all the reliability coefficients above 0.80 showed that the scale is reliable. Having the correlation coefficient calculated for the whole scale score and sub-factor scores between 0.70 and 1.00 showed that there is a high-level correlation. Having correlation coefficients among factors as 0.30-0.70 was interpreted as there is a mid-level correlation between factors. The research data was obtabined from middle school students. For this reason, it could be said that the scale could be used at middle school level. Whether the scale is suitable for primary or high school students depends on the results of the studies to be carried out at these levels.

The Second Stage

The purpose of the study was also to determine the relationships between inquiry learning skills towards math of middle school student and their inquiring, evaluating, reasoning, and reflective thinking skills for problem-solving, and to analyze them in terms of various variables. In this sense, while the inquiry learning skills of students, their evaluation, reasoning, and reflective thinking skills for problem solving are at the high-level, their inquiry skills are at the middle level. However, the results obtained for these skills were collected from the responses of the participants that they provided for the scale. Therefore, they were based on subjective self-perception and they may not reflect reality. Ev Çimen and Aygüner (2018) also stated in their studies that the real performances of middle school students might differ from the values of the scale. It is stated that the reason of this situation may be the fact that students at this age do not really know their own self-sufficiencies. For this reason, it is suggested to search for this situation deeply by using qualitative methods.

For Kızılkaya and Aşkar (2009), reflective thinking appeared as a result of teaching is a skill which can help to reveal latent learning habits, to develop high-level thinking skills like critical thinking, to develop strategies for the problems encountered, and to develop an improved process for a study carried out in technical wise. Reflection requires from a learner to focus on the process rather than the result. In order to have a reflection, first of all, learning should be realized and it is necessary for the learner to transfer learned knowledge into behavior. After that point, the thing is to evaluate the displayed behavior, especially by the learner (Başol & Evin Gencel, 2013). Having a high correlation between reflective thinking skills presented with the features stated above and inquiry learning skills towards math could be interpreted as learning environments and recently updated teaching programs at our schools have positive effects on students to acquire these skills.

It is obvious that students whose inquiry learning skills towards math are high have also high-level reasoning skills (Erdem, 2011) which help to understand by asking "why" and "how" naturally and which ensure to make right decisions as a result of this understanding. According to TIMSS students who have reasoning skills have also acquired skills like analyzing, generalizing, creating correlations, making decisions, solving nonroutine problems within the scope of the reasoning skills (TIMSS, 2003). For this reason, it could be said that there is a strong correlation between reflective thinking skills of students who have reasoning skills. Within the scope of the things stated above, this finding of the study is parallel with the following studies (Anagün & Yaşar, 2009; Aydın & Yılmaz, 2010; Çimen, 2008; Erdem, 2011; Hu, 2005; Kızılkaya, 2009; Pilten, 2008). On the other hand, as students have middle-level inquiry skills could be evidence for the fact that students need support in terms of questioning oneself in the teaching process to determine the points that they have realized and have not realized yet and evaluating the result. Wu and Hsieh (2006) concluded in their studies that the inquiry skills of the students who participated in inquiry-based learning activities developed at a greater extent. In this sense, the necessity of using inquiry-based activities in maths lessons has emerged. Using these activities by teachers is strongly recommended. Inquiry-based activities can be prepared by math teachers by taking support from related literature and can be used during classes. Wu and Hsieh (2006) also mentioned that we can contribute to the development of inquiry skills of students by providing them different learning opportunities to the students. They presented the stages of inquiry as in the following; i) asking questions and deciding which questions t used, ii) searching for information, iii) designing a research, iv) doing research, v) data analysis and making inferences, vi) creating products and vii) sharing them. Teachers can support the increase of inquiry skills by using these stages in their classes. Besides, the inquiry is an all-round activity requiring the following; making observations, posing problems, analyzing books and other resources in order to see what is already known, planning research, using tools for collecting, analyzing, and interpreting data (Maaß & Artigue, 2013). In conclusion, it is recommended for teachers to teach making observations to their students in order to increase their inquiry skills. In addition to this, it is deemed necessary to ensure analyzing different resources and using problem-posing activities to strength inquiry skills.

There is a significant difference between inquiry learning skills towards math by gender and this difference is in favour of female students. This finding of the study is parallel with the result of the study carried out by İnel Ekici (2017). In addition to this; this finding also matches up with various studies in which the correlation between gender and various variables (self-efficacy, attitude, motivation) were examined (Akay & Boz, 2011; Britner & Pajares, 2001; Khamis, Dukmak, & Elhoweris, 2008; McGraw, Lubienski, & Strutchens, 2006; Pierce, Stacey, & Barkatsas, 2007; Ursini & Sanchez, 2008; Yaman & Dede, 2007; Yıldırım, Hacıhasanoğlu, Karakurt, & Türkleş, 2011; Yücel & Koç, 2011). It is expected from students who acquired inquiry learning skills to be better at skills such as managing problem-solving properly, identifying necessary strategies for determining, and solving the problem, being patient to get the result. Mayer (2002, 2004) states in his study that students in the inquiry learning environments ask questions, collect data through observation, and reach conclusions under the lights of the questions generated as a result of the data analysis and interpretation. For this reason, it is thought that female students believe that their competencies related to the process rather than result is higher than male students as they are more patient to cope with the problems that they encounter while dealing with math and they are more eager to participate in learning activities (Abalı Öztürk & Şahin, 2014), they can study in collaboration and they can establish fruitful communication with their teachers (İnel Ekici, 2017) and more they try to do their best (Lightbody, Sienn, Stocks, & Walsh, 1996).

Another result of the study is inquiry learning skills of middle school students differ significantly by grade-levels. This result is in a way to support the findings obtained by İnel Ekici (2017). As the grade-levels of the students are increasing their inquiry skills are decreasing. There may be many reasons for this. First of all, as they proceed for the upper grades, math topics are getting more abstract and challenging. Besides, there are some other reasons for decreasing students' motivation and relevance. These are: i) since the students are trying to get ready entrance exams during the attending high schools, teachers are not able to inquiry all topics, ii) constantly repeating similar examples because of trying to memorize rules that are learned at school, iii) applying the tests which are related to problem-solving in a short time. Yaman and Dede (2007) also determined as a general tendency in their studies that as the grade-levels of the students are increasing, their motivation towards math are decreasing.

It was determined as another result in the study that middle students' mathematical achievements affect their inquiry skills towards science and math positively. It is natural that students whose academic achievements are high will be more competent than other students in problem-solving and evaluating the result. It is also obvious that their conceptual learning levels and their ability to establish correlations among concepts will be higher than others. It is stated in İnel Ekici's study (2017) that the achievements of students whose scientific inquiry skills are high will increase due to their understanding related to associated concepts will increase as they attend learning process actively and they have a high interest and motivation for their lessons. Özsoy (2005) determined that students' problem-solving skills and implementing a plan step are effective in their mathematical achievements. Some of the studies carried out before presented that there is a linear correlation between the inquiry learning skills of the students and their achievements (Wolf & Fraser, 2008; Taşkoyan, 2008). Hacısalihoğlu, Mirasyedioğlu, and Akpınar (2003) emphasized in their studies that being a successful problem solver is correlated with such skills stated as in the following; reflective thinking, making inquiries, making analysis and synthesis, critical thinking and making decisions. Kogan and Laursen (2014) presented in their longitudinal study in which they evaluated the long-term effects of inquiry-based learning that math scores of students who took part in inquiry-based learning are better than students who did not. Under the light of the studies stated above, the result obtained in this study is in a way to support these findings.

According to another result obtained in this study, there is a significant positive correlation between watching a science program for kids and inquiry learning skills towards math of middle school students. This result of the study supports İnel Ekici (2017). When we consider the age group of the learners, it is thought that the effect of attractive TV programs which use colourful animations that will arise one's curiosity in their contents can be a reason for the positive correlation between a kid's program about science and their inquiry learning skills. Doğan and Göker (2012) also found in their studies that students have benefits from thematic TV channels in terms of having fun, getting information, and their education. On the other hand, it is thought that as science programs for children use high technology in terms of content and provide an enriched discussion environment, they have a positive contribution to improving students' inquiry learning skills towards math. Indeed, it is stated that well-designed computer tools support students' learning and thinking for the scientific inquiry process (Kim, Hannafin, & Bryan, 2007). Computer modelings can be used as a powerful tool to help students to understand (Löhner, Van Joolingen, Savelsbergh, & Van Hout Wolters, 2005). Within this framework, scientific TV programs for kids can be prepared with computer modeling and so inquiry skills of the students can be improved. Because, computer systems give chances for students to check their learning and help them to focus on the learning process in a better way (Bell, Urhahne, Schanze, & Ploetzner, 2010). It is predicted that students who follow science children's programs online will develop easier inquiry skills both in terms of being responsible for their own learning and in terms of being in a close connection with technology.

The last result of the study is whether or not there is a correlation between following a scientific magazine regularly and inquiry learning skills towards math of middle school students. This result is not parallel with İnel Ekici (2017). It is thought for the reason of this situation that today students are more inclined to watching visuals to reading texts. Aksaçlıoğlu and Yılmaz (2007) stated in their studies that students prefer reading books as their last choice in their free time when it is compared to activities like watching TV and using computers. Their first two choices are using computers and watching TV for their free time. Again, in the study, it is also stated that students do not find reading as attractive as the other free-time activities. From this, it can be said that students are at the desired level in terms of getting information by reading a scientific book, inquiring, and structuring this information, making evaluation and analysis about the subjects mentioned in the book.

The following points could be suggested within the scope of the findings and results:

- The activities could be observed by designing enriched learning environments improving students' inquiry learning skills for math depending on their grade-levels.
- The results of the qualitative studies about how and why gender affects students' mathematical inquiry skills could be examined.
- Within the scope of the lessons or courses, students could be asked to have discussions to inquire cause and effects of the results of their activity after reading scientific books and summarizing them.
- The parents could be encouraged to watch scientific programs on TV together with their children and to discuss the content of the program with their children after being informed during the parents' meeting.
- Having scientific magazines for kids at school libraries in order for school children to be able to follow them regularly could be provided so that teacher could use them while assigning homework and they could give one of their written exam scores based on their homework that they have done.
- Families are required to infuse their children with the habit of reading books and magazines. Today, technology has an important place and again children can acquire reading habits with the help of technology. We can contribute to the improvement of inquiry skills of children by using e-readers to increase their reading habits.

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Appendix 1. Inquiry Learning Skills Scale towards Math (ILSSM)

	Dear students, Please do not forget that the expression of "problem" used in the sentences of this scale is meant for math problems. Your answers will be used for a scientific research and they will not have an influence on your marks. Besides, the answers of each sentence may vary from person to person, so giving sincere responses after reading the questions is very important for the research. After you read each sentence, please put an (X) under the option which you think is suitable for you and try not leaving any sentences without a response. Thank you very much for your cooperation and interest. ☺	**Strongly Disagree**	**Disagree**	**Neither Agree Nor Disgare**	**Agree**	**Strongly Agree**
1.	I do research for the topics that I cannot learn.					
2.	After solving a problem, I argue with my friends to decide the accuracy of the solution.					
3.	When I cannot pose a problem shortly, I give up trying.					
4.	I want to find a solution to the problems I got confused by doing research.					
5.	When I solve a problem, I can do the explanation of the solution.					
6.	While posing a problem, I do not try to use scientific methods.					
7.	I would like my teacher to ask me questions when s/he teaches a topic.					
8.	When I pose a problem, I cannot explain how I have posed that problem.					
9.	I look for solution methods to solve the problems which I encountered.					
10.	If I cannot get the predicted result, I review the problem which I have solved.					
11.	I check the correctness of the problem that I posed.					
12.	I do not think that I need to solve problems to learn math.					
13.	I use my previous knowledge in problem-solving.					
14.	I would like to do profound studies on the topics that I have learned in classes.					
15.	I do not search different resources in order to pose a problem.					
16.	I check up my knowledge to answer the questions asked by the teacher.					
17.	I give up when I cannot solve a problem.					
18.	I pose problems by using my prior knowledge.					
19.	After solving a problem, I do not need to prove the accuracy of the solution.					
20.	After solving a problem, I check the accuracy of the solution.					
21.	I do not check the things I have learned in class by using some other resources.					
22.	I do not need to prove the accuracy of a problem that I posed.					
23.	While looking for solution strategies to a problem I encountered, I do not make an effort using scientific methods.					
24.	I ask questions about the things that I cannot learn.					
25.	I do not use my prior knowledge when learning new topics.					