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Determination of the epistemological and ontological beliefs of secondary school students

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Abstract

The purpose of the study was to determine the epistemological and ontological beliefs of secondary school students concerning some demographic variables such as gender, class, education status of the mother, education status of the father, and the location where science activities are carried out (classroom/laboratory). The participants of the study were composed of 519 female and 510 male students at the 6th, 7th and 8th grades in five different public secondary schools in İstanbul, Turkey. In the study, which was conducted in 2014-2015 school year and reported in 2017, the relational screening model was utilized. The data collection tools comprised Epistemological Opinion Scale and Ontological Opinion Scale developed by Ünal-Çoban and Ergin (2008; 2010). The data were analysed via SPSS 21.0 statistical program. As a result of the data analysis, it was found that the epistemological and ontological beliefs of students were at moderate level and effective in some variables.

Keywords: Epistemological belief, ontological belief, secondary school students, science education

1. Introduction

One of the most important cognitive variables with impacts on learning-teaching processes are epistemological beliefs and are important for lifelong learning in addition to significant impacts on the acquisition and constructivism of knowledge in education (Hofer, 2001). Approaches on the nature of science are classified in two: the first is the

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scientific models and the ontology that is in accordance with their experimental counterparts, whereas the second is the epistemology that makes up the reliability of the explanations that comprise knowledge (Séré et. al. 2001). While epistemology as a branch of philosophy examines when knowledge is valid and which knowledge is considered as correct, ontology examines what exists in addition to issues such as what something expresses with its existence (Packer & Goicoechea, 2000). The scope of ontology and science education to define the conditions under which scientific entities emerge in addition to defining the beliefs they have in such issues (Eflin, Glennan & Reisch, 1999). In this regard, it is important that the ontological beliefs of students' progress in order for them to be able to understand epistemology. (Perner, 1991). In the study by William Perry (1970) university students believe that knowledge is absolute and certain (either correct or false); they believe that only the right information is created and transferred by experts. Whereas individuals who develop a pluralistic perspective over time believe that the knowledge of experts cannot be certain and that they have the right to form their own opinions (Hofer 2004). Belenky, Clinchy, Goldberger & Tarule (1986) carried out studies in which they reached similar results with studies by Perry (Whitmire, 2003; Deryakulu, 2004). Baxter-Magolda (1992) developed a model as a result of their studies carried out in a longitudinal manner which was based on the assumption that the epistemologies of students affect their interpretations. King & Kitchener (1994) developed a model as a result of studies carried out with a study group with a wide age interval (Buehl & Alexander, 2001; Hofer, 2001). In these studies, epistemological beliefs were handled in a single dimensional manner, that is encompassing only the beliefs related with knowledge (Aydemir, Aydemir & Boz, 2013). Schommer (1990) laid emphasis on how beliefs regarding the nature and acquisition of knowledge affect the way students approach learning thus putting forth a different dimension. He developed the Epistemological Beliefs Questionnaire as a result of the study carried out with university students for putting forth the epistemological beliefs and their factors. The scale is comprised of four factors which are; Simple Knowledge, Certain Knowledge, Quick Learning and Innate Ability (Schommer, 1990).

The results of the studies carried out attract attention to the importance of epistemological beliefs on education processes (Başbay, 2013). Students with advanced epistemological beliefs use more and more quality cognitive information processing strategies, have higher academic success, a more positive attitude towards school and can develop more complex, deeper and multi-dimensional thoughts (Deryakulu & Büyüköztürk, 2005). Individuals with undeveloped or immature epistemological beliefs are of the opinion that knowledge is simple, certain/unchangeable, that learning takes place quickly, that ability to learn is innate and that it cannot be developed afterwards (Buehl & Alexander, 2001). It is widely accepted that students understand the epistemology of science, the nature of science, and what scientific inquiry is, both for educational purposes and for its role in scientific understanding (Elby, Macrander & Hammer, 2016).

The nature of scientific literacy affects the judgments of individuals regarding their personal and social problems. Teachers strive in order to develop the skills of students as well as their interest in science so that they can understand the nature of science. The fundamental goal of science education which ensures that individuals are scientific literates also affects the world views of individuals (Lederman, Lederman & Antink, 2013). It has been a common goal of science educators for many years to teach the nature of science to the students (Reif & Larkin, 1991; Lederman, 1992; Driver, Leach, Millar & Scott, 1996; Abd-El-Khalick, Bell & Lederman, 1998; Hogan, 2000). The vision of the Science Course Curriculum put forth by the Ministry of National Education in Turkey (MEB, 2013) has been determined as making all students literate in science. The following points have been considered in studies carried out on the importance of scientific knowledge and why it should be learned (Sandoval, 2005): Creativity plays a very important. Cooperation and competition interact in the social structuring of scientific knowledge. The most important point related with scientific knowledge is that it can change with new studies and thoughts (Doğan, 2010).

The study focused on the epistemological and ontological beliefs of secondary school students with regard to certain demographic variables. In this regard, the research questions can be stated as in the following:

1. What are the epistemological and ontological beliefs of secondary school students?

2. Do the epistemological and ontological beliefs of secondary school students differ concerning respect to demographical variables such as: “gender”, “class”, “education status of the mother”, “education status of the father”, “location where science activities are carried out (classroom/laboratory)”?

3. Who conducts the science activities? Themselves, as a group or the teacher?

4. What is the frequency of science activities?

5. Do students like science activities or not?

2. Method

2.1. Research Model

In this study, which was conducted in 2014-2015 school year and reported in 2017, the quantitative research design and the relational screening model were utilized (Karasar, 2008).

2.2. Participants

The participants of the study were composed of 6th, 7th and 8th grade students from five different public secondary schools in İstanbul, Turkey. In this regard, the participants of the study consisted of: 352 (34.2%) 6th grade, 302 (29.3%) 7th grade and 375 (36.4%) 8th grade students with 519 (49.4%) females and 510 (50.6%) males for a total number of 1029 students.

2.3. Data Collection Tools

Data collection tool consists of three parts. The first part was comprised of: as the demographic characteristic of students, which are "gender", "class", "education status of the mother", "education status of the father", "location of science activities (classroom/laboratory)", "who the science activities are carried out with (by myself/as a group/teacher)", "frequency of science activities" and "whether students like science activities or not"; the second part comprised of the Epistemological Opinion Scale (EOS), and the third part included the Ontological Opinion Scale (OOS).
EOS is a 5-point Likert type scale developed by Ünal-Çoban & Ergin (2008) comprised of 16 items and 3 factors. Since the items of the first factor put forth that knowledge is certain, correct and authority based by reflecting the traditional understanding of science, this factor has been called "Scientific Knowledge is Closed (SKCL)". Since the items in the second factor include expressions on questioning, causality and experimenting which make up the justification process of scientific knowledge, this factor has been called as "Scientific Knowledge is Justified (SKJ)". Whereas, since the expressions in the third factor include opinions on the changeability of scientific knowledge, thought, this factor has been called as "Scientific Knowledge may Change (SKCH)". The reliability coefficient of the scale was determined as 0.75. OOS is a 5-point Likert type scale developed by Ünal-Çoban & Ergin (2010) comprised of 15 items with a structure of 5 factors which are "Scientific Study and Entities (SSE)", "True Correspondence of Scientific Studies (CSS)", "Scientific Entities (SE)", "Continuity of Entities (CE)" and "Reaching the Reality (RR)". The reliability coefficient of the scale has been determined as 0.75.

2.4. Data Analysis

SPSS 21.0 was used for data analysis. One-way ANOVA, Independent Group t-Test and Scheffe test have been used.

3. Results

Findings were examined within the framework of the answers given to the questions determined concerning the objective of the study. Scores that can be obtained from EOS range between 16-80. The scale total score was calculated as 52.379 at the end of this study (Table 1). Scores that can be obtained from OOS range between 15-75. The scale total score was calculated as 51.088 at the end of this study (Table 2) as in the following.

Table 1. EOS Descriptive Statistics

Factor	X	SS	SH_x	Min.	Max.
Scientific Knowledge is Closed	20.437	4.968	0.151	8	40
Scientific Knowledge is Justified	20.426	3.361	0.105	5	25
Scientific Knowledge may Change	11.515	2.306	0.075	3	15
EOS	52.379	5.923	0.189	16	80

Table 2. OOS Descriptive Statistics

Factor	X	SS	SH_x	Min.	Max.
Scientific Study and Entities	14.483	2.535	0.079	4	20
True Correspondence of Scientific Studies	14.731	2.636	0.082	4	20
Scientific Entities	7.747	3.070	0.095	3	15
Continuity of Entities	6.433	1.876	0.058	2	10
Reaching the Reality	7.692	1.747	0.054	2	10
OOS	51.088	7.013	0.218	15	75

As presented in Table 3 below, a statistically significant difference in favour of females was determined for the scale total score and “Scientific Knowledge is Justified” as a result of the independent group t-Test carried out for determining whether the EOS scores according to “Gender” variable ($p<0.05$). No statistically significant difference was determined between “Scientific Knowledge is Closed” and “Scientific Knowledge may Change” factor scores ($p>0.05$).

No statistically significant difference was determined as a result of the independent group t-Test carried out for the OOS scores according to “gender” variable ($p>0.05$). In addition, a statistical significance in favour of males was determined for the “Scientific Entities” and “Continuity of Entities” factors ($p<0.05$).

Table 3. Independent Group t-Test Results of the EOS Scores with Regard to the “Gender” Variable

	t-Test

Factor	Gender	N	X	SD	SH_x	T	Sd	P
Scientific Knowledge is Closed	Male	510	20.296	5.160	0.228	-0.903	1027	0.366
	Female	519	20.576	4.773	0.209			
Scientific Knowledge is Justified	Male	510	20.074	3.643	0.161	-3.348	1027	0.001
	Female	519	20.772	3.022	0.132			
Scientific Knowledge may Change	Male	510	11.515	2.236	0.099	0.009	1027	0.993
	Female	519	11.514	2.376	0.104			
EOS	Male	510	51.886	5.997	0.265			
	Female	519	52.863	5.813	0.255	-2.652	1027	0.008

As presented in Table 4 below, a statistically significant difference was determined according to the results of ANOVA applied the EOS total and factor scores of students vary statistically significantly concerning "class" variable (p<0.05).

Table 4. ANOVA Results for the EOS Total and Factor Scores with Regard to the "Class" Variable

N, X and SD Values					ANOVA Results					
Factor	**Class**	**N**	**X**	**SD**	**Var.K.**	**K.T.**	**SD**	**K.O**	**F**	**p**
Scientific Knowledge is Closed	6th	352	19.690	5.203	Between	355.194	2	177.597	7.28	0.001
	7th	302	20.503	4.844	Within	25026.013	1026	24.392		
	8th	375	21.085	4.755	Total	25381.207	1028			
	Total	1029	20.437	4.968						
Scientific Knowledge is Justified	6th	352	20.556	3.289	Between	91.459	2	45.729	4.072	0.017
	7th	302	19.970	3.752	Within	11522.251	1026	11.230		
	8th	375	20.672	3.052	Total	11613.710	1028			
	Total	1029	20.426	3.361						
Scientific Knowledge may Change	6th	352	11.565	2.331	Between	53.786	2	26.893	5.093	0.006
	7th	302	11.178	2.411	Within	5417.231	1026	5.280		
	8th	375	11.738	2.168	Total	5471.017	1028			
	Total	1029	11.515	2.306						
EOS	6th	352	51.812	5.428	Between	740.324	2	370.162	10.75	0.000
	7th	302	51.653	5.859	Within	35325.862	1026	34.431		
	8th	375	53.496	6.258	Total	36066.187	1028			
	Total	1029	51.812	5.923						

Scheffe test was selected since the group variances were not determined to be homogeneous (L=3.949, L=0.854, L=6.056, L=3.243, p>0.05) according to the Levene's test results applied after ANOVA in order to determine between which sub-groups the EOS scores differ concerning the "Class" variable. When the EOS Scheffe test scores of the students were examined, it was observed that the "Scientific Knowledge is Closed" scores of 8th grade students were higher at a statistically significant level than those of 6th grade students; that the "Scientific Knowledge is Justified" and "Scientific Knowledge may Change" scores of 8th grade students were higher at a statistically significant level than those of the 7th grade students; that the scores of 8th grade students obtained from the EOS were higher at a statistically significant level in comparison with those of the 6th and 7th grade students.

No statistically significant difference was determined between the total scores according to the ANOVA results carried out the OOS total and factor scores students vary at statistically significant differences about the "Class" variable or not (p>0.05). However, a statistically significant difference was determined (p<0.05) between the factors of "Scientific Study and Entities", "True Correspondence of Scientific Studies", "Continuity of Entities" and "Reaching the Reality". Since the group variances were not determined to be homogeneous according to the results of the Levene's test applied after ANOVA for determining between which sub-groups (L=4.263, L=0.474, L=0.019, L=0.854, L=6.532, L=8.535, p<0.05), Scheffe test was selected. When the OOS Scheffe test scores were examined, it was observed that the "Scientific Study and Entities" factor scores of 6th grade students were higher than those of the 7th and 8th grade students, "True Correspondence of Scientific Studies" factors scores of the 8th grade students were higher than those of the 6th and 7th grade students, "Continuity of Entities" factor scores of the 6th grade students were higher than those of the 8th and "Reaching the Reality" factor scores of 6th grade students were higher than those of the 7th and 8th grade students at a statistically significant level.

A statistically significant difference was determined (p<0.05) as a result of the ANOVA results applied the EOS total and factor scores of students vary concerning the "Education Status of the Mother" variable (Table 5).

Table 5. ANOVA Results for the EOS total and factor scores with Regard to the "Education Status of the Mother" Variable

	N, X and SD Values				ANOVA Results					
Factor	**School**	**N**	**X**	**SD**	**Var.K.**	**K.T.**	**SD**	**K.O**	**F**	**p**
Scientific Knowledge is Closed	Primary	310	19.893	4.911	Between	215.942	3	71.981	2.932	0.033
	Secondary	329	20.300	4.660	Within	25165.265	1025	24.551		
	High	310	20.954	5.251	Total	25381.207	1028			
	University	80	21.100	5.112						
	Total	1029	20.437	4.968						
Scientific Knowledge is Justified	Primary	310	20.474	3.329	Between	99.370	3	33.123	2.95	0.032
	Secondary	329	20.066	3.346	Within	11514.340	1025	11.234		
	High	310	20.554	3.429	Total	11613.710	1028			
	University	80	21.225	3.146						
	Total	1029	20.426	3.361						
Scientific Knowledge may Change	Primary	310	11.500	2.306	Between	53.675	3	17.892	3.385	0.018
	Secondary	329	11.310	2.236	Within	5417.342	1025	5.285		
	High	310	11.567	2.328	Total	5471.017	1028			
	University	80	12.212	2.406						
	Total	1029	11.515	2.306						
EOS	Primary	310	51.867	5.765	Between	766.732	3	255.577	7.421	0.000
	Secondary	329	51.677	5.292	Within	35299.455	1025	34.438		

High	310	53.077	6.121	Total	36066.187	1028
University	80	54.537	7.346			
Total	1029	52.379	5.923			

Since the group variances were not determined as homogeneous (L=4.443, L=1.249, L=0.256, L=0.283, p>0.05) as a result of the Levene's test results applied after ANOVA for determining between which sub-groups the EOS scores vary concerning the "Education Status of the Mother" variable, Scheffe test was selected. When the EOS Scheffe test scores of the students were examined, it was observed that the "Scientific Knowledge is Closed" scores of the children of mothers who are high school and university graduates were higher at statistically significant levels in comparison with the children of mothers who are primary and secondary school graduates; that the "Scientific Knowledge is Justified" scores of the children of mothers who are high school graduates were higher at a statistically significant level in comparison with those of the children whose mothers are secondary school graduates and that the scores of children whose mothers are university graduates were higher at statistically significant levels in comparison with the scores of children whose mothers are primary and secondary school graduates; that the "Scientific Knowledge may Change" scores of children whose mothers are university graduates were higher at statistically significant level in comparison with the scores of children whose mothers are secondary school graduates. When the EOS Scheffe test scores of the students were examined, it was observed that the scores of children whose mothers are high school graduate mothers were higher at statistically significant levels in comparison with the scores of children whose mothers are secondary school graduates and that the scores of children whose mothers are university graduates were higher at statistically significant levels in comparison with the scores of children whose mothers are primary and secondary school graduates.

No statistically significant difference was determined according to the ANOVA results carried out there are any statistically significant differences between the OOS total and factors scores of students concerning the "Education Status of the Mother" variable (p>0.05).

As presented in Table 6 below, whereas a statistically significant difference was determined for the scale total score with regard to the "Scientific Knowledge is Justified" and "Scientific Knowledge may Change" factors according to the results of the ANOVA applied for determining whether the EOS total and factors scores displayed any statistically significant difference with regard to the "Education Status of the Father" variable or not (p<0.05), no statistically significant difference was determined for the "Scientific Knowledge is Closed" factor (p>0.05).

Table 6. ANOVA Results for the EOS Total and Factor Scores According to the "Education Status of the Father" Variable

	N, X and SD Values						**ANOVA Results**			
Factor	**School**	**N**	**X**	**SD**	**Var.K.**	**K.T.**	**SD**	**K.O**	**F**	**p**
Scientific Knowledge is Closed	Primary	235	20.025	4.607	Between	167.361	3	55.787	2.268	0.079
	Secondary	316	20.098	4.856	Within	25213.846	1025	24.599		
	High	326	20.800	5.091	Total	25381.207	1028			
	University	152	21.000	5.393						
	Total	1029	20.437	4.968						
Scientific Knowledge is Justified	Primary	235	20.051	3.396	Between	131.917	3	43.972	3.925	0.008
	Secondary	316	20.221	3.547	Within	11481.793	1025	11.202		
	High	326	20.558	3.193	Total	11613.710	1028			
	University	152	21.151	3.155						
	Total	1029	20.426	3.361						
Scientific Knowledge may Change	Primary	235	11.229	2.338	Between	102.143	3	34.048	6.5	0.000
	Secondary	316	11.322	2.238	Within	5368.874	1025	5.238		
	High	326	11.592	2.363	Total	5471.017	1028			
	University	152	12.190	2.146						
	Total	1029	11.515	2.306						
EOS	Primary	235	51.306	5.154	Between	1134.229	3	378.076	11.1	0.000
	Secondary	316	51.642	5.736	Within	34931.957	1025	34.080		
	High	326	52.950	5.652	Total	36066.187	1028			
	University	152	54.342	7.263						
	Total	1029	52.379	5.923						

Since the group variances were not determined as homogeneous (L=6.126, L=1.434, L=1.404, L=1.646, p>0.05) according to the Levene's test values carried out after the ANOVA for determining between which sub-groups there are differences for the EOS scores with regard to the "Education Status of the Father" scores, Scheffe test was selected. When the EOS Scheffe test scores of the students were examined, it was determined that the "Scientific Knowledge is Justified" and "Scientific Knowledge may Change" scores of children whose fathers are university graduates were higher at a statistically significant level in comparison with those of the children whose fathers are primary and secondary school graduates and that the EOS scores of children whose fathers are high school and university graduates were higher at a statistically significant level in comparison with those of the children whose fathers are primary and secondary school graduates.

No statistically significant difference was determined between the scale total and factor scores according to the ANOVA results applied the OOS total and factor scores of students varied at statistically significant difference with regard to the "Education Status of the Father" variable (p>0.05).

No statistically significant difference was determined between the total and factor scores according to the ANOVA results applied the EOS and OOS total and factor scores of students varied at statistically significant difference concerning the "who the science activities are carried out with (by myself/as a group/teacher)" variable (p>0.05).

A statistically significant difference was determined between the groups concerning "Scientific Knowledge is Closed" and "Scientific Knowledge is Justified" factors according to the ANOVA results applied the EOS total and factor scores of students vary at a statistically significant level according to the "frequency of science activities" variable (p<0.05). Since the group variances were not determined as homogeneous (L=1.797, L=0.594, L=0.767, L=0.606, p>0.05) according to the Levene's test values carried out after the ANOVA for determining between which sub-groups there are differences, Scheffe test was selected. When the EOS Scheffe test scores of the students were examined, it was observed that the "Scientific Knowledge is Closed" scores of students who carry out frequently, rarely activities and who do not carry out any activities were always higher at a statistically significant level in comparison with the scores of students who are always carry out activities; that the "Scientific Knowledge is Justified" scores of students who carry out activities frequently were higher at a statistically significant level in comparison with the scores of students who carry out activities rarely and who do not carry out any activities.

No statistically significant difference was determined (p>0.05) as a result of the ANOVA results applied there is a statistically significant difference between the OOS total and factor scores of students with regard to the "frequency of science activities" variable.

A statistically significant difference was determined according to the ANOVA results applied the EOS total and factor scores of students vary "whether students like science activities or not" variable, "Scientific Knowledge is Closed" and "Scientific Knowledge is Justified" factors statistically significant ($p<0.05$). No statistically significant difference was determined with regard to the scale total score and the "Scientific Knowledge may Change" factor ($p>0.05$).

Since the group variances were not determined as homogeneous (L=4.488, L=14.824, L=4.211, L=12.005, $p>0.05$) according to the Levene's test values carried out after the ANOVA for determining between which sub-groups there are differences for the EOS scores with regard to the "Whether students like science activities or not" scores, Scheffe test was selected. When the EOS Scheffe test scores of the students were examined, it was determined that the "Scientific Knowledge is Closed" scores of children who state that they sometimes like science activities were higher at statistically significant level in comparison with those of the children who like science activities; that the "Scientific Knowledge is Justified" scores of children who state that they like science activities were higher at a statistically significant level in comparison with those of the children who state that they sometimes like science activities and those who state that they do not like science activities.

Statistically significant difference was determined between the groups concerning "Whether students like science activities or not" factor according to the ANOVA results applied for determining whether the OOS total and factor scores of students vary at statistically significant level among groups according to the "Scientific Study and Entities", "True Correspondence of Scientific Studies", "Scientific Entities" and "Reaching the Reality" factors ($p<0.05$). No statistically significant difference was determined with regard to the scale total score and the "Continuity of Entities" factor ($p>0.05$).

Since the group variances were not determined as homogeneous (L=2.681, L=4.049, L=1.037, L=2.533, L=0.269, L=1.564, $p>0.05$) according to the Levene's test values carried out after the ANOVA for determining between which sub-groups there are differences Scheffe test was selected. It was determined that the "Scientific Study and Entities" scores of children who state that they like science activities were higher at a statistically significant level in comparison with those of the children who state that they do not like science activities, that the "True Correspondence of Scientific Studies" and "Reaching the Reality" scores of children who state that they like science activities were higher at statistically significant level in comparison with the scores of students who state that they sometimes like science activities and that the "Scientific Entities" scores of students who state that they sometimes like science activities were higher at a statistically significant level in comparison with the scores of those who state that they like science activities.

4. Discussion and Conclusion

In this study, the epistemological and ontological beliefs of secondary school students in terms of some demographic variables were determined. The results of the study revealed that the epistemological belief levels of secondary school students were statistically at a moderate level. When the EOS factors used for determining the epistemological belief levels of students were examined, it was observed that the factor with the highest score was "Scientific Knowledge is Closed", which was followed respectively by "Scientific Knowledge is Justified" and "Scientific Knowledge may Change".

The fact that the "Scientific Knowledge is Closed" factor which includes items reflecting the traditional understanding of science that puts forth that knowledge is certain, correct and authority based indicating that scientific data always reach the correct results, that they are constant and that the results are certain expressing the belief that the same correct answers may be found continuously was higher in comparison with other factors may be indicated as an indicator for the result that the epistemological belief level of students is at a moderate level. Different results have been obtained in different studies. Özmusul (2012) carried out a study on 6th, 7th and 8th grade students in which the students mostly accepted the "Scientific Knowledge is Justified" factor when the other options in the scale are considered; whereas they agreed with the "Scientific Knowledge may Change" and "Scientific Knowledge is Closed" factor at a moderate level. Aydın & Geçici (2017) carried out a study on 6th grade students and Boz, Aydemir & Aydemir (2011) carried out a study on 4th, 6th and 8th grade students in which it was determined that the students have a moderate level epistemological belief with regard to the factors of the source of knowledge and the development of knowledge, whereas they had advanced epistemological beliefs with regard to the justification of knowledge factor.

In this study, the relationship between the epistemological beliefs of students with the "Gender" variable was also examined and statistically significant difference in favour of females was found for the scale total score and the "Scientific Knowledge is Justified" factor. Topçu & Yılmaz-Tüzün (2009) carried out a study with primary school students in which it was put forth that girls had more advanced epistemological beliefs in comparison with boys. Kurt (2009) and Boz, Aydemir & Aydemir (2011) determined that female students have stronger beliefs regarding, source and certainty the accuracy of the knowledge. Balantekin (2013) carried out a study on 6th, 7th and 8th grade students in which statistically significant difference in favour of female students was determined for the scores obtained from the "Scientific Knowledge is Justified" factor. In addition, it was put forth as a result of the study carried out by Sadıç, Çam & Topçu (2012) on primary school 4th, 6th and 8th grade students for determining the epistemological beliefs that males had more advanced epistemological beliefs for the justification, certainty and source of knowledge in comparison with female students. Özkal, Tekkaya, Sungur, Çakıroğlu & Çakıroğlu (2010) carried out studies in which it was put forth that the perspective regarding the changeability of scientific knowledge is more common among male students in comparison with female students. Tüken (2010) aimed to determine the philosophical opinions on science and scientific knowledge with regard to the traditional and constructivist context and no statistically significant difference was determined between the female and male students for the "Scientific Knowledge may Change" factor. Conley, Pintrich, Vekiri & Harrison (2004) carried out a study on primary school students in which no statistically significant difference was determined between the gender and epistemological beliefs of students. Similarly, Özmusul (2012), Yankayış, Güven & Türkoğuz (2014), Yiğit, Alev, Akşan & Ursavaş (2010) carried out studies in which no statistically significant differences were determined between gender and the opinions on scientific knowledge.

As a result of the analysis concerning the relationship between the epistemological belief of students and the "Class" variable showed that the scale total score and all factors scores of 8th grade students were higher at statistically significant level in comparison with those of the 6th and 7th grade students. Balantekin (2013) carried out a study in which a statistically significant difference in favour of the 7th and 8th grade students were determined for the "Scientific Knowledge is Closed" sub-factor. A similar result was determined in the study by Kurt (2009) on 6th, 8th and 10th grade students. It was put forth as a result of the study that students in the 10th grade have stronger epistemological beliefs in comparison with the students in 6th and 8th grade. Yankayış, Güven & Türkoğuz (2014) carried out studies in which no statistically significant difference was determined between the scores obtained from the "Scientific Knowledge may Change" factor and class of students. Yeşilyurt (2013) carried out a study for examining the epistemological beliefs of students in 7th and 8th grades in which statistically significant difference was not determined between the classes of the students and their epistemological beliefs. Boz, Aydemir & Aydemir (2011) carried out studies in which they compared the class levels of students in 4th, 6th and 8th grade with their epistemological beliefs thus putting forth according to the findings that the beliefs of students regarding the formation and justification of knowledge become underdeveloped with increasing class level.

In the study the relationship between the epistemological beliefs of students and the "Education Status of the Mother" were examined and statistically significant difference was found between the EOS score and the "Scientific Knowledge is Justified" and "Scientific Knowledge may Change" factors. It was observed that the scores of students whose mothers were high school and university graduates were higher at statistically significant level in comparison with the scores of students whose mothers were primary and secondary school graduates. The items in the "Scientific Knowledge is Justified" factor which is related with the justification process of scientific knowledge including asking questions, causality and experimentation include opinions on the changeability of scientific knowledge and thought. In this regard, it can be stated that the children of mothers who are high school and university graduates have more advanced epistemological beliefs. Yankayış, Güven & Türkoğuz (2014) carried out studies in which a statistically significant difference was determined between the EOS total and "Scientific Knowledge is Closed" factor.

The result of the relationship between the epistemological beliefs of students and the "Education Status of Father" variable revealed that the "Scientific Knowledge is Justified" and "Scientific Knowledge may Change" scores of children whose fathers were university graduates were higher in comparison with the scores of children whose fathers were primary and secondary school graduates and that the Opinion Scale for Scientific Knowledge total scores of children whose fathers were high school and university graduates were higher in comparison with the scores of children whose fathers were primary and secondary school graduates. Özmusul (2012) carried out a study on the 6th, 7th and 8th grade students in which it was put forth that there is statistically significant difference in favour of children whose fathers are university graduates between the education status of the father and the scores they received from "Scientific Knowledge is Closed" and "Scientific Knowledge is Justified" factors.

The relationship between the epistemological beliefs of students and the "location where science activities were carried out (classroom/laboratory)" revealed no statistically significant difference between the groups. Tsai (1999) examined how the learning activities carried out at the laboratory vary with regard to the epistemological beliefs of 8th grade students. It was put forth as a result of the study that the students carry out the activities in the classroom step by step as given in the textbooks instead of carrying out the activities with an understanding for science in the laboratory environment and that they consider the activities carried out as auxiliaries to the memorizing of the scientific concepts. In addition, it has also been put forth that students with a high epistemological belief who carry out activities in the laboratory environment discuss the results of the experimental studies afterwards, that they consider the laboratory environments as a good guidance for the individual and that they prefer free education environments focused more on learning.

The relationship between the epistemological beliefs of students and the "who do the science activities are carried out with (by themselves/as a group/teacher)" variable was examined as a result of which it was determined that only the "Scientific Knowledge is Justified" scores of students who carry out the activities as a group were higher at statistically significant level in comparison with those of the students for whom activities are carried out by the teacher. The relationship between the epistemological beliefs of students and the "Frequency of Science Activities" variable was examined and it was determined that the "Scientific Knowledge is Closed" scores of students who carry out activities rarely and never were higher at a statistically significant level in comparison with the scores of students who carry out activities frequently and always; and that the "Scientific Knowledge is Justified" scores of students who carry out scientific activities always and frequently were higher at a statistically significant level in comparison with those of the students who carry out activities sometimes and never.

The relationship between the epistemological beliefs of students and "whether students like science activities or not" variable was examined and it was determined that the "Scientific Knowledge is Closed" scores of students who indicated that they sometimes like activities were higher at a statistically significant level in comparison with those of the students who state that they like science activities; and that the "Scientific Knowledge is Justified" scores of students who state that they like science activities were higher at a statistically significant level in comparison with the scores of students who indicated that they sometimes like science activities as well as those of the students who indicated that they do not like science activities. Güneş, Şener-Dilek, Hoplan & Güneş (2012) carried out studies in which they examined whether the students like laboratory courses or not. It was determined that the students like almost all kinds of experiments and laboratory activities.

Evcim, Turgut & Şahin (2011) carried out a study with 8th grade students in which they determined statistically significant relationships between the epistemological beliefs of students and their skills for solving daily life problems. In the direction of this relationship; the researchers put forth that students with advanced epistemological beliefs indicating that they have been able to form an understanding on the constructivism and evaluation processes for knowledge will be able to display effective skills in generating solutions to problems. Also, studies indicate that epistemological beliefs affect students' efforts, successes and performances (Buehl & Alexander, 2001; Cano & Cardella-Elawar, 2004).

It was observed the ontological belief levels of the students included in the study were at moderate levels. When the OOS factors used for indicating the belief levels of students regarding the existence of scientific knowledge, it was observed that the highest scores were obtained for the factors of "Scientific Study and Entities", "True Correspondence of Scientific Studies". It was determined in the study that there were statistically significant differences between the class, education status of the father and whether they like science activities or not variables in the OOS scores of students. When these variables were examined with regard to factors: statistically significant differences were determined in the variables of the "Scientific Entities" factor, for gender (in favour of males) and whether students like science activities or not (in favour of students who like science activities); in the variables of the "Scientific Study and Entities" factor for class (in favour of the 6th grade) and whether they like activities or not; in the variables of the "True Correspondence of Scientific Studies" factor in the class (in favour of the 8th grade) and whether students like activities or not (in favour of students who like activities) variables; in the variables of the "Continuity of Entities" factor for gender (in favour of males) and class (in favour of the 6th grades) variables; in the variables of the "Reaching the Reality" factor for class (in favour of the 6th grade) and whether students like activities or not (in favour of the students who like activities). In addition, no statistically significant difference was determined for the scale total score and all factors between the education status of the mother and the father, location where the activities are carried out (classroom/laboratory) and who science activities are carried out with (by themselves/as a group/teacher) variables. It can be observed as a result of a general examination that there are statistically significant differences between the gender, class and liking activities variables of the "Scientific Study and Entities", "True Correspondence of Scientific Studies", "Scientific Entities", "Continuity of Entities" and "Reaching the Reality" factors. The items in the "Scientific Study and Entities" factor are related with the fact that scientific studies are related with existing things and the fact that scientists try to reach realities by making experiments and observations; the items in the "True Correspondence of Scientific Studies" factor are related with the fact that the entities put forth by scientific studies (either visible or not) exist in reality and that these entities have a correspondence in real life; the items in the "Scientific Entities" factor are related with entities on which scientific studies are carried out on either visible or not; the items in the "Continuity of Entities" factor are related with the fact that the entities that are the subjects of studies do not change even when scientific studies change; whereas the expressions in the "Reaching the Reality" factor are related with understanding reality in scientific studies.

Concerning the reason why there were no statistically significant differences between whether activities are carried out in class or in the laboratory; when it is considered that about two-thirds of the participants who are enrolled at the classes where this study took place carry out activities rarely and that the remaining one third never carries out any activities, it can be stated that students do not have important opinions regarding where the activities are carried out. Concerning the reason why there is a statistically significant difference between who carries out the activities (themselves/teachers/as a group), when it is considered that almost half of the activities are carried out by the teacher despite the low frequency of activities, it can be stated that students do not have important opinions regarding who the activities are carried out by. It was observed in this study that the epistemological and ontological beliefs of students are at moderate levels. Epistemological and ontological beliefs are affected from many variables such as gender, class, personal characteristics, teaching approaches, learning habits, socio-economic level, teaching skills of the teacher etc. When a consideration is made from the perspective of the constructivism as an understanding supporting the students to have epistemological and ontological beliefs; it was observed that that the students who participated in this study have a traditional scientific knowledge understanding even though the Science Education programs in our country have been renewed according to constructivist approach (MEB, 2005) starting from 2004 and according to inquiry based approaches starting from 2013 (MEB, 2013). Besides, it is expected that the science teachers who will teach the science course should carry out the teaching activities in accordance with the renewed science education programs. It was thought that the reason why the epistemological and ontological beliefs of students who participated in this study were at moderate levels may be due to the lack of sufficient use of the constructivist and inquiry approaches. In addition, the most important factors for the development of the epistemological and ontological beliefs in science education are laboratories and activities applied in laboratories. Constructivism and inquiry approach-based education is carried out as student-centered by way of activities. The fact that two-thirds of the students who participated in the study do not use laboratories in addition to the fact that the environment where the activities take place as well as by whom the activities are carried out do not have statistical significance supports the opinion that constructivism and inquiry-oriented instruction approaches are not used sufficiently in science education. Concerns regarding the failure to complete the education program on time may be considered as one of the reasons why the teachers cannot sufficiently apply the constructivism and inquiry-oriented instruction approaches. In addition, it is pleasing that majority of the students indicated that they enjoy activities and that education carried out via activities are adopted by the students. Smith, Maclin, Houghton & Hennessey (2000) carried out studies with primary school students in which findings were related which indicate that students may develop their epistemological beliefs by way of participating in science programs supported by scientific knowledge. In the study conducted by Lin & Chan (2018) with 5th grade students, it was shown that students predicted their conceptual understanding beyond their previous understanding of science as a result of examining their conceptual epistemic understanding. Constructivism and inquiry-oriented instruction methods which are among the most important factors for students having advanced epistemological and ontological beliefs have to be applied effectively by teachers. It is apparent within the scope of the application that awareness should be increased regarding the importance of laboratory use and carrying out activities in laboratories. The awareness of teachers should be increased in this matter.

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