


## QUANTITATIVE RESEARCH ON GIFTED STUDENTS' SCIENTIFIC EPISTEMOLOGICAL BELIEFS

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*This study explores the scientific epistemological beliefs of gifted students. It attempts to investigate gender, age and grade level-based differences in scientific epistemological beliefs. The study group comprised 120 gifted students (67 girls, 53 boys). To determine the scientific epistemological beliefs of these students, the Scientific Epistemological Beliefs Survey was employed. The results reveal that while the average scores of fifth and sixth-grade students were close to each other, the highest mean epistemological beliefs score was at the seventh and eighth-grade levels. Thus, there is a positive change in the scientific epistemological beliefs of gifted students who receive more science education. Statistically, the results showed that the difference between the epistemological beliefs scores of the female and male students was not statistically significant.*

**KEYWORDS:** Age, Belief, Gender, Gifted Students, Grade

### INTRODUCTION

It is thought that science is formed and progressed with the development of scientific knowledge and individuals' understanding of scientific knowledge. Therefore, learning science will help them understand the world, think scientifically in the face of events, and understand the critical perspectives of scientists (Ugulu, 2020). For this reason, educating individuals who research, question and understand and produce scientific knowledge is considered among the most basic objectives of educational institutions of modern societies (Yorek, Ugulu, & Aydin, 2016). These targets have also been included in the educational programs of the countries (Erkol & Ugulu, 2014). The general objectives of these curriculums are to enable individuals to transfer their theoretical knowledge and what they have learned to their daily life, to be able to think

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inquiring and critical, to interpret cause-effect relationships, to be able to renew themselves by following scientific and technological developments, to be able to make interdisciplinary connections, to be able to consider the importance of ethical values in practice, and to be able to contribute to the development of science by putting forward ideas [Turkey Ministry of Education \(2019\)](#).

Scientific epistemological beliefs, which play an important role in the formation of an information society, include individuals' beliefs about what science is, its characteristics, methods and how science should be taught. Scientific epistemological beliefs also reflect individuals' philosophical understanding of what science and valid-reliable scientific knowledge are, how it is produced and how it is shared. Interest in scientific epistemological beliefs has arisen with the change in the perspective of scientists in the scientific process ([Yorek et al., 2016](#)). In this process, from the traditional empirical understanding of science, which tries to exclude the subjective perspectives of scientists from the scientific processes and which is based on reproducible observations and controlled experiments, a new understanding of science that does not ignore the individual characteristics of the scientists and the place of their culture in the scientific process has emerged ([Pomeroy, 1993](#)). Scientific epistemological beliefs reflect the subjective perspectives of individuals about these two extremes of science and have emerged as a variable that educators have shown great interest in in recent years. It is observed that the effects of teachers 'and students' scientific epistemological beliefs on learning and teaching processes are frequently subject to research ([Hashweh, 1996](#); [Pomeroy, 1993](#); [Tsai, 2000](#)).

[Perry \(1970\)](#), who carried out one of the first studies examining the epistemological development of individuals, received student opinions on subjects such as the nature of knowledge, learning, the role of the student and the teacher in the learning process in an interview study conducted to determine the cognitive development of university students. According to the research findings, the cognitive development of university students consists of various stages ([Aydin & Gecici, 2017](#)). Intellectual and Ethical Development Model, which was established in line with the results of this research by [Perry \(1970\)](#), has been a reference point for many subsequent studies ([Baxter & Magolda, 1992](#)) ([King & Kitchener, 1994](#); [Kuhn, 1991](#)). However, in most of the models created after this model, epistemological beliefs are dealt with in a one-dimensional manner and only to cover beliefs related to knowledge. [Schommer \(1990\)](#), evaluating the results of the past studies, argued that considering epistemological beliefs under a single dimension (such as knowledge, intelligence, learning) is an inadequate approach and suggested that epistemological beliefs should be considered as a multidimensional structure. After the widespread acceptance of the multidimensional structure of epistemological beliefs, the number of studies on epistemological beliefs increased and the factors affect-

ing this structure of epistemological beliefs were investigated. The main factors affecting the development of epistemological beliefs in individuals can be considered as mental development, age, family structure, education and the culture in which they live (Aydin & Gecici, 2017).

Students with advanced epistemological beliefs use more qualified cognitive information processing strategies in the learning process, control their level of metacognitive teaching materials more often and accurately, have higher academic achievements, have more positive attitudes towards school and develop more complex, deep and multifaceted ideas (Baltaci, Yildiz, & Ozcakil, 2016). In this respect, it is expected that gifted students have more epistemological beliefs than mainstream students. Gifted students have different learning characteristics than mainstream students, which should be considered when planning teaching and curriculum (Sak et al., 2015; Ugulu, 2015b). For example, they often have a deeper and wider knowledge base than their peers of the same age. Intellectually, they are more inquisitive and often ask more questions than a teacher must deal with during a school day. In addition, they often learn more quickly and can absorb greater amounts of information than their peers Ugulu (2019).

Schommer and Dunnell (1994) compared gifted and non-gifted students' beliefs about the nature of knowledge. An epistemological questionnaire was administered to 1165 high school students, assessing students' beliefs about stable learning ability, simple knowledge, rapid learning, and precise knowledge. It was determined that there was no difference in the epistemological beliefs of the students at the beginning of high school. At the end of high school, it was determined that the probability of gifted students believing in simple knowledge and fast learning decreased and the beliefs of non-gifted students in simple knowledge and fast learning remained stable. In terms of gender, men were more likely to believe in the fixed ability and quick learning.

Schommer and Dunnell (1997) examined gifted students' beliefs about the nature of knowledge, learning, and epistemological beliefs and how these beliefs relate to problem-solving and academic performance. In the study conducted with 69 gifted high school students, descriptive statistics performed on the epistemological questionnaires filled out by the students revealed significant variability in the students' epistemological beliefs. Regression analyses showed that the more students believe that their ability to learn is inherently stable, that learning is rapid or non-existent, and that knowledge is immutable, the more likely they are to write overly simple and unalterable solutions. Analysis of variance showed that students who performed below academic expectations were more likely to believe that learning ability was fixed at birth.

Donmez and Yucel (2020) examined the relationship between gifted

students' STEM attitudes and scientific epistemological beliefs. The sample of the research consists of 105 gifted students. In the analysis of the data obtained in the study, a descriptive survey model and non-parametric tests, which are among the quantitative research methods, were used. As a result of the research, it has been seen that gifted students have scientific epistemological beliefs in advanced knowledge generation, reasoning, and knowledge variance, and they have traditional epistemological beliefs in their sub-dimensions. It has been determined that authority-accuracy and source of information and STEM attitudes have low averages in mathematics and science dimensions.

## GIFTED EDUCATION IN TURKEY

Educational models on gifted education in Turkey can be divided into three groups as special schools, special classes, and after-school programs. While science high schools, sports high schools and conservatories can be given as an example for special schools, Gifted Education Programs, and Science and Art Centers (SACs) can be shown as examples for after-school programs. Special classes for gifted students are available only in private sector schools (Sak et al., 2015).

One of the major problems existing in the education of gifted students in the national education system in Turkey is the issue of flexibility. For example, according to National Education legislation, gifted students can only skip one class during their entire school year and the education system does not offer them the opportunity to take courses from universities or upper classes (Sak, 2013). Therefore, the opportunities created for the development of gifted students attending regular classes are not sufficient. Therefore, after-school programs and especially SACs play an important role in the education of gifted students (Ugulu, 2015b).

After-school programs are educational programs for gifted students in school or outside school hours, in addition to their school schedule (Ugulu, 2019). The research and education centres on university campuses, the SACs, which are run by the Ministry of National Education and widely used throughout the country, and the centres run by the private sector, are the leading after-school programs for gifted students in Turkey (Sak et al., 2015).

## SCIENCE AND ART CENTRES

Science and Art Centers (SACs), which were established in 1995 to develop their potential by educating gifted students in primary, secondary, and high schools in the period remaining from normal education, are currently the

country-wide after-school program model. As of 2019, there are 139 SACs in various provinces and districts of Turkey ([Turkey Ministry of Education , 2019](#)). The SAC model aims to provide gifted students with enriched programs at extracurricular hours without separating them from their normal peers. In SACs, students from various grades are educated on certain days of the week except for formal education. In these centres, gifted students mostly work on social and scientific projects and produce solutions to real-life problems ([Karabulut, 2010](#)).

## OBJECTIVES OF THE STUDY

It is known that students with a higher scientific background and literacy level are more successful in making decisions. In this respect, it is of utmost importance to ensure the active participation of gifted individuals, who are defined as the most important human resources of a country, in all scientific processes. Relevant literature was examined but a scientific study to determine the epistemological beliefs of gifted students in Turkey could not be found. In this direction, the main objective of this study is to explore the scientific epistemological beliefs of gifted students. An additional objective of this study was to investigate gender, age and grade level-based differences in gifted students' scientific epistemological beliefs.

## HYPOTHESES OF THE STUDY

This study intended to investigate the following hypotheses:

H1: There exists no significant difference between gifted students of different grades concerning scientific epistemological beliefs

H2: There exists no significant difference between gifted students of different ages concerning scientific epistemological beliefs

H3: There exists no significant difference between girls and boys gifted students concerning scientific epistemological beliefs

## RESEARCH DESIGN

This study is a descriptive one-shot survey model to determine the scientific epistemological beliefs of gifted students and to determine whether these attitudes differ according to gender, age and grade variables (Yorek et al., 2010a, b).

SAMPLE OF THE STUDY

The study group of the research comprised 120 gifted students (67 girls, 53 boys) studying at Manisa Science and Art Centre. The distribution of these students according to their class levels and age groups is presented in Table 1 and Table 2.

**Table 1**  
**Distribution Of Students According to Gender and Age Levels.**

		10		11		12		13	
		f	%	f	%	f	%	f	%
Gender	Girls	1	100	20	57.1	31	57.4	15	50.0
	Boys	-	-	15	42.9	23	42.6	15	50.0
Total		1	100	35	100	54	100	30	100.0

**Table 2**  
**Distribution Of Students According to Grades.**

	5 <sup>th</sup> Grade	6 <sup>th</sup> Grade	7 <sup>th</sup> Grade	Total
f	45	34	41	120
%	37.5	28.3	34.2	100

DATA COLLECTION TOOL

In the research, the Scientific Epistemological Beliefs Survey developed by [Pomeroy \(1993\)](#) and adapted to Turkish by [Deryakulu and Bikmaz \(2003\)](#) was used. The survey, which consisted of 50 items, was reduced to 30 items at the end of the Turkish adaptation process. In the scale consisting of 30 items, participants were asked to evaluate themselves on a four-point Likert scale ranging from "1 = I do not agree" to "4 = I agree". In addition, in the personal information form of the test, there are questions about the independent variables such as the names, surnames, genders and grades of the participants ([Yorek, Aydin, Ugulu, & Dogan, 2008](#)).

The scale shows a two-pronged structure that reflects individuals' understanding of science. Of the 30 items on the scale, 22 items reflecting the traditional understanding of science are positive (+) and 8 items reflecting the non-traditional understanding of science are coded in the negative (-) direction. [Deryakulu and Bikmaz \(2003\)](#) found that Cronbach's alpha reliability

coefficient of the Scientific Epistemological Beliefs Survey was 0.91 ( $\alpha=0.91$ ). Considering the results obtained from gifted students in this study, the consistency among the items in the scale was re-examined and the Cronbach alpha reliability coefficient of the scale was determined as 0.82 ( $\alpha=0.82$ ). The values explained about the reliability of the Scientific Epistemological Beliefs Survey are indicated as appropriate values for determining the students' scientific epistemological beliefs [Deryakulu and Bikmaz \(2003\)](#) .

## RESULTS OF THE STUDY

Determining the scientific epistemological beliefs of gifted students is important in terms of evaluating the students' views on science and the factors affecting their participation in scientific processes. In this section, the average scores obtained from the Scientific Epistemological Beliefs Survey by gifted students and the statistical analysis of these scores are presented.

The responses of the gifted students in the research group to the Scientific Epistemological Beliefs Survey were evaluated and it was determined that the students reached an average score of 85.78 on a scale of 120 points (Table 3). These values range from a minimum of 73 points to a maximum of 105 points. The average scores of the students for the "The traditional understanding of science" subdimension were found to be 70.4 out of 88, and 15.38 out of 32 for the "The non-traditional understanding of science" subdimension.

**Table 3**

**Scientific Epistemological Beliefs of Gifted Students.**

Scale-Subscale	N	Item No.	Mean	SD	Max.	Min.
Scientific Epistemological Beliefs Survey	120	30	85.78	4.87	105.00	73.00
The Traditional Understanding of Science	120	22	70.40	6.10	88.00	48.00
The Non-Traditional Understanding of Science	120	8	15.38	2.95	25.00	8.00

**Hypothesis 1: There exists no significant difference between gifted students of different grades concerning scientific epistemological beliefs.**

When the survey scores of gifted students were examined according to their grade levels, the mean scores of fifth-grade students were 83.80; the mean

scores of the sixth-grade students were determined to be 85.61 and the mean scores of the seventh-grade students as 88.09 (Table 4). While the average scores of fifth and sixth-grade students were close to each other, the highest mean epistemological beliefs score was observed at seventh-grade students. In this case, it can be said that there is a positive change in the scientific epistemological beliefs of gifted students who receive more science education. A similar development was found in the subdimension of "The traditional understanding of science". However, the subdimension of "The non-traditional understanding of science" was observed to decrease as the grade level increased. For the "The traditional understanding of science" sub-dimension, the 7th-grade students' scores (72.87) were higher than the 5th-grade students (68.28), while the 5th-grade students' scores (15.51) for the "The non-traditional understanding of science" sub-dimension were higher than the 7th-grade students (15.21).

**Table 4**  
**Scientific Epistemological Beliefs According to Grades.**

Grade	N	Scale-Subscale	Mean	SD	Max.	Min.
5	45	Scientific Epistemological Beliefs Survey	83.80	4.32	92.00	73.00
		The Traditional Understanding of Science	68.28	6.00	84.00	48.00
		The Non-Traditional Understanding of Science	15.51	2.92	25.00	8.00
		Scientific Epistemological Beliefs Survey	85.61	4.31	96.00	80.00
6	34	The Traditional Understanding of Science	70.20	5.69	85.00	62.00
		The Non-Traditional Understanding of Science	15.41	2.82	20.00	8.00
		Scientific Epistemological Beliefs Survey	88.09	4.99	105.00	79.00
		The Traditional Understanding of Science	72.87	5.75	88.00	63.00
7	41	The Non-Traditional Understanding of Science	15.21	3.15	22.00	8.00

ANOVA (one-way ANOVA) analysis was conducted to determine whether the epistemological beliefs of gifted students showed significant differences according to grade. It was found that the epistemological beliefs scores of the students for the whole scale and subdimension of "The traditional understanding of science" showed a statistically significant difference ( $p < 0.05$ ). However,



the epistemological beliefs scores of the students for the subdimension of "The non-traditional understanding of science" did not show a statistically significant difference ( $p < 0.05$ ) (Table 5). Hence, the formulated hypothesis "There exists no significant difference between gifted students of different grades concerning scientific epistemological beliefs." was not accepted.

**Table 5**

**ANOVA Analysis of Epistemological Belief Scores According to Grades.**

		Sum of Squares	df	Mean Square	F	Sig.
Scientific Epistemological Beliefs Survey * GRADE	Between Groups	397.52	2	198.76	9.55	0.00
	Within Groups	2432.83	117	20.79		
	Total	2830.36	119			
The traditional understanding of science * GRADE	Between Groups	453.60	2	226.80	6.66	0.00
	Within Groups	3983.19	117	34.04		
	Total	4436.80	119			
The non-traditional understanding of science * GRADE	Between Groups	1.86	2	0.93	0.10	0.90
	Within Groups	1040.50	117	8.89		
	Total	1042.36	119			

**Hypothesis 2: There exists no significant difference between gifted students of different ages concerning scientific epistemological beliefs.**

When the epistemological beliefs scores of the students in the research group were evaluated according to the age variable, it was seen that the average scores of gifted students in different age groups had values close to the general average ( $X = 85.78$ ) (Table 6). On the other hand, except for this 10-year-old student, the scientific epistemological beliefs of gifted students increased relatively with increasing age. As in the findings related to the grade level, it can be said that as the age of the students' increases, their epistemological beliefs increase. Similar findings were found for the subdimensions of the scale. For the "The traditional understanding of science" sub-dimension, the 13-year-old students' scores (71.03) were higher than the 11-year-old students (68.85), while the 11-year-old students' scores (15.51) for the "The non-traditional understanding of science" sub-dimension were higher than the 13-year-old students (15.03). According to the ANOVA results, the differences

between mean scores for scale and all dimensions was not statistically meaningful ( $p<0.05$ ) (Table 7). Hence, the formulated hypothesis “There exists no significant difference between gifted students of different ages concerning scientific epistemological beliefs.” was accepted.

**Table 6**  
**Scientific Epistemological Beliefs According to Age.**

Age	N	Scale-Subscale	Mean	SD	Max.	Min.
10	1	Scientific Epistemological Beliefs Survey	86.00	-	86.00	86.00
		The Traditional Understanding of Science	73.00	-	73.00	73.00
		The Non-Traditional Understanding of Science	13.00	-	13.00	13.00
11	35	Scientific Epistemological Beliefs Survey	84.37	4.59	96.00	73.00
		The Traditional Understanding of Science	68.85	6.61	84.00	48.00
		The Non-Traditional Understanding of Science	15.51	3.19	25.00	8.00
12	54	Scientific Epistemological Beliefs Survey	86.03	5.41	105.00	75.00
		The Traditional Understanding of Science	71.00	6.45	88.00	61.00
		The Non-Traditional Understanding of Science	15.03	2.98	22.00	8.00
13	30	Scientific Epistemological Beliefs Survey	86.96	3.89	96.00	79.00
		The Traditional Understanding of Science	71.03	4.62	81.00	62.00
		The Non-Traditional Understanding of Science	15.03	2.63	20.00	9.00

**Table 7****ANOVA Analysis of Epistemological Belief Scores According to Ages.**

		Sum of Squares	df	Mean Square	F	Sig.
Scientific Epistemological Beliefs Survey * AGE	Between Groups	115.30	3	38.43	1.64	0.18
	Within Groups	2715.06	116	23.40		
	Total	2830.36	119			
The traditional understanding of science * AGE	Between Groups	121.54	3	40.51	1.08	0.35
	Within Groups	4315.25	116	37.2		
	Total	4436.80	119			
The non-traditional understanding of science * AGE	Between Groups	21.83	3	7.27	0.82	0.48
	Within Groups	1020.53	116	8.79		
	Total	1042.36	119			

**Hypothesis 3: There exists no significant difference between girls and boys gifted students concerning scientific epistemological beliefs.**

In terms of gender, although the scores are close to each other, female students' epistemological beliefs scores ( $X = 86.18$ ) were higher than male students' scores ( $X = 85.46$ ) (Table 8). For the "The traditional understanding of science" sub-dimension, the scores of the female students (70.92) were higher than the male students (69.98), while for the "The non-traditional understanding of science" sub-dimension, the scores of the male students (15.47) were higher than the female students (15.26). Statistically, the results of the analysis showed that the difference between the epistemological beliefs scores of the female and male students was not statistically significant ( $p < 0.05$ ) (Table 9). Hence, the formulated hypothesis "There exists no significant difference between girls and boys gifted students concerning scientific epistemological beliefs." was accepted.

**Table 8**  
**Scientific Epistemological Beliefs According to Gender.**

Gender	N	Scale-Subscale			Mean	SD	Max.	Min.
Girls	67	Scientific Epistemological Beliefs Survey			86.18	4.94	105.00	76.00
		The Traditional Understanding of Science			70.92	6.00	85.00	62.00
		The Non-Traditional Understanding of Science			15.26	2.98	22.00	8.00
Boys	53	Scientific Epistemological Beliefs Survey			85.46	4.83	96.00	73.00
		The Traditional Understanding of Science			69.98	6.19	88.00	48.00
		The Non-Traditional Understanding of Science			15.47	2.96	25.00	8.00

**Table 9**  
**ANOVA Analysis of Epistemological Belief Scores According to Gender.**

		Sum of Squares	df	Mean Square	F	Sig.
Scientific Epistemological Beliefs Survey * GENDER	Between Groups	15.59	1	15.59	0.65	0.42
	Within Groups	2814.77	118	23.85		
	Total	2830.36	119			
The traditional understanding of science * GENDER	Between Groups	26.11	1	26.11	0.69	0.40
	Within Groups	4410.68	118	37.37		
	Total	4436.80	119			
The non-traditional understanding of science * GENDER	Between Groups	1.34	1	1.34	0.15	0.69
	Within Groups	1041.01	118	8.82		
	Total	1042.36	119			

## DISCUSSION AND CONCLUSION

This study aims to determine the scientific epistemological beliefs of gifted students who are thought to be scientifically important potential and compare these beliefs in terms of variables such as grade, gender and age. According to the results of the study, in general, it can be said that epistemological belief levels increased with class and age levels. In terms of gender, it was concluded that female students' epistemological belief scores were slightly higher than male students.

Cross-age research are useful in understanding a particular concept structured by students at various age and grade levels and offer the opportunity to observe changes in conceptual development and increase intellectual development because of maturation (Egalite & Kisida, 2017; Zeneli, Tymms, & Bolden, 2018). According to the many important studies in science education that approached experimental research from a cross-age perspective, although the concepts of children's scientific phenomena changed over time, some alternative concepts lasted from preschool to high school (Westbrook & Marek, 1991). In the present study, because of the findings, it was concluded that as students' educational year increased, generally epistemological beliefs developed. When the relevant literature is examined, it is seen that studies are supporting the findings of the study (Conley, Pintrich, Vekiri, & Harrison, 2004; Kizilgunes, Tekkaya, & Sungur, 2009; Onen, 2011).

Students with advanced epistemological beliefs use more qualified cognitive processing strategies in the learning process, have higher academic achievements, have more positive attitudes towards the school, and develop more complex, deep and versatile ideas. Evcim (2010) found that there is a strong relationship between 8th-grade students' epistemological beliefs and their ability to use the gains they have gained in science classes in their daily lives. Also, Elder (1999), in a study carried out with 5th-grade students, concluded that students with advanced epistemological beliefs were more successful in science education. The fact that gifted students with high potential in terms of these characteristics show a high level of scientific epistemological belief, as in this study, may demonstrate a positive correlation between intelligence and epistemological belief level.

The existence of gender-based differences in academic achievement and participation in science is widely accepted. As a result of many studies investigating the effect of gender on epistemological beliefs, different findings were reached. Some of these studies suggest that females have a higher level of epistemological beliefs (Bendixen, Schraw, & Dunkle, 1998; Kurt, 2009; Onen, 2011; Ozkal, 2007; Ozkan, 2008), while some have stated that males have a higher level of epistemological beliefs, and some argue that there is no differ-

ence between females and males (Aydin & Gecici, 2017; Schommer & Dunnell, 1994). In this study, although there was no statistically significant difference between them, the scientific epistemological beliefs of female students were found to be higher than male students. There may be many reasons for this difference between the results of the research studies. These include the use of different measurement tools, characteristics of research samples, class level, cultural differences and psychological status of the sample.

Science has become increasingly important and evident in all aspects of life for people living in all countries, especially in a developing country. It seems necessary to investigate the epistemological beliefs of gifted students that have the critical potential for scientific developments. Although not statistically significant, it was found that higher grade students had more advanced scientific epistemological beliefs than lower grade students. Also, there is no significant difference between the scientific epistemological beliefs of male and female students. However, it is widely accepted that gender-based differences are one of the factors affecting science participation. The inclusion of gender in this study will contribute to the literature on the scientific epistemological beliefs of gifted males and females and their active participation in scientific studies. In addition, it is thought that comparing the findings obtained with the results of similar studies which accept gender as an additional variable for analysis would be beneficial for the relevant literature. Further studies are needed to identify the educational needs of gifted students and to improve learning environments and, most importantly, identify all factors affecting these processes.

## REFERENCES

- Aydin, M., & Gecici, M. E. (2017). Investigation of 6th grade students' epistemological beliefs with respect to some variables. *Journal of Kirsehir Educational Faculty*, 18(1), 213-229. Retrieved from <https://dergipark.org.tr/en/download/article-file/1481453>
- Baltaci, S., Yildiz, A., & Ozcakil, B. (2016). The relationship between metacognitive awareness levels, learning styles, genders and mathematics grades of fifth graders. *Journal of Educational Learning*, 5(4), 78-89. <https://doi.org/10.5539/jel.v5n4p78>
- Bendixen, L. D., Schraw, G., & Dunkle, M. E. (1998). Epistemic beliefs and moral reasoning. *Journal of Psychology*, 132, 187-200. <https://doi.org/10.1080/00223989809599158>
- Conley, A. M., Pintrich, P. R., Vekiri, I., & Harrison, D. (2004). Changes in epistemological beliefs in elementary science students. *Contemporary Educational Psychology*, 29, 186-204. <https://doi.org/10.1016/j.cedpsych.2004.01.004>

- Deryakulu, D., & Bikmaz, F. H. (2003). The validity and reliability study of the scientific epistemological beliefs survey. *Educational Science Practices*, 2(4), 243-257.
- Donmez, I., & Yucel, S. Y. (2020). Analysis of Scientific Epistemological Beliefs and STEM Attitudes of The Gifted Students. *Bartın Universitesi Egitim Fakultesi Dergisi*, 9(3), 515-526. <https://doi.org/10.14686/buefad.644698>
- Egalite, A. J., & Kisida, B. (2017). The effects of teacher match on students' academic perceptions and attitudes. *Educational Evaluation and Policy Analysis*, 40(1), 59-81. <https://doi.org/10.3102/0162373717714056>
- Elder, A. D. (1999). *An exploration of fifth-grade students' epistemological beliefs in science and an investigation of their relation to science learning*. Unpublished doctoral dissertation, University of Michigan, Michigan..
- Erkol, S., & Ugulu, I. (2014). Examining biology teachers candidates' scientific process skill levels and comparing these levels in terms of various variables. *Procedia - Social and Behavioral Sciences*, 116, 4742-4747. <https://doi.org/10.1016/j.sbspro.2014.01.1019>
- Evcim, I. (2010). *The relation between 8th grade primary school students' epistemological beliefs, science lesson acquisition, level of use of science in daily life and academic success*. Unpublished Master Thesis, Marmara University Educational Sciences Institute, Istanbul.
- Hashweh, M. Z. (1996). Effects of science teachers' epistemological beliefs in teaching. *Journal of Research in Science Teaching*, 33(1), 47-63.
- Karabulut, R. (2010). *The history of education of gifted and talented students in Turkey*. Unpublished master's thesis, University of Abant Izzet Baysal, Turkey.
- King, P. M., & Kitchener, K. S. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*. San Francisco: Jossey-Bass.
- Kizilgunes, B., Tekkaya, C., & Sungur, S. (2009). Modeling the relations among students' epistemological beliefs, motivation, learning approach, and achievement. *Journal of Educational Research*, 102(4), 243-255. <https://doi.org/10.3200/JOER.102.4.243-256>
- Kuhn, D. (1991). *The skills of argument*. Cambridge: Cambridge Univ. Press.
- Kurt, F. (2009). *Investigating students' epistemological beliefs through gender, grade level, and fields of the study*. Unpublished master's thesis, Middle East Technical University, Ankara.
- Onen, A. S. (2011). Investigation of students' epistemological beliefs and attitudes towards studying. *Hacettepe University Journal of Education*, 40, 300-309.
- Ozkal, K. (2007). *Scientific epistemological beliefs, perceptions of constructivist*

- learning environment and attitude towards science as determinants of students approaches to learning*. Unpublished Master Thesis, Middle East Technical University, Ankara.
- Ozkan, S. (2008). *Modeling elementary students' science achievement: the interrelationships among epistemological beliefs, learning approaches, and self-regulated learning strategies*. Unpublished Doctoral Thesis, Middle East Technical University, Ankara.
- Perry, W. G. (1970). *Forms of intellectual and ethical development in the college years. a scheme*. USA: Harvard University Press.
- Pomeroy, D. (1993). Implications of teachers beliefs about the nature of science: Comparison of the beliefs of scientists, secondary science teachers, and elementary teachers. *Science Education*, 77(3), 261-278. <https://doi.org/10.1002/sce.3730770302>
- Sak, U. (2013). Education programs for talented students model (EPTS) and its effectiveness on gifted students' mathematical creativity. *Educational Science*, 38, 51-61.
- Sak, U., Ayas, M. B., Sezerel, B. B., Opengin, E., Ozdemir, N. N., & Gurbuz, S. D. (2015). Gifted and Talented Education in Turkey: Critics and Prospects. *Turkish Journal of Giftedness Education*, 5(2), 110-132. Retrieved from <https://dergipark.org.tr/tr/download/article-file/1476066>
- Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology*, 82, 498-504. <https://doi.org/10.1037/0022-0663.82.3.498>
- Schommer, M., & Dunnell, P. A. (1994). A comparison of epistemological beliefs between gifted and non-gifted high school students. *Roeper Review*, 16(3), 207-210. <https://doi.org/10.1080/02783199409553575>
- Schommer, M., & Dunnell, P. A. (1997). Epistemological beliefs of gifted high school students. *Roeper Review*, 19(3), 153-156. <https://doi.org/10.1080/02783199709553812>
- Tsai, C. C. (2000). The effects of STS-oriented instruction on female tenth graders' cognitive structure outcomes and the role of student scientific epistemological beliefs. *International Journal of Science Education*, 22(10), 1099-1115. <https://doi.org/10.1080/095006900429466>
- Turkey Ministry of Education . (2019). *Ministry of Education statue*. Retrieved 2019-09-15, from <http://www.meb.gov.tr/mevzuat>
- Ugulu, I. (2015b). A quantitative investigation on recycling attitudes of gifted/talented students. *Biotechnology & Biotechnological Equipment*, 29, 20-26. <https://doi.org/10.1080/13102818.2015.1047168>
- Ugulu, I. (2019). Efficacy of recycling education integrated with ecology course prepared within the context of enrichment among gifted students. *International Journal of Educational Sciences*, 26(1-3), 49-58.



- <https://doi.org/10.31901/24566322.2019/26.1-3.1086>
- Ugulu, I. (2020). Gifted students' attitudes towards science. *International Journal of Educational Sciences*, 28(1-3), 7-14. <https://doi.org/10.31901/24566322.2020/28.1-3.1088>
- Westbrook, S. L., & Marek, E. A. (1991). A cross-age study of student understanding of the concept of diffusion. *Journal of Research in Science Teaching*, 28, 649-660. <https://doi.org/10.1002/tea.3660280803>
- Yorek, N., Aydin, H., Ugulu, I., & Dogan, Y. (2008). An Investigation on Students' Perceptions of Biodiversity. *Natura Montenegrina*, 7(3), 175-184.
- Yorek, N., Ugulu, I., & Aydin, H. (2016). Using self-organizing neural network map combined with ward's clustering algorithm for visualization of students' cognitive structural models about aliveness concept. *Computational Intelligence and Neuroscience*, 1-14. <https://doi.org/10.1155/2016/2476256>
- Zeneli, M., Tymms, P., & Bolden, D. (2018). Interdependent cross-age peer tutoring in mathematics. *International Journal of Psychology and Educational Studies*, 5(3), 33-50. <https://doi.org/10.17220/ijpes.2018.03.004>