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Abstract

One of the most talked about and discussed topics in our current time is climate change. Therefore, it is important to draw attention to this issue in educational environments. The purpose of this study is to examine the relationship between scientific epistemological beliefs and climate change awareness of gifted students and whether these variables differ according to gender. The study was conducted using a relational screening model. The Scientific Epistemological Belief Scale and the Global Warming/Climate Change Awareness Scale were used as data collection tools. The sample of the study consists of 106 gifted students at the secondary school level in a city in the western region of Turkey. The research findings showed that there was a relationship between the epistemological beliefs of gifted students and their awareness levels of the causes and effects of climate change, their awareness of personal initiatives, and their tendency to change behaviour. In addition, the awareness level of personal initiatives to prevent climate change and the scientific epistemological belief levels differed significantly in favor of gifted female students.

Introduction

Climate change is defined as long-term changes in the balance of climate systems worldwide as a result of human activities (Kurnaz, 2023). Global climate change has been discussed since the 1970s but has become a topic that has begun to attract attention in the 21st century as its effects have become more felt (Selçuk, 2023). For this reason, it is important for countries to develop correct and applicable strategies in case of exposure to the risks that climate change may cause (Calda et al., 2022). Education is one of the most effective methods in developing these strategies. In addition, climate change education has become one of the most emphasized topics in terms of increasing the awareness levels of individuals regarding the global environmental problem (Beasy et al., 2023; Cantell et al., 2019; Schreiner et al., 2005). However, climate change is a serious problem with no simple solutions and climate change education is also defined as a multidimensional problem (Cantell et al., 2019; IPCC, 2023; Liu & Roehrig, 2019). Climate change being a key issue in the field of natural sciences requires multifaceted scientific knowledge. Conflicts between scientific evidence and public perceptions of climate change lead to belief systems and discussions about climate change (Yli-Panula et al., 2021). Although there is a significant level of acceptance and discourse about integrating climate change into education and training activities and providing motivation for climate action (Cutter-Mackenzie & Rousell, 2018), researches show that these efforts may be ineffective in changing children's attitudes and behaviours (Benevento, 2023; Busch et al., 2019). Although school-aged individuals are interested and active in climate change, they may also be anxious and feel that they have no impact on the societal level. Some individuals may be completely indifferent to the issue of climate change or even deny its seriousness (Cordie & Maxwell, 2023; Veijonaho et al., 2024). In addition, researchers state that students have difficulty creating mental models to understand climate change and that learning and problem solving on these topics depend not only on knowledge but also on individuals' beliefs about the subject (Leiserowitz et al., 2010; Yli-Panula et al., 2021).

Engaging with scientific information, including climate change, may depend on epistemological factors that affect what a person chooses to believe and how these beliefs are justified (Quarderer et al., 2021). Epistemological cognition is a process that includes the dispositions, beliefs and skills that determine what individuals actually know, believe, doubt, or distrust (Green & Yu, 2016). Epistemological beliefs are subjective belief systems about the source of knowledge, its certainty, creation, learning and structure of knowledge (Schommer, 1990). Epistemological beliefs allow individuals to understand the ways they determine the accuracy of conflicting information, evaluate new information and make decisions that will affect their own lives and those around them (Kuhn, 1991 as cited in Sapancı, 2012). Scientific epistemology includes topics such as how scientific knowledge develops, how its accuracy is proven and how the quality of data used to obtain knowledge is evaluated, along with general subjective beliefs (Coban & Sengoren, 2020). According to

researchers in the field of science education, the subject of climate change can be seen as a tool through which students' epistemological cognitions can be explored and how students choose to believe and interpret information can affect their decisions to take action on climate (Busch et al., 2019; Sinatra et al., 2012; Quarderer et al., 2021). Although individuals know the content of climate science, the processes that scientists go through to make their claims are not fully understood. This shows that teachers should not only provide students with understanding of how climate systems work or the causes and effects of climate change but also provide cognitive support that supports how students know what they know (Holthuis et al., 2014). How an individual learns in the context of science in general and specifically is an epistemological issue and how an individual interacts with science depends on his/her epistemological cognition or basic assumptions about knowledge and how knowledge is developed (Quarderer et al., 2021). It can be said that the current constructivist understanding in the field of education also includes epistemological beliefs, that is, it shapes individuals' learning within the framework of their epistemological beliefs (Schreiber & Shinn, 2003). Research in the literature shows that epistemological beliefs can affect students' cognitive development and therefore their learning strategies and academic performance (Asut & Koksal, 2013; Greene et al., 2018; Kılıç & Demirbağ, 2020; Schommer-Aikins & Hutter, 2002). Especially for science education, students' epistemological beliefs are an important part of gaining a deeper understanding of scientific research, the scientific process and the nature of science (Fulmer, 2014; Kılıç & Demirbag, 2020). In this context, researchers working in the field of science education will need to better understand why students support certain ideas and beliefs about climate change which will help create and shape effective learning environments that promote the development of climate literacy and epistemological cognition (Quarderer et al., 2021).

One of the learner groups that should be carefully considered in shaping learning environments is gifted individuals (Koshy & Pinheiro-Torres, 2013). Gifted students are defined as individuals who need special education due to their cognitive characteristics that differ from their peers (MEB, 2024). One of the distinguishing aspects of gifted children is that they are more sensitive to global and environmental problems than their peers (Davis & Rimm, 1989; Nacaroglu &Karakaya, 2020; Ugulu, 2013; Sontay, 2014; Karakaya et al., 2018). Researchers state that gifted children need cognitive stimulation, support to solve complex problems and goals that will challenge them to deeply investigate and question the topics they are interested in (Daglıoglu, 2010; Koshy & Robinson, 2006; Taber, 2010; VanTassel-Baska, 2010). The potential of gifted children and the roles they can undertake in the world of the future should be taken into consideration, and this potential should be considered when planning educational activities (Koshy & Robinson, 2006; Yalman & Çepni, 2021). In the MEB (2024) Science and Art Centers Directive, the principles of the education and training program for gifted students include the following statements:

> *Programs are prepared under the guidance of relevant class/branch teachers, in a student-centered and interdisciplinary structure, suitable for individual learning, and differentiated and enriched according to their interests, abilities, and potential in a way that will enable students to acquire high-level mental, social, personal, and academic skills that they will need in adulthood, such as effective problem solving, decision-making and creativity.*

In this context, it is thought that a study on the scientific epistemological beliefs of gifted students can also provide clues for differentiation in the teaching process on climate change. When the studies on gifted students are examined in the literature, it is possible to come across studies on the epistemological beliefs of students. Kılıc and Demirag (2020) tried to measure the epistemological beliefs of students with a field-independent scenario in order to determine and compare the epistemological belief profiles of gifted students and their parents. Based on the study findings they stated that gifted students and their parents have definitive epistemological belief profiles. Akpınar (2018) examined the effect of STEM education on the students' self-regulation, motivation for science teaching and epistemological beliefs and at the end of the study it was revealed that there was a significant difference in the pre-test-posttest scores of self-regulated learning strategies, motivation for science learning and epistemological beliefs scale. Apart from the studies mentioned above on general epistemological beliefs in the national literature only one study (Asut & Koksal, 2013) was found on the scientific epistemological beliefs of gifted students. In their study conducted with gifted students at the middle school level Asut and Koksal (2013) examined the relationship between the students' scientific epistemological beliefs and their motivation level for learning science and their success in science. In their research findings they stated that there was a statistically significant relationship between the motivation level for learning science and their scientific epistemological belief scores. It is possible to come across various studies in the national literature on the climate change awareness of gifted individuals (Akhan et al., 2022; Balaban, 2023; Bodur et al., 2013; Mutlu & Nacaroglu, 2019; Nacaroglu &Karakaya, 2020; Ozarslan, 2022; Yılmaz & Emir; 2024). This study focused on the relationship between the scientific epistemological beliefs of gifted individuals and their climate change awareness levels. It is thought that this study will provide a

framework for research on the awareness of gifted individuals regarding global environmental problems, climate change, and epistemological beliefs, as well as provide clues for differentiating teaching processes for gifted students.

Purpose of the Research

The purpose of this study is to examine the relationship between scientific epistemological beliefs and climate change awareness of gifted students and whether these variables differ by gender. The research questions created for this purpose are as follows:

1. Is there a significant relationship between Scientific Epistemological Beliefs and Global Warming/Climate Change Awareness of gifted students?
2. Are there any significant differences in the Scientific Epistemological Beliefs and Global Warming/Climate Change Awareness of gifted students based on gender?

Method

Research Design

In this study the relational screening method which is one of the quantitative research methods was used. Survey studies allow the determination of the tendencies and attitudes of a sample (Creswell, 2017). In the relational screening model the relationship between the determined characteristics of the sample group is examined (Buyukozturk et al., 2019). In this study the relational screening method was used because it was aimed to examine the relationship between the Scientific Epistemological Belief Scale scores and the Global Warming/Climate Change Awareness Scale scores of the students in the sample and to examine the change in scale scores depending on gender.

Participants and Procedure

The sample of the study consists of 106 gifted students at the secondary school level who are studying in three different Science and Art Centers in Aydın province in the 2023-2024 academic year. Science and art centers (BİLSEM) are institutions affiliated with the Ministry of National Education that provide support education to gifted students in Turkey. At the end of a diagnosis process determined by the Ministry of National Education, students were diagnosed as gifted according to the scores they got from the Wechsler Nonverbal (WNV) test. Typical case sampling, one of the purposive sampling methods was used in the selection of the study group. In typical case sampling a group typical of many situations in the universe related to the research problem is selected and this group is examined (Buyukozturk et al., 2019). Students' academic achievement socioeconomic status and the schools they attend show similar characteristics. The characteristics of the participants regarding gender and grade level are presented in Table 1.

Table 1. Distribution of participants according to grade level and gender

		Frequency (f)	Percentage (%)
Gender	Female	50	47.2
	Male	56	52.8
	Total	106	100
Grade level	5	54	50.9
	6	38	35.8
	7	14	13.2
	Total	106	100

Measurements

Scientific Epistemological Belief Questionnaire

It was developed by Conley et al. (2004) and adapted to Turkish by Ozkan (2008). The scale used by Ozkan (2008) in his study with 7th grade students is a 26-question, five-point Likert-type scale (5; strongly agree, 1;

strongly disagree). The scale aims to measure the epistemological beliefs of the participants in the sub-dimensions of justification of knowledge, development of knowledge, source of knowledge, and certainty of knowledge. Ozkan (2008) reported the overall reliability coefficient of the scale as .76. The Scientific Epistemological Belief Scale was also used by Kılıc and Demirbag (2020) in a study on gifted middle school students.

We examined the construct validity of the scale for the sample within the scope of this study using the LISREL program. In the first step of the confirmatory factor analysis, it was seen that the data set did not meet the normality assumption (Khattree & Naik, 1999) as a result of Mardia's multivariate normality test (Skewness=68.34, Kurtosis=295.73). Accordingly, as a result of the analysis we conducted the items with factor loadings less than .30 (1, 2, 6, 7, 14, 15, 16, 18, 19, 21, 26) were removed from the scale and the analyses were repeated. The Scientific Epistemological Beliefs Questionnaire which was originally four-dimensional (Conley et al., 2004) was analyzed in three dimensions within the scope of this study in parallel with the study adapted to Turkish by Ozkan (2008). The Cronbach's Alpha values for the scale, which consists of a total of 15 items, are given in Table 2.

Table 2. Reliability analysis values for the scientific epistemological belief questionnaire

Dimensions	Items	Cronb. Alpha
Justification	3,4,5,9,11,22,25	.88
Source/Certainty	10,12,20,23	.75
Development	8,13 17,24	.81
All scale	All Item	.88

In Table 2, it is seen that the reliability coefficient values for the dimensions of the Scientific Epistemological Beliefs Questionnaire and the general reliability coefficient value are above .70 which is an acceptable value (Buyukozturk, 2011).

Global Warming/Climate Change Awareness Questionnaire

The questionnaire developed by Halady and Rao (2010) was adapted to Turkish by Dal et al. (2015). The sections of the four-point Likert-type scale (4; I am quite aware, 1; I am not aware) consist of awareness of the causes and effects of climate change, awareness of personal initiatives related to climate change, awareness of industrial initiatives related to climate change, and behavioral change tendency. Reliability coefficients were reported by Dal et al. (2015) as .91 for awareness of the causes and effects of climate change, .91 for awareness of personal initiatives related to climate change, .89 for awareness of industrial initiatives related to climate change and .70 for behavioral change tendency. The scale was used in a study conducted with gifted 6th grade students by Bodur et al. (2023).

In this study we examined the construct validity of the scale for a gifted sample using the LISREL program. During the application of the scale, the “Awareness of Industrial Initiatives Related to Climate Change” section was not included in the analysis as it was thought to be inappropriate for the age level of the students based on the feedback received from the students. In the first step of the confirmatory factor analysis, it was seen that the data set did not meet the normality assumption as a result of Mardia’s multivariate normality test (Skewness=1611.80, Kurtosis=2839.88) (Khattree & Naik, 1999). Accordingly, at the end of the analysis, the items with factor loadings less than .30 (6, 9, 10, 20, 24) were removed from the scale and final analyses were performed. Cronbach’s Alpha values for the Global Warming/Climate Change Awareness Scale are given in Table 3. Table 3 shows that the reliability coefficient values for the sections of the Global Warming/Climate Change Awareness Scale are above .70, which is acceptable (Buyukozturk, 2011).

Table 3. Reliability analysis data on global warming/climate change awareness questionnaire

Sections	N	Cronb. Alpha
Reasons and impacts of climate change	15	.85
Awareness of individual initiative	23	.89
Propensity for behavioral change	7	.82

Results

Findings Regarding the First Research Question

In the first step of the analysis studies conducted for the first research question of the study, "Is there a significant relationship between the Scientific Epistemological Beliefs of gifted students and their Global Warming/Climate Change Awareness?", descriptive values of the scores for both scales were examined. Descriptive data regarding the Scientific Epistemological Belief Scale scores are presented in Table 4 and descriptive data regarding the Global Warming/Climate Change Awareness Scale are presented in Table 5. Considering the minimum and maximum scores in Table 4, it can be said that the participants' average scores are high in the scale dimensions and in the overall scale.

Table 4. Descriptive data on scientific epistemological belief scale questionnaire

	X	SD	Minimum	Maximum
Justification	3.86	.87	1	5
Source/Certainty	3.97	.90	1.75	5
Development	3.95	.84	1	5
Scientific epistemological belief	3.91	.70	1.40	5

Table 5. Descriptive data on global warming/climate change awareness questionnaire scores

	X	SD	Minimum	Maximum
Reasons and impacts of climate change	3.09	.53	1.73	4
Awareness of individual initiative	3.19	.47	2	4
Propensity for behavioral change	3.29	.59	2	4
Global warming/Climate change	3.19	.47	2	4

When Table 5 is examined, it is seen that the scale scores vary between 1.73 and 4 and the average scores are high when the minimum and maximum scores are taken into account. A correlation test was conducted to determine whether there was a significant relationship between the scores of the Scientific Epistemological Belief Questionnaire and the Global Warming/Climate Change Awareness Questionnaire. The normality status of the scores obtained from the scales was examined and in the normality examination, the statistical values were found to be Skewness= -1.12 Kurtosis=1.33 for the Scientific Epistemological Belief Questionnaire and Skewness= -0.40 Kurtosis= -0.22 for the Global Warming/Climate Change Awareness Questionnaire, and it was determined that both scale scores showed a normal distribution. In this direction the parametric test Pearson test correlation was used. The analysis data regarding the correlation levels between the scores of the Scientific Epistemological Belief Scale and the scores obtained from the sections of the Global Warming/Climate Change Awareness Scale are presented in Table 6.

Table 6. The level of correlation between scientific epistemological belief questionnaire scores and global warming/climate change awareness questionnaire scores

	I	II	III	IV
I. Scientific epistemological belief	1			
II. Reasons and impacts of climate change	,364**	1		
III. Awareness of individual initiative	,375**	,722**	1	
IV. Propensity for behavioral change	,523**	,619**	,631**	1

**p< .01

When Table 6 is examined, it is seen that there is a positive significant relationship (p< .01) between the participants' Scientific Epistemological Belief Questionnaire scores and the scores obtained from all three sections of the Global Warming/Climate Change Awareness Questionnaire. It can be said that the scientific epistemological belief scores are lowly related to the level of awareness of the causes and effects of climate change (r= .36); lowly related to the awareness of personal initiatives (r= .38) and moderately related to the tendency to change behavior (r= .52).

Findings Regarding the Second Research Question

In the analysis study conducted for the second research question of the study, "Are there any significant differences in the Scientific Epistemological Beliefs and Global Warming/Climate Change Awareness of gifted students based on gender?", tests were conducted using a statistical program in order to determine whether the scores obtained from the scales differed significantly according to gender. A normality analysis of the Scientific Epistemological Belief Questionnaire scores was performed and it was seen that the scores were normally distributed for both genders (female participant scores Skewness= -0.87 Kurtosis= 0.00; male participant scores Skewness= -1.12 Kurtosis=1.29). Statistical results were obtained by performing an independent samples t-test.

The statistical values regarding the difference in the Scientific Epistemological Belief Questionnaire scores according to gender are presented in Table 7:

Table 7. t-test results regarding gender-related differences in scientific epistemological belief questionnaire scores

	Gender	N	X	SD	t	p
Scientific epistemological belief	Female	50	4.07	.60	2.14	.03
	Male	56	3.78	.76		

When Table 7 is examined, it is seen that the mean scores of the Scientific Epistemological Belief Questionnaire are higher in female students (X=4.07) than in male students (X=3.78) and this difference is significant (p< .05). A normality analysis of the Global Warming/Climate Change Awareness Questionnaire scores was conducted, and it was seen that the scores were normally distributed for both genders (female participant scores Skewness= -0.50 Kurtosis= -0.43; male participant scores Skewness= -0.31 Kurtosis=0.07). Statistical results were obtained by performing an independent samples t-test. The statistical values regarding the gender-based differentiation status of the Global Warming/Climate Change Awareness Questionnaire scores are presented in Table 8:

Table 8. t-test results regarding gender-related differences in global warming/climate change questionnaire scores

Section	Gender	N	X	SD	t	p
Reasons and impacts of climate change	Female	50	3.12	.54	.67	.50
	Male	56	3.05	.52		
Awareness of individual initiative	Female	50	3.30	.41	2.30	.02
	Male	56	3.09	.51		
Propensity for behavioral change	Female	50	3.37	.62	1.21	.23
	Male	56	3.23	.56		

When Table 8 is examined, it is seen that the mean scores for the Awareness and Behavior Change Tendency section on the Causes and Effects of Climate Change do not differ significantly between male and female participants while in the Awareness of Personal Initiatives section, the mean scores of female students (X=3.30) are higher than the mean scores of male students (X=3.09) and this difference is significant (p< .05).

Discussion

In this study, it was examined whether there was a significant relationship between the Scientific Epistemological Beliefs and Global Warming/Climate Change Awareness of gifted students and whether the scores of both scales differed according to the gender variable. When the descriptive data obtained in this study are compared with the data of similar studies on epistemological beliefs (Asut and Koksal, 2013; Ozbay, 2016; Ozkan, 2008), it can be said that gifted students have scientific epistemological beliefs above the average level. Considering that gifted students have skills such as innately developed reasoning abilities, questioning attitudes and the ability to reflect on what they have learned (Gilbert & Newberry, 2017; Taber, 2017), it is a predictable result that these characteristics may have also affected their epistemological belief level. The data obtained from the Global Warming/Climate Change Awareness scale, another data collection tool in the study, show that the participants' global warming and climate change awareness levels are high. Yılmaz and Emir (2024) stated that there was a significant difference in favor of gifted students in terms of climate literacy in the findings of the study in which they aimed to compare the 21st century skills and climate literacy levels of gifted middle school students and their peers. Ozarslan (2022), on the other hand, stated in the findings of his study, which aimed to examine the solution proposals of gifted middle and high school students to global environmental problems, that the students emphasized air/water pollution and global warming. The findings of this study are similar to the findings of Yılmaz and Emir (2024) and Ozarslan (2022). Studies indicate that gifted students are more sensitive to global environmental problems than their peers (Davis & Rimm, 1989; Nacaroglu & Karakaya, 2020; Ugulu, 2013; Sontay, 2014; Karakaya et al., 2018). This situation may have caused the gifted students' climate change awareness levels to be high.

In the study, the relationship between the students' Scientific Epistemological Belief Questionnaire scores and the Global Warming/Climate Change Awareness Scale scores was examined and it was observed that there was a positive and significant relationship between the participants' Scientific Epistemological Belief Questionnaire scores and the scores obtained from all three sections of the Global Warming/Climate Change Awareness

Questionnaire. In the study where Quarderer et al. (2021) examined the relationship between the climate literacy level and epistemological beliefs of eighth-grade students, they stated that there was a positive relationship between the students' climate literacy level and epistemological beliefs. The data obtained from this study also revealed similar findings. The high epistemological beliefs of individuals may cause them to shape their lives regarding the information and concepts they learn. In this case, they question the information they learn about climate change from the media, the environment and the education they receive at school and structure their own beliefs according to this information (Holthuis et al., 2014; Quarderer et al., 2021). Therefore, it is an expected result that individuals with high epistemological beliefs also have high awareness of climate change.

The analysis results for the second research question of the study examined whether there was a significant difference in the Scientific Epistemological Belief Questionnnaire scores and Global Warming/Climate Change Awareness Questionnnaire scores of gifted students according to gender. The data obtained at the end of the analysis showed that the Scientific Epistemological Belief Scale scores differed significantly in favor of female students. Similarly, Topcu and Yılmaz-Tuzun (2009) stated in their study that female students had more developed epistemological beliefs than male students in their findings in which they examined the relationship between science achievement, metacognitive knowledge-organization and epistemological beliefs of primary and secondary school students. Schommer (1993) reported that there was a decline in the epistemological belief levels of female students compared to male students in the education and training process of the students in their study in which they examined the development of secondary school students' beliefs about the nature of knowledge and learning and epistemological beliefs and the effect of these beliefs on academic performance. Along with studies showing that the epistemological beliefs of male and female students differ, there are also studies showing that epistemological beliefs do not differ by gender. For example, Yli-Panula et al. (2021) stated in their research findings that high school students' epistemological beliefs on the subject of climate change did not differ by gender. Similarly, Sapancı (2012) stated in his research that examined the epistemological belief and metacognition levels of prospective teachers in terms of various variables that the level of epistemological belief did not differ by gender. Terzi (2005) examined the scientific epistemological beliefs of university students and stated that there was no significant difference between the scientific epistemological belief levels of male and female students. Topcu and Yılmaz-Tuzun (2009) mentioned that the fact that science courses in our national education system are usually in the form of presentations and that female students have more note-taking, monitoring and planning behaviors than male students may be effective in the development of epistemological beliefs. A similar situation may be the case for gifted female students. Although gifted students receive support education at Science and Art Centers, this time is limited to one hour per week and the educational environment in full-time schools may be more disadvantageous for male students than female students in terms of metacognitive achievements.

When the differences in the Global Warming/Climate Change Awareness Questionnaire scores were examined according to gender, it was seen that the mean scores for the Awareness and Behavior Change Tendency section towards the Causes and Effects of Climate Change did not differ significantly between male and female participants, while the scores obtained from the Awareness of Personal Initiatives section differed significantly in favor of female students. Ceylan et al. (2023) examined the attitudes of gifted 4th grade students towards the environment and stated that female students showed more responsible behaviors towards the environment than male students. Yıldırım and Utkugun (2023), in their study examining the interest of high school students in global warming and climate change, stated that the global warming/climate change awareness of female students differed significantly compared to male students. Sahin and Durkaya (2023) stated that the awareness level of high school students differed significantly in favor of female students in the findings of their study on global climate change awareness. Blocker and Eckberg (1997) stated that parents' sensitivity to environmental problems is effective in their behaviors in the family environment and that mothers are more sensitive to environmental problems in terms of their children's future than fathers. In the Turkish family structure the fact that girls have a closer relationship with their mothers in the family environment, female students take a more active role in family responsibilities and in addition to this the fact that male students are more involved with technology than girls in today's conditions may have affected the awareness level of gifted female about personal initiatives towards climate change.

Conclusion

This study focused on the relationship between gifted students' scientific epistemological beliefs and climate change awareness. The findings obtained from the Scientific Epistemological Belief Questionnaire scores of gifted students showed that the participating students had scientific epistemological beliefs above the average level. When the data obtained from the Global Warming/Climate Change Awareness Questionnaire which was

another data collection tool in the study was examined together with similar studies, it showed that gifted students had high levels of awareness of global warming and climate change. When the relationship between the students' Scientific Epistemological Belief Questionnaire scores and the Global Warming/Climate Change Awareness Scale scores was examined in the study, it was seen that there was a positive significant relationship between the Scientific Epistemological Belief Scale scores of the gifted students and the scores obtained from all three sections of the Global Warming/Climate Change Awareness Questionnaire. According to these findings, it is thought that the scientific epistemological beliefs of gifted students and their global warming/climate change awareness interact and that studies to be conducted to develop the scientific epistemological beliefs of gifted students will affect their climate change awareness levels. We think that when designing a curriculum for gifted students regarding global warming/climate change, studies on children's scientific epistemological beliefs can also be integrated into the content.

When the findings regarding whether there is a significant difference in the Scientific Epistemological Belief Questionnaire scores and the Global Warming/Climate Change Awareness Questionnaire scores according to gender are examined, it is seen that the Scientific Epistemological Belief Questionnaire scores differ significantly in favor of female students. When the findings regarding the differentiation of the Global Warming/Climate Change Awareness Questionnaire scores according to gender are examined, it is seen that there is a difference in the scale sections according to gender. While the mean scores regarding the Awareness of the Causes and Effects of Climate Change and Behavior Change Tendency section do not differ significantly between female and male participants, it is seen that the scores obtained from the Awareness of Personal Initiatives section differ significantly in favor of female students. Within the framework of these findings, it can be said that gifted female students have more developed scientific epistemological beliefs than male students and that the awareness levels of female students regarding personal initiatives regarding climate change are higher than male students. However the fact that the sample of this study is not sufficient to make generalizations regarding the findings is one of the limitations of the research. Another limitation is that the sample was not randomly selected. In addition, gifted eighth grade students do not attend Science and Art Center due to their preparation for the high school entrance exam, so they were not included in the study.

Recommendations

In this study, the relationship between scientific epistemological beliefs of gifted middle school students and their awareness of global warming and climate change was examined using the quantitative method. Mixed design studies can be conducted to obtain in-depth data on the scientific epistemological beliefs of gifted students. In addition, it is thought that longitudinal studies on the relationship between scientific epistemological beliefs and climate change will be important in terms of examining the change in the teaching process. In addition, a larger gifted sample can be used to examine the relationship between these two variables. The relationship between scientific epistemological beliefs and climate change awareness of gifted primary and high school students can be examined and compared with the findings of the study conducted with middle school students. The changes in scientific epistemological beliefs and climate change awareness of gifted girls and boys based on gender can be investigated in depth and the reasons for gender-based differences can be examined.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

References

Akhan, N. E., Cicek, S., & Kocaaga, G. (2022). Critical and creative perspectives of gifted students on global problems: Global climate change. *Thinking Skills and Creativity*, *46*, 101131.

Akkas, E., ve Tortop, H. S. (2015). Ustun yetenekliler egitiminde farklılastırma: Temel kavramlar, modellerin karsılastırılması ve oneriler. *Ustun Zekâlılar Egitimi ve Yaratıcılık Dergisi*, *2*(2), 31-44.

Akpinar, D. *Ustun yetenekli ve zekâlı ogrencilerde Stem egitiminin ozduzenleme, fene yonelik motivasyonları ve epistemolojik inanclarına etkisinin incelenmesi* (Master's thesis, Erzincan Binali Yıldırım Universitesi).

Asut, N., & Koksal, M. S. (2013). Ustun zekâlı ogrencilerin epistemolojik inanclarının fen ögrenmeye yonelik motivasyon duzeyi ve basarıyla iliskisi. *Duzce Universitesi Sosyal Bilimler Dergisi*, *5*(2), 22-44.

Balaban, H. (2023). The effect of context-based approach on gifted students' understanding the topic of global warming. *Journal of Computer and Education Research*, *11*(22), 572-595.

Beasy, K., Jones, C., Kelly, R., Lucas, C., Mocatta, G., Pecl, G., & Yildiz, D. (2023). The burden of bad news: educators' experiences of navigating climate change education. *Environmental Education Research*, *29*(11), 1678-1691.

Benevento, S. V. (2023). Communicating climate change risk to children: A thematic analysis of children's literature. *Early Childhood Education Journal*, *51*(2), 201-210.

Blocker, T. J., & Eckberg, D. L. (1997). Gender and environmentalism: Results from the 1993 general social survey. *Social Science Quarterly*, 841-858.

Bodur, N. C., Tuysuz, C., & Turan, M. D. (2023). Kutuplar: Keşfedilmeyi bekleyen topraklar etkinliginin ozel yetenekli 6. sınıf ogrencilerinin iklim degisikligi farkındalıgına etkisinin incelenmesi. *Usak Universitesi Eğitim Arastırmaları Dergisi*, *9*(3), 144-161.

Busch, K. C., Ardoin, N., Gruehn, D., & Stevenson, K. (2019). Exploring a theoretical model of climate change action for youth. *International Journal of Science Education*, *41*(17), 2389-2409.

Buyukozturk, S. (2011). S*osyal bilimler icin veri analizi el kitabı* (p.141). Ankara: Pegem Akademi.

Buyukozturk, S., Kılıc-Cakmak, E., Akgun, O.E., Karadeniz, S., & Demirel, F. (2019*). Egitimde bilimsel arastırma yontemler*i (26th ed.). Ankara: Pegem.

Calda, B., Kutlug, E., An, N., & Kurnaz, L. (2022). Iklim degişikligi etkilerinin küresel performans gostergeleri acısından degerlendirilmesi. *Resilience*, *6*(1), 171-196.

Cantell, H., Tolppanen, S., Aarnio-Linnanvuori, E., & Lehtonen, A. (2019). Bicycle model on climate change education: Presenting and evaluating a model. *Environmental Education Research*, *25*(5), 717-731.

Ceylan, S., Tetik, T., & Peker, R. (2023). Ozel yetenekli ilkokul öğrencilerinin cevreye yonelik tutum ve sorumlu davranıslarının cesitli demografik degiskenlere gore incelenmesi. *Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi*, *25*(3), 897-917.

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.

Cordie, D. R., & Maxwell, L. (2023). Shifting from climate change denial to acceptance: a mixed-method, semester long case study in an undergraduate first-year experience course. *Environmental Education Research*, *29*(12), 1870-1890.

Creswell, J. W. (2017). *Arastırma deseni nitel, nicel ve karma yontem yaklasımları* (3th ed.). Ankara: Egiten Kitap.

Cutter-Mackenzie, A., & Rousell, D. (2018). Education for what? Shaping the field of climate change education with children and young people as co-researchers. *Children's Geographies, 17*(1), 90–104.

Coban, G. U., & Sengoren, S. K. (2020). Epistemological views of prospective physics teachers. *International Online Journal of Educational Sciences*, *3*(3), 1224-1258.

Dal, B., Alper, U., Ozdem-Yilmaz, Y., Ozturk, N., & Sonmez, D. (2015). A model for pre-service teachers' climate change awareness and willingness to act for pro-climate change friendly behavior: adaptation of awareness to climate change questionnaire. *International Research in Geographical and Environmental Education*, *24*(3), 184-200.

Daglıoglu, H.E. (2010). Ustun yetenekli cocukların egitiminde ögretmen yeterlikleri ve ozellikleri. *Milli Egitim Dergisi*. 40(186), 72-84.

Davis, G. A., & Rimm, S. B. (1989). *Education of the gifted and talented*. Prentice-Hall, Inc.

Fulmer, G. W. (2014). Undergraduates' attitudes toward science and their epistemological beliefs: Positive effects of certainty and authority beliefs. *Journal of Science Education and Technology*, *23*(1), 198–206.

Gilbert, J.K. & Newberry, M. (2017). Fen alanında ustun yetenekli olan ve sıra dışı yetenege sahip bireylerin ozellikleri. In K.S. Taber (Ed.), *Ustun yetenekliler için fen egitimi*. (pp 21-40). Ankara: Pegem Yayınları.

Greene, J. A., & Yu, S. B. (2016). Educating critical thinkers: The role of epistemic cognition. *Policy Insights from the Behavioral and Brain Sciences*, *3*(1), 45-53.

Greene, J. A., Cartiff, B. M., & Duke, R. F. (2018). A meta-analytic review of the relationship between epistemic cognition and academic achievement. *Journal of Educational Psychology, 110*(8), 1084.

Holthuis, N., Lotan, R., Saltzman, J., Mastrandrea, M., & Wild, A. (2014). Supporting and understanding students' epistemological discourse about climate change. *Journal of Geoscience Education*, *62*(3), 374-387.

IPCC. (2023). Summary for policymakers. In H. Lee, J Romero (Eds.), *Climate change 2023: Synthesis report.*

Kale - Oksuz, B. (2019). *Bilimsel argumantasyona dayalı etkinliklerin ortaokul 7. sınıf ogrencilerinin insan ve cevre unitesindeki akademik basarılarına ve iklim değişimine yönelik farkındalıklarına etkisi* (Master's thesis).

Karakaya, F., Unal, A., Cimen, O., & Yılmaz, M. (2018). Ustun yetenekli öğrenciler ve akranlarının çevre algılarının incelenmesi. *Online Science Education Journal*, *3*(1), 25-32.

Khattree, R., & Naik, D. N. (1999). *Applied multivariate statistics with SAS software*. New York, NY: Wiley.

Kılıc, M., & Demirbag, M. (2020). Ustun yetenekli ogrenciler ile velilerinin epistemolojik inanc profillerinin belirlenmesi ve karsılastırılması. *Istanbul Aydın Üniversitesi Eğitim Fakültesi Dergisi*, *6*(2), 151-173.

Korkut, S. (2022). Environmental sensitivity of gifted children: A picture analysis based research. *Journal of Gifted Education and Creativity*, *9*(3), 243-259.

Koshy, V., & Pinheiro-Torres, C. (2013). 'Are we being de-gifted, miss?'Primary school gifted and talented co-ordinators' responses to the gifted and talented education policy in England. *British Educational Research Journal*, *39*(6), 953-978.

Koshy, V. & Robinson, N. M. (2006). Too long neglected: Gifted young children. *European Early Childhood Education Research Journal*, *14*(2), 113-126.

Kurnaz, M. L. (2023). Iklim degisikligi ve uyum sureclerinde Turkiye. *Resilience*, *7*(1), 199-208.

Kursad, M. S. (2015). Bilimsel arasstırmaya yoonelik tutum ve epistemolojik inanc arasındaki iliskinin incelenmesi. *Abant Izzet Baysal Universitesi Egitim Fakultesi Dergisi*, *15*(2), 217-246.

Leiserowitz, A.; Maibach, E.; Roser-Renouf, C.; Smith, N. (2010). Climate change in the American mind: Americans' global warming beliefs and attitudes. In *Yale project on climate change communication*. Yale University and George Mason University, New Haven, CT, USA.

Liu, S., & Roehrig, G. (2019). Exploring science teachers' argumentation and personal epistemology about global climate change. *Research in Science Education*, *49*, 173-189.

Milli Egitim Bakanlıgı [MEB]. (2024). *Bilim ve sanat merkezleri yonergesi.* Ankara: Milli Eğitim Bakanlığı.

Mutlu, F., & Nacaroglu, O. (2019). Examination of perceptions of gifted students about climate change and global warming. *Journal of Baltic Science Education*, *18*(5).

Nacaroglu O. & Karaaslan G. (2020). Ozel yetenekli ogrencilerin iklim değişikliğine yönelik bilişsel yapılarının incelenmesi. *Gumushane Universitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*, *11*, 1-13.

Orbay, K., Cansaran, A., Kalkan, M. (2009). Ogretmen adaylarının küresel ısınmaya bakıs acıları. *Ahmet Kelesoglu Egitim Fakultesi Dergisi*, *27*, 85-97.

Ozarslan, M. (2022). Environmental problems according to the gifted and talented students and their solutıon proposals: A qualitative research. *IJTASE*, *11*(4), 201-216.

Ozbay, H. E. (2016). *Ortaokul öğrencilerinin akademik basarılarının bilimsel epistemolojik inanclar ve zihinsel risk alma davranışları ile iliskisinin incelenmesi*. (Doctoral dissertation, Inonu University).

Ozkan, S. (2008). *Modeling elementary students' science achievement: The interrelationships among epistemological beliefs, learning approaches, and self-regulated learning strategies*. Doctoral dissertation.

Quarderer, N. A., Fulmer, G. W., Hand, B., & Neal, T. A. (2021). Unpacking the connections between 8th graders' climate literacy and epistemic cognition. *Journal of Research in Science Teaching*, *58*(10), 1527–1556.

Sapanci, A. (2012). Ogretmen adaylarının epistemolojik inancları ile bilisustu duzeylerinin akademik başarıyla ilişkisi. *Celal Bayar Universitesi Sosyal Bilimler Dergisi*, *10*(01), 311-331.

Schommer, M. (1990). Effect of beliefs about the nature of knowledge on comprehension. *Journal of Educational of Psyhology*, *(82*), 498-504.

Schommer, M. (1993). Epistemological development and academic performance among secondary students. *Journal of Educational Psychology*, *85*(3), 406-411.

Schommer-Aikins, M. & Hutter, R. (2002). Epistemological beliefs and thinking about everyday controversial issues. *The Journal of Psychology*, *136*(1), 5–20.

Schreiber, J. B. & Shinn, D. (2003). Epistemological beliefs of community college students and their learning processes, *Community College Journal of Research and Practice*, *27*(4), 699-709.

Schreiner, C., Henriksen, E., & Hansen, P. J.K. (2005). Climate Education: Empowering today's youth to meet tomorrow's challenges. *Studies in Science Education*, *41* (1), 3-49.

Selcuk, S. F. (2023). Uluslararası iklim degisikligi anlasmaları ve Turkiye'nin tutumu. *Ulusal Cevre Bilimleri Arastırma Dergisi*, *6*(1), 9-19.

Sinatra, G. M., Kardash, C. M., Taasoobshirazi, G., & Lombardi, D. (2012). Promoting attitude change and expressed willingness to take action toward climate change in college students. *Instructional Science*, *40*(1), 1-17.

Sontay, G., Gokdere, M., & Usta, E. (2014). Ustun yetenekli ogrencilerle akranlarının çevresel davranışlarının karşılastırmalı incelenmesi. *Turk Ustun Zekâ ve Egitim Dergisi*, *4*(2), 90-106.

Sahin, M., & Durkaya, B. (2023). Bartın lise ogrencileri kuresel iklim degişimi ve orman biyokutlesi farkındalıgı. *Bartın Orman Fakultesi Dergisi*, *25*(3), 466-478.

Taber, K. S. (2010). Challenging gifted learners: General principles for science educators; and exemplification in the context of teaching chemistry. *Science Education International*, *21*(1), 5-30.

Taber, K.S. (2017). Neden ustun yetenekliler icin fen egitimi? In K.S. Taber (Ed.), *Ustun yetenekliler icin fen eğitimi.* (pp. 3-19). Ankara: Pegem Yayınları.

Terzi, A.R. (2005). Universite ogrencilerinin bilimsel epistemolojik inancları uzerine bir arastırma. *Sosyal Bilimler Dergisi*, 298–311.

Topcu, M. S., & Yılmaz-Tuzun, O. (2009). İlköğretim öğrencilerinin bilis otesi ve epistemolojik inançlarıyla fen başarıları, cinsiyetleri ve sosyoekonomik durumları. *Ilkogretim Online*, *8*(3), 676-693.

Ugulu, I. (2013). Ustun zekalı/yetenekli olan ve olmayan ogrencilerin cevreye yonelik tutumlarının karsılastırılması. *Dokuz Eylul Universitesi Buca Egitim Fakultesi Dergisi*, (35), 1-14.

VanTassel-Baska, J. ,& Wood, S. (2010). The integrated curriculum model. *Learning and Individual Differences, 20,* 345–357.

Veijonaho, S., Ojala, M., Hietajärvi, L., & Salmela-Aro, K. (2024). Profiles of climate change distress and climate denialism during adolescence: A two-cohort longitudinal study. *International Journal of Behavioral Development*, *48*(2), 103-112.

Yıldırım, R., & Utkugun, C. (2023). Lise ogrencilerinin kuresel ısınma ve iklim degisikligine yonelik bilgi ve algıları. *Cumhuriyet Uluslararası Egitim Dergisi, 12*(4), 998-1013.

Yılmaz, S. B., & Emir, S. (2024). Comparison of the 21st century skills and climate literacy: A study on the gifted and undiagnosed gifted secondary school students. *Journal of Hasan Ali Yücel Faculty of Education/Hasan Ali Yucel Egitim Fakültesi Dergisi (HAYEF), 21*(1), 22072

Yli-Panula, E., Laakkonen, E., & Vauras, M. (2021). High-school students' topic-specific epistemic beliefs about climate change: An assessment-related study. *Education Sciences, 11*(8), 440.

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