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Middle School Students' Environmental Attitudes and Informal Reasoning Regarding an Environmental Socioscientific Issue

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Abstract

The purpose of the current study is to reveal students' environmental attitudes, their informal reasoning, and how their informal reasoning on a socioscientific issue changes depending on their environmental attitudes. The study participants were 104 eighth-grade students. A form consisting of a scenario and open-ended questions was used as data collection tools. During the analysis of the collected data, the descriptive analysis method and descriptive statistics were used. The findings revealed that the majority of the students had an anthropocentric attitude toward the socioscientific issue and largely presented rationalistic reasoning. Moreover, while the students with an anthropocentric attitude used rational reasoning more, students with an ecocentric attitude presented rationalistic, emotional, and rationalistic-emotional reasoning. Considering the findings of the current study, suggestions are made to develop students' emotional reasoning as well as rational reasoning by means of training students to have an ecocentric attitude.

Keywords: Environmental Attitudes; Informal Reasoning; Middle School Students; Socioscientific Issue

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INTRODUCTION

The main goal of science education in many countries is to prepare students to be scientifically literate (DeBoer, 2000; Liu, Lin, & Tsai, 2011; Osborne, 2007; Tsai, 2010). Scientific literacy includes the thinking skills that citizens should have about issues that they are likely to encounter throughout their lives (Hurd, 1998). Researchers argue that science teaching based on real-life experiences will support the development of students into individuals who are capable of coping with the problems of daily life and who can improve their quality of life (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1991).

Socioscientific issues (SSI) currently contribute to the training of scientifically literate individuals by establishing a bridge between science classes and the daily life of students (Dolan, Nichols, & Zeidler, 2009). One of most common contexts for SSI study is environmental issues (Tekin, Aslan & Yılmaz, 2016). Exploring the attitudes of individuals about environmental socioscientific issues will help to have information about the decisions they will take or the behaviors they will exhibit about these issues. Numerous researchers have shown that behaviors and/or decisions regarding environmental issues are affected by individuals' environmental attitudes (Esmaeilpour & Bahmiary, 2017; Gadenne, Sharma, Kerr & Smith, 2011; Uğulu, Şahin, & Başlar, 2013). For example, Polonsky, Vocino, Grau, Garma, and Ferdo (2012) found that having a positive attitude toward the environment is associated with making environmentally friendly decisions. Esmaeilpour and Bahmiary (2017) revealed that a positive environmental attitude has a significant impact on the decision to buy environmentally friendly products. Thompson and Barton (1994) showed a positive and significant relationship between ecocentrism and performing environmentally friendly behaviours, while there was no significant relationship between anthropocentrism and environmentally friendly behaviours. Therefore, it can be stated that our environmental attitudes affect whether we will make an environmentally friendly decision or exhibit an environmentally friendly behaviour. Drawing from this conclusion, it is clearly important to educate individuals to have an ecocentric attitude rather than an anthropocentric attitude through environmental education (Goldman, Assaraf & Shaharaban, 2013). The first step of training individuals with desired environmental attitudes can be expressed as exploring their environmental attitudes. The most important changes related to attitudes occur in the time preceding high school; attitudes are hardened and become difficult to change during the high school period (Eagles & Demare, 1999). For this reason, determining the attitudes of primary school students toward the environment is critical in terms of training students to have an ecocentric attitude.

In addition to attitudes, informal reasoning processes also influence our decisions on SSI. The decision-making process regarding SSI requires individuals to engage in informal reasoning (Sadler, 2003). Indeed, the process of decision-making in SSI is defined by the concept of informal reasoning (Sadler, 2004; Sadler & Zeidler, 2005a). Research has shown that the more informal reasoning patterns used in the decision-making process, the more informed and reasonable the decisions will be (Yapıcıoğlu & Aycan, 2018). Sadler and Zeidler (2005a) recommend using different subject contexts to foster student presentation of different informal reasoning patterns. However, although the issues such as global warming (Topçu, 2008; Zorlu, 2017) and water pollution (Karpudewan & Roth, 2016) have been used more frequently in recent times to reveal students' informal reasoning, the literature indicates that investigation of students' informal reasoning is generally limited to certain subjects: biotechnology, cloning, genetically modified organisms, gene therapy, and genetic engineering (Dawson & Venville, 2009, 2013; Kolarova, Hadjiali, & Denev, 2013; Sadler & Zeidler, 2005a,b). Moreover, most of the studies on informal reasoning were conducted in high schools and universities (Cerbin, 1988; Kolarova et al., 2013; Sadler & Zeidler, 2005a, 2005b; Topçu, 2008; Topcu, Sadler, & Yilmaz-Tuzun, 2010; Venville & Dawson, 2010, 2013; Wu & Tsai, 2007; Yang & Anderson, 2003). Revealing the informal reasoning of younger students will help education researchers to understand which cognitive and affective processes they use to solve a complex environmental socioscientific problem. The findings can be used to educate students to be effective citizens who can use different informal reasoning processes from an early age in the face of many dilemmas.

The relationship between informal reasoning patterns and attitude approaches can also facilitate improved informal reasoning and environmental attitudes. For example, although two people

who have decided against the destruction of forest areas seem to have made the same decision, their reasons may be different. While one person may be against the destruction of forests because it will harm plants and animals—thus presenting a more ecocentric attitude—the other may take a more anthropocentric stance, saying that trees produce fresh air for humans. Therefore, one of the aims of the present study is to determine how the informal reasoning patterns that students present when making decisions about an SSI change depending on their environmental attitudes. In designing the current study, individuals with an anthropocentric environmental attitude were expected to present more rationalistic reasoning, while individuals with an ecocentric attitude were expected to present emotional reasoning as well as rationalistic reasoning. Because individuals with an ecocentric attitude feel strongly that other living things are valuable and have the same right to live as humans, the well-being of other creatures is as important as the well-being of humans in their perspective. Thus emotional reasoning, which involves caring for the well-being of others in the decision-making process, was expected to be used more frequently by individuals with an ecocentric attitude.

The findings of the current study may be able to guide educators and researchers in the process of designing environmental education curriculum. In addition to the outcomes of having an ecocentric attitude mentioned in the literature—such as buying "green" products or displaying environmentally friendly behaviours—there is also the potential to develop higher order thinking skills like informal reasoning. Future educational environments will be designed to benefit from this potential. Based on these goals, the following research questions were used to guide the current study:

1. What kinds of informal reasoning patterns (rationalistic, emotional, intuitive) do the middle school student participants present about an environmental socioscientific issue?

2. What environmental attitudes (anthropocentric or ecocentric) do the middle school student participants have toward the environmental socioscientific issue?

3. How do the informal reasoning patterns demonstrated by the middle school student participants during decision making on a socioscientific issue change depending on their environmental attitudes?

Conceptual framework

In modern societies, people face many controversial issues as a result of rapid scientific and technological developments. Those issues that involve scientific processes or products and cause social debates are defined as socioscientific issues (SSI) (Sadler & Zeidler, 2005a). Because they have no single answer and can be evaluated from different perspectives (Sadler, Chambers, & Zeidler, 2004). They may require making choices on a personal or social level, generating ideas, conducting profit/loss analysis, or making ethical judgments (Ratcliffe & Grace, 2003). Cloning, genetically modified organisms, and nuclear power plants are common SSI likely to affect our lifestyle, standards, and health.

The emphasis on SSI in educational research is increasing. One reason for this increase may be attributed to the role of SSI in the acquisition of scientific literacy. Today, scientific literacy is more than having content knowledge—rather, it is related to the use of this knowledge in decision-making processes concerning issues with both social and scientific aspects (Lederman, Antink, & Bartos, 2014). In fact, one way to improve scientific literacy is the acquisition of socioscientific skills and values (Holbrook & Rannikmae, 2009; Sadler, 2004). The National Research Council (NRC) and the American Association for the Advancement of Science (AAAS), two of the most recognized science education research centers in the world, also emphasize the importance of SSI in science education. For example, the NRC (1996) states that individuals should be able to participate in social debates on important issues involving science and technology. At the end of a successful science education, individuals are expected to be able to make inferences about SSI, to interpret the evidence, and to have discussion skills (Sadler & Zeidler, 2005a). Determining the decision-making processes that students undertake when they encounter SSI is important in determining the extent to which the objectives of

science education have been achieved. Revealing the processes and patterns used by students will help to develop appropriate socioscientific issue curricula and pedagogical strategies, and thus promote scientific literacy (Sadler & Zeidler, 2005a). Therefore, the present study attempted to reveal students' environmental attitudes, their informal reasoning, and how their informal reasoning on an environmental SSI changes depending on their environmental attitudes.

Informal reasoning and socioscientific issues

One of our duties as citizens is to take part in finding solutions to social problems (Patronis, 1999). Informal reasoning is used to address social problems like SSI (Means & Voss, 1996; Sadler, 2004; Sadler & Zeidler, 2005a) because informal reasoning is used with problems that are complex, loosely defined, poorly-structured, and open-ended problems, i.e., problems that do not have a single correct answer but different solutions (Venville & Dawson, 2010; Widodo, Saptarani, Riandi, & Rochintaniawati, 2017; Wu & Tsai, 2007). Using informal reasoning processes to think about SSI gives students the opportunity to use what they have learned in science classes to solve the problems they face in daily life (Wu & Tsai, 2007). Educating individuals who can find more rational solutions for real-life problems by applying science knowledge is one of the objectives of science education (Kırpık & Engin, 2009). Therefore, it can be argued that informal reasoning is a competence that is necessary for solving the SSI we face in daily life, and that it must be developed in order to achieve the objectives of science education.

Informal reasoning on SSI has been the subject of many studies. Different studies have used different informal reasoning evaluations, in terms of quality or patterns. Since informal reasoning occurs during the argumentation process, the quality of informal reasoning is often measured by the quality of argumentation (Topçu, 2008; van Eemeren et al., 1996). Besides, informal reasoning is analyzed through patterns in some studies (Liu et al., 2011; Sadler & Zeidler, 2005a) and by modes in others (Patronis, Potari, & Spiliotopoulou, 1999; Yang & Anderson, 2003). In their study, Patronis et al. (1999) classified the informal reasoning presented by students into four modes: social, ecological, economic, and practical. Yang and Anderson (2003) identified three modes, stating that people's informal reasoning on the use of nuclear energy tended to be scientific, social, or both scientific and social. Wu and Tsai (2007) developed a different framework to analyze students' informal reasoning on socioscientific issues. According to this framework, informal reasoning is categorized under socially-, ecologically-, economically-, scientifically-, or technologically-oriented arguments. Another framework belonging to Liu et al. (2011) used four categories: ecological, ethical-aesthetical, scientific-technological, and socio-economical. Sadler and Zeidler (2005a) conducted interviews with university students about genetic engineering. At the end of their research, they found that students presented three kinds of informal reasoning: rationalistic, emotional, and intuitive. Rationalistic reasoning involves reason or cause-oriented thinking and includes pros-and-cons analysis. Emotional reasoning is used when the primary point of view in the decision-making process is empathy and caring for the well-being of others. Finally, intuitive reasoning is based on quick reactions. Sadler and Zeidler (2005a) found that rationalistic, emotional, and intuitive informal reasoning patterns are not always used alone; sometimes several patterns simultaneously appear in individuals' expressions. They found that individuals often use multiple informal reasoning patterns even for a single SSI. They used the term "integrated patterns" for this reasoning. The four kinds of integrated patterns are rationalistic and emotional, rationalistic and intuitive, intuitive and emotional, and rationalistic, intuitive and emotional.

One of the purposes of the current study is to determine how the students' informal reasoning patterns change depending on the environmental attitudes they have—i.e., whether having an anthropocentric attitude or ecocentric attitude caused any differences in terms of using rationalistic, emotional, or intuitive reasoning. To this end, the analytical framework developed by Sadler and Zeidler (2005a) was chosen.

In the literature, various SSI have been used to elicit the informal reasoning patterns used by students. Yet these issues have generally focused on scenarios with a genetic content (Dawson & Venville, 2009, 2013; Kolarova et al., 2013; Sadler & Zeidler, 2005a). The results of the existing

research have revealed that students generally presented rationalistic reasoning when discussing SSI with a genetic content (Sadler & Zeidler, 2005a, b; Venville & Dawson, 2010). In addition, issues such as global warming (Topçu, 2008; Zorlu, 2017) and water pollution (Karpudewan & Roth, 2016) have been used more frequently in recent times to reveal students' informal reasoning. In these studies, the participants also largely used rationalistic reasoning (Karpudewan & Roth, 2016; Topçu, 2008; Zorlu, 2017). Sadler and Zeidler (2005a) stated that different SSI can be used to elicit different reasoning patterns. They argued that environment-centred scenarios, such as nuclear energy and global warming, would be useful to further evaluate student reasoning and decision making. In the current study, an environmental SSI was selected, on the grounds that it could allow students to present different reasoning patterns.

Environmental attitudes and socioscientific issues

The recent spread of pollution and ecological problems has made environmental issues one of the most widely discussed global issues (Alpak-Tunç & Yenice, 2017). Extinction of species, global warming, and water pollution are just few of the important environmental problems facing societies today (Kortenkamp & Moore, 2001). Studies on the environment agree that the main factor in efforts to prevent environmental problems is humanity—and that humankind is also the main factor in creating these problems (Erten, 2008). Therefore, it can be argued that the protection and development of the environment should begin with the education of people.

Because our stance on environmental issues is influenced by our values and beliefs (Lundmark, 2007), environmental education should emphasize ethics (Alpak-Tunç & Yenice, 2007) in addition to knowledge-based education. For example, the answer to the question "Do we see the environment as a property that we can exploit as we wish for our own interests, or as an element valuable in itself?" (Kortenkamp & Moore, 2001) will provide important insights into our perception of the environment and environmental decisions. Des Jardins (2006), in his book *Environmental Ethics*, describes environmental ethics as a systematic investigation of the moral relations between humans and their natural environment.

In the literature, there are different theories of environmental ethics. Ertan (2004) categorizes the ethical approaches as anthropocentric, biocentric, and ecocentric. In an anthropocentric ethical approach, the environment is valuable as long as it is beneficial for people and should be protected for the benefit of future generations. In the biocentric ethical approach, both humans and all other living things are intrinsically valuable. It argues that humans should feel responsibility towards these living things. The ecocentric approach recognizes people as part of the environment and attaches a great importance to ecological laws. Kortenkamp and Moore (2001) use the terms ecocentrism, anthropocentrism, and non-environmental to differentiate ethical reasoning patterns. They write that anthropocentric ethics focuses on how nature affects people; because the behaviours exhibited towards nature affect people in turn, nature deserves ethical consideration. Ecocentric ethics focuses on the benefit of nature, arguing that nature deserves ethical consideration because nature itself has value. Finally, Kortenkamp and Moore (2001) used the non-environmental code when a response referred to social contracts, guilt, or truthfulness. In another study, Amerigo, Aragonés, Frutos, Sevillano & Cortés, (2007) discussed environmental beliefs in three dimensions: anthropocentric, biospheric, and egobiocentric. In the study, anthropocentrism is defined as caring about the instrumental value of the environment to human beings. Those in the biocentric dimension value the environment for the good of the environment, while the egobiocentric dimension is the conception that humanity is valuable as a whole *within* nature (Amerigo et al., 2007).

Thompson and Barton (1994) introduced anthropocentrism (nature valued because of the material or physical benefits it can provide to human beings) and ecocentrism (nature valued for the good of nature) as environmental attitudes. In both approaches individuals attach importance to the environment, but their reasoning differs. Many studies in the literature have examined ecocentrism and anthropocentrism under the heading of environmental attitudes using the Thompson and Barton (1994) study (e.g., Erten, 2008; Siegrist, 1997). In the present study, these concepts are discussed under the heading of environmental attitude similar to Thompson and Barton (1994) and the focus of

investigation was how informal reasoning patterns change depending on the environmental attitudes, i.e., the reason they value nature. For this reason, it was decided that the dual anthropocentric and ecocentric attitudes defined by Thompson and Barton (1994) would serve the purpose of the current study.

METHOD

Research design

In the data collection and analysis processes, the basic qualitative research method was used. Qualitative research design focuses on a detailed explanation of the subject under investigation and production of its holistic definitions (Fraenkel, Wallen, & Hyun, 2012). Qualitative research also makes it possible to collect first-hand information about the participant's experiences and insights (Patton, 2002). The data of the current study were collected through forms completed by 104 middle school students. These forms were analyzed using descriptive statistics to conduct a detailed investigation of how the students' informal reasoning changed depending on the environmental attitudes they have.

Participants

The study participants were 104 eighth grade students. Of the participating students, 49 were female (47.1%) and 55 were male (52.9%). The participating students were attending a state school of the Ministry of National Education in a city located in eastern Turkey. The students had not taken a special environmental education course, though they had received some environmental education within the courses, such as science education and life sciences.

After the required permissions were granted from the parents and school administration, the students completed the forms at a time decided by the school administration. It took approximately an hour for the students to complete the form.

Data collection tools

The form used as the data collection tool, a scenario with response questions, was developed by the researchers. For the purposes of the study, the scenario used could illicit rationalistic, emotional, or intuitive answers. It was also agreed that the scenario should have a context that required the students to think both anthropocentrically and ecocentrically so that their environmental attitudes could be determined. In studies in the field of informal reasoning, many scenarios related to biotechnology, genetic studies, cloning, and gene therapy are used (Dawson & Venville, 2009, 2013; Kolarova et al., 2013; Sadler & Zeidler, 2005a, b). However, it was agreed that these scenarios would not be suitable for revealing students' environmental attitudes and that an environmental SSI would better serve the purpose of the current study. In addition, in the literature, students generally presented rationalistic reasoning (Topçu, 2008; Karpudewan & Roth, 2016; Sadler & Zeidler, 2005a, b; Venville & Dawson, 2010; Zorlu, 2017). Therefore, the researchers wrote environmentally oriented content that would require not only people, but also other living things to be taken into consideration, thus allowing participants to reveal any emotional reasoning. After the desired scenario was written, questions used by Sadler and Zeidler (2005a) were added to the end of the scenario to reveal the students' environmental attitudes and informal reasoning patterns. The scenario and questions were then revised in line with the views of a faculty member who was an expert in SSI, a research assistant doing a PhD in Science Education, and a Turkish teacher. The piloting of the form was conducted with 15 eighth-grade students and the form was finalized.

Data analysis

The data collected through the form were analyzed from three perspectives: attitudes toward the environment, informal reasoning patterns, and how informal reasoning patterns change depending on attitude toward the environment. Diversity of researchers ensured the reliability and confirmability of the study. To this end, each researcher analyzed 30 of the forms individually in terms of both environmental attitude approaches and informal reasoning patterns. Then the analyses were compared and disagreements were eliminated. The remaining forms were analyzed by one of the researchers. For those student statements found to be difficult to code, the researchers discussed and reached common decisions.

Analysis of attitudes toward the environment

Students' attitudes towards the environment were analyzed within the context of the environmental attitude approaches developed by Thompson and Barton (1994). Thompson and Barton (1994) evaluated people's environmental attitudes as anthropocentric (human-based) or ecocentric (ecologically-based). In both approaches, people can care about nature and make decisions for the benefit of the environment, but the reasons behind their decisions are different. In the present study, students' environmental attitudes were analyzed with anthropocentrism and ecocentrism codes. The anthropocentrism-ecocentrism code was used for people having both approaches. Sample statements suitable for each code in the framework are given in the findings section. In addition, frequency and percentage calculations were made for the codes.

Analysis of informal reasoning

The students' informal reasoning was analyzed according to the informal reasoning patterns developed by Sadler and Zeidler (2005a). These patterns were rationalistic, emotional, and/or intuitive. Rationalistic reasoning involves reason or cause-oriented thinking and pros-and-cons analysis. Emotional informal reasoning involves empathy and caring for the well-being of others in the decision-making process. Intuitive reasoning is defined as impulsive emotions and reactions that cannot be explained in the framework of logic, based on sudden reactions to a certain scenario. Sadler and Zeidler (2005a) found that students generally used for expressions containing more than one informal reasoning pattern and they called these patterns as integrated patterns (such as rationalistic-emotional, rationalistic-intuitive, emotional- intuitive, rationalistic-emotional- intuitive). Sample statements suitable for each of the patterns in the framework are given in the findings section. As there was no student presenting intuitive reasoning, the sample intuitive statement is given in conjunction with other patterns. After coding the answers given by the students according to informal reasoning patterns, frequency and percentage calculations were made for the related codes.

FINDINGS

In this section, findings related to the environmental attitudes possessed by the students, the informal reasoning patterns presented by the students, and how their informal reasoning patterns changed depending on their environmental attitudes are presented. Moreover, in order to support the findings from data analysis, direct quotations from the students are also given in this section.

Environmental attitudes

Environmental attitudes of the students toward the environmental SSI are coded as anthropocentric, ecocentric and both anthropocentric and ecocentric. Frequency and percentage calculations of these codes are presented in Table 1.

Table 1. Environmental attitudes possessed by the students

Variables		
Environmental attitude	f	%
Anthropocentric	60	57.7
Ecocentric	20	19.2
Anthropocentric and ecocentric	24	23.1
Total	*104*	*100*

As can be seen in Table 1, of the 104 students, 60 (57.7%) have an anthropocentric attitude, 20 (19.2%) have an ecocentric attitude, and 24 (23.1%) have both an anthropocentric and ecocentric attitude. This finding shows that most students had an anthropocentric attitude towards the environmental SSI. Sample student statements from an anthropocentric, ecocentric, and both anthropocentric and ecocentric approach are presented below.

Antropocentric statements: No, I do not support cutting trees because if there are no trees, there will be no oxygen, no life. People cut trees for winter and therefore cutting trees is not correct."

Ecocentric statements: *Trees, forest should not die… I want humans to live, but animals also have [the] right to live. Only for their own interests, humans should not give harm to animals and plants. Each living thing deserves living.*

Anthropocentric and ecocentric statements: *…a lot of animals live in the forest. [An] animal's life is as important as our life. We are not the only creatures living in this world. The world, universe, forest are not only for human beings; animals are also important (Ecocentric). Moreover, animals help people in many respects. Plants help us find cures to our illnesses (Antropocentric).*

Informal reasoning patterns

The informal reasoning patterns presented by the students were coded as rationalistic, emotional, intuitive, rationalistic-emotional, emotional-intuitive, rationalistic-intuitive, or rationalistic-emotional-intuitive. Frequency and percentage calculations for these codes are presented in Table 2.

Table 2. Informal reasoning patterns presented by the students

Variables		
Informal reasoning	f	%
Rationalistic	54	51.9
Emotional	10	9.6
Rationalistic and emotional	26	25
Rationalistic and Intuitive	10	9.6
Emotional and intuitive	1	1
Rationalistic, Emotional and Intuitive	3	2.9
Total	*104*	*100*

As shown in Table 2, of the 104 students participating in the current study, 54 (51.9%) presented rationalistic; 10 (9.6%) emotional; 26 (26%) rationalistic and emotional; 10 (9.6%) rationalistic and intuitive; 1 (1%) emotional and intuitive; and 3 showed (2.9%) rationalistic, emotional and intuitive reasoning. This finding shows that rationalistic reasoning was most frequently used when making decisions about the environmental SSI. Sample student statements for the informal reasoning patterns presented by the students are given below. For statements with multiple patterns, each sentence is labelled with the appropriate pattern—for example, (R), (E), or (I)—after the punctuation.

Rationalistic: *No, because trees are the source of oxygen for us, source of life for animals. Animal species may become extinct and oxygen may be depleted*.

Emotional: *I think it should be done because it [could] be your brother or one of your relatives [that had] cancer.*

Rationalistic and Emotional: *No, I do not support. Put yourself into the shoes of those animals that will die, if your house is destroyed, how do you feel? (E) If trees die, our oxygen is depleted, then we die. (R)*

Rationalistic and Intuitive: *Yes, I would like because they are cure[s] to many illnesses. (R) I would ask this question to persuade my friends, "are humans or forests more important?" And then I leave it to their conscience. (I) I think people who do not want trees to be cut are people who do not care about people and who only care about their own interests. (I)*

Rationalistic, Emotional, and Intuitive: *No, I don't support because the world is not only ours. If trees become extinct, we won't have any air to breathe. (R) The God created this world not only for us but also for animals and plants. (I) If someone destroyed your house, wouldn't you feel sorry? Put yourself into their shoes and think. (E) If there were no trees, plants and animals, how could we find oxygen? How could we make use of medicinal herbs? (R) These animals have families, so we cannot destroy their home. (E)*

Informal reasoning patterns corresponding to the students' environmental attitudes

In order to find an answer to the question of how the informal reasoning patterns presented by the students change depending on the environmental attitudes they have, frequency and percentage calculations of the informal reasoning patterns alignment with each environmental attitude were made. The obtained findings are presented in Table 3.

Table 3. Informal reasoning patterns corresponding to the students' environmental attitudes

Attitude	Informal reasoning	f	%
Anthropocentric	Rationalistic	37	61.7
	Emotional	5	8.3
	Rationalistic and Emotional	10	16.7
	Rationalistic and Intuitive	7	11.7
	Rationalistic, Emotional, and Intuitive	1	1.7
	Total	*60*	*100.0*
Ecocentric	Rationalistic	8	40.0
	Emotional	5	25.0
	Rationalistic and Emotional	6	30.0
	Emotional and Intuitive	1	5.0
	Total	*20*	*100.0*
Anthropocentric and ecocentric	Rationalistic	9	37.5
	Rationalistic and Emotional	10	41.7
	Rationalistic and Intuitive	3	12.5
	Rationalistic, Emotional, and Intuitive	2	8.3
	Total	*24*	*100.0*

As can be seen in Table 3, 37 (61.7%) of the 60 students with an anthropocentric attitude presented rationalistic reasoning, 5 (8.3%) emotional reasoning, 10 (16.7%) rationalistic and emotional reasoning, 7 (11.7%) rationalistic and intuitive reasoning, and 1 (1.7%) rationalistic, emotional, and intuitive reasoning. Moreover, 8 (40%) of the 20 students with an ecocentric attitude presented rationalistic reasoning, 5 (25%) emotional reasoning, 6 (30%) rationalistic and emotional

reasoning, and 1 (5%) emotional and intuitive reasoning. Of the 24 students with an anthropocentric and ecocentric attitude, 9 (37.5%) presented rationalistic reasoning, 10 (41.7%) rationalistic and emotional, 3 (12.5%) rationalistic and intuitive, and 2 (8.3%) rationalistic, emotional, and intuitive reasoning. These findings show that students with an anthropocentric attitude often presented rationalistic reasoning, and individuals with an ecocentric attitude presented rationalistic reasoning, emotional reasoning, and rationalistic-emotional reasoning more. The findings also suggest that the students with an anthropocentric-ecocentric attitude presented rationalistic and rationalistic-emotional reasoning more.

Discussion and suggestions

In this section, the findings regarding the eighth-grade students' environmental attitudes, the informal reasoning they presented, and how their informal reasoning was related to their environmental attitudes are discussed. Some suggestions are made and limitations are discussed to train students to have an ecocentric attitude and to use different informal reasoning patterns.

Environmental attitudes

One aim of the current study was to explore eighth-grade students' environmental attitudes toward a SSI. Analysis indicated that of the 104 students, 60 students (57.7%) were found to have an anthropocentric attitude, 20 (19.2%) an ecocentric attitude, and 24 (23.1%) an anthropocentric-ecocentric attitude. These results show that the majority of the participants had an anthropocentric attitude. In other words, the primary motivation behind the student arguments against the destruction of forest areas seemed to be the benefits that forests offer humans. This finding is supported by a study conducted by Bahar and Şahin (2017) to evaluate middle school students' behaviours toward the environment, their motivational concerns, and the extent to which they relate to nature. The findings indicated that the students had concerns about environmental issues, but the reason behind these concerns was their own health, their future, and the possible effects on their children. In addition our finding is consistent with the results of a similar study by Kahraman-Öztürk, Olgan, and Tuncer (2012) on younger children. That research revealed that the reasons for children's ecocentric behaviours were anthropocentric.

Another explanation for the prevalence of anthropocentric attitudes in the current study may be the promise to find a cure for a disease that is frequently encountered in the participants' daily life. Kortenkamp and Moore (2001) also reported that a social promise can lead to the emergence of more anthropocentric tendencies. Given that one of the objectives of environmental education is to train students toward ecocentric attitudes, environmental education programs that promote fewer anthropocentric tendencies should be developed. In this regard it can be given more importance to activities in educational programs that allow students to grow plants, to write projects for animals, to be member of environmental organizations, to participate field trips and being in touch with nature.

Informal reasoning

In the current study, the informal reasoning patterns students presented when writing about an SSI were also investigated. The findings obtained as a result of the analyses performed showed that 54 (51.9%) of the 104 students presented rationalistic reasoning, 10 (9.6%) emotional reasoning, 26 (26%) rationalistic-emotional, 10 (9.6%) rationalistic-intuitive, 1 (1%) emotional-intuitive reasoning, and 3 (2.9%) rationalistic-emotional-intuitive reasoning. These findings show that the students presented rationalistic reasoning the most, followed by rationalistic-emotional, while intuitive reasoning was presented least often. This finding is consistent with the results of a study conducted by Demir (2017) in which middle school students' informal reasoning and arguments on an environmental issue were investigated and it was found that the students presented rationalistic and rationalistic-emotional reasoning the most. Akbaş and Çetin (2018) and Widodo et al. (2017) also found that most middle school students used rational reasoning regarding an environmental SSI, which supports the results of the current study. Although the class levels and SSI studied were not similar,

the results of studies by Sadler and Zeidler (2005a, b) and Venville and Dawson (2010) designed to investigate the informal reasoning presented by high school students on genetic issues also support the findings of the current study. As in the current study, students presented rationalistic reasoning most frequently.

One reason that students tend to present more rationalistic reasoning may be that they have knowledge of the subject content. In the present study, although the knowledge level of the students was not measured, their statements about the importance of plants for life, their usage areas, and the protection of natural balance revealed their knowledge about the subject. It is possible that the students used this knowledge in their rationalistic reasoning which is based on data. As a matter of fact, Sadler and Zeidler (2005b) revealed that students are more likely to incorporate their content knowledge into their informal reasoning patterns. Therefore, content knowledge on the issue may have increased rationalistic reasoning.

Dawson and Venville (2009) found that middle school students mostly used intuitive and emotional reasoning, in contradiction with the findings of the present study. This may also be attributed to the chosen SSI. While an environmental socioscientific issue was used in the present study, Dawson and Venville (2009) used topics such as biotechnology, cloning, and genetically modified organisms. Supporting this finding, Topçu, et al. (2010) found that informal reasoning was influenced by the subject content. Given that the students generally presented rationalistic reasoning patterns in the current study, the design of educational environments that foster the use of different reasoning patterns is suggested. In this regard, SSI can be given more place in classroom settings, students can be directed to make decisions on different SSI, activities can be organized to explore different dimensions of the SSI, and students' personal experiences on SSI can be enriched (for example, through field trips).

Another finding of the current study is that (after rationalistic reasoning) rationalistic-emotional reasoning is the second-most frequent reasoning used. Demir (2007), consistent with the findings of the present study, also found that middle school students presented rationalistic-emotional reasoning the second-most, after rationalistic reasoning, on an environmental issue. The results of a study conducted by Kolarova et al. (2013), who found that rationalistic and then emotional reasoning were most common in high school students studying genetic engineering, also support the results of the present study. Students should not only provide rationalistic reasoning based on data, but also present emotional reasoning that requires them to use empathy (Demir, 2007). Empathy is necessary to ensure that classrooms are environments where intuition and emotion are valuable, as well as reason (Sadler & Zeidler, 2005a; Venville & Dawson, 2010). Emotional and intuitive reactions are also important in making moral decisions, especially on SSI, and thus the expression of various emotions and intuitions should be valued in the classroom (Kolarova et al., 2013). Therefore, based on these findings, we argue that students should be made aware of different reasoning processes. Students should then make their decisions by taking these processes into consideration, and we recommend that the educational environments be arranged in this direction.

Informal reasoning patterns corresponding to environmental attitudes

Finally, this study also investigated how informal reasoning patterns change depending on the environmental attitudes students have. Findings revealed that 37 (61.7%) of the total 60 students with an anthropocentric attitude presented rationalistic reasoning, 5 (8.3%) emotional reasoning, 10 (16.7%) rationalistic-emotional reasoning, 7 (11.7%) rationalistic-intuitive reasoning, and 1 (1.7%) rationalistic-emotional-intuitive reasoning. These results show that the majority of the students with an anthropocentric attitude utilized rationalistic reasoning. Individuals with an anthropocentric attitude pay great attention to human benefits. Therefore, it is likely that individuals with this attitude will use a reasoning process for the benefit of people when considering an environmental issue, and that they will provide reasonable judgments as a result of the profit/loss analysis. Because they have an anthropocentric attitude, they consider other living things less valuable than humans and are unlikely to exhibit empathy toward animals. This can cause anthropocentric individuals to present less

emotional reasoning. Therefore, in line with the findings obtained, it can be stated that individuals with an anthropocentric attitude experience more rationalistic reasoning processes.

Another finding obtained from the analyses conducted to determine how the informal reasoning patterns presented by the students changed depending on their environmental attitudes is that 8 (40%) of the 20 students having an ecocentric attitude presented rationalistic reasoning, 5 (25%) emotional reasoning, 6 (30%) rationalistic and emotional reasoning, and 1 (5%) emotional and intuitive reasoning. In addition, 9 (37.5%) of the 24 students with an anthropocentric and ecocentric attitude presented rationalistic reasoning, 10 (41.7%) rationalistic and emotional, 3 (12.5%) rationalistic and intuitive, and 2 (8.3%) rationalistic, emotional, and intuitive reasoning. This finding shows that the students who have an anthropocentric-ecocentric attitude presented rationalistic, emotional, and intuitive-emotional reasoning at ratios similar to each other. This is an expected finding because people with an ecocentric attitude value the environment as much as they do people, and accept that all living things have an equal right to live. Therefore, individuals with an ecocentric attitude are likely to care about other living things and to put themselves in their place while deciding on any subject. They are also likely to make decisions by making a profit/loss analysis for both humans and other living things in the process of making an environmental decision. For this reason, it can be stated that individuals with an ecocentric attitude experience rationalistic and emotional reasoning processes.

In the present study, the finding that individuals with an ecocentric attitude more often showed emotional reasoning may bring a different perspective to the literature in the field of environmental education. While there is some information and research about the benefits of an ecocentric attitude, it has not been investigated in relation to informal reasoning. For example, one of the objectives of environmental education is to enable learners to shift from an anthropocentric attitude towards an ecocentric attitude (Goldman et al., 2013). Similarly, the adoption of ecocentrism, rather than anthropocentrism, by society is said to be of great importance for a safer and healthier future (Karataş, 2016). However, no study has been found showing that ecocentric attitudes will support students' emotional reasoning; that is, the processes that require students to use their empathy and sympathy and to attach importance to the well-being of other living creatures. The results of the current study show that students with an ecocentric attitude use more emotional reasoning. Thus, it is recommended that students be supported to acquire an ecocentric attitude and that by doing so some contribution will be made to the training of individuals with a developed sense of empathy.

Given that people who have a strong sense of empathy can establish better communication with their environment, have more developed moral judgments, and care about the effects of their behaviours on others (Derman, 2013), the training of individuals to have an ecocentric attitude can yield many more positive outcomes (Derman, 2013). The findings in the current research provide important information for researchers and educators to design a successful environmental education curriculum. Similarly, the findings support the conclusion that training individuals with an ecocentric attitude can foster students' developing emotional reasoning as well. Given that rationalistic, emotional, and intuitive reasoning are all used in real life, and that one of the objectives of science education is to prepare students for real life, we can also argue that training of individuals to have an ecocentric attitude can support the training of individuals with developed informal reasoning in general.

Finally, by developing students' informal reasoning ability, the development of individuals with an ecocentric attitude may even be supported. The findings could be interpreted to suggest that rationalistic and emotional reasoning support the ecocentric attitude, in addition to the interpretation that the ecocentric attitude supports rationalistic and emotional reasoning. This is an area of development for potential future research in the area. This mutual relationship between informal reasoning and environmental attitudes can be used in organizing educational environments.

Limitations

One of the limitations of the current study is the use of only one data collection tool. Triangulation can be achieved by using different data collection tools; this increases the reliability and validity of the findings. Another limitation is that the scenario included in the data collection tool was a hypothetical sample event. Using real-life dilemmas can support the emergence of different moral tendencies compared to hypothetical dilemmas (Walker, 1989).

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