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A Q methodological investigation of students' perspectives on power plants

Sadık Taner Güdük
Mehmet Akif Ersoy Secondary School, Sinop, Türkiye, eynesil76@hotmail.com
Hüseyin Eş
Sinop University, Mathematics and Science Education Department, Sinop, Türkiye, huseyines@sinop.edu.tr
Ayşe Yenilmez Türkoğlu
Alanya Alaaddin Keykubat University, Mathematics and Science Education Department, Antalya, Türkiye, ayse.yenilmez@alanya.edu.tr

ABSTRACT The aim of this research, which was conducted through the use of Q methodology, was to examine eighth grade students' perspectives on power plants (PPs). Suggesting that variables can be replaced by individuals in factor analysis and thus interpersonal factor analysis can be done, Q methodology is a method that aims to examine individuals' self-referenced perspectives by revealing the differences and commonalities of these perspectives; that is, where they are positioned relative to each other in a holistic structure. In this research, a total of 35 Q-statements were presented to a number of 19 eight-grade students, who were attending to a public middle school and were voluntarily participated in the study. Students' Q-sorts resulted in a two-factor solution, meaning that two perspectives emerged towards PPs. The perspectives were named as economy-oriented and science and technology-oriented. Students holding the economy-oriented perspective pointed out to the positive impact of PPs on economy, while others holding the science and technology-oriented perspective specified the contribution of PPs to scientific and technological development.

Keywords: *Decision-making, Power plants, Q methodology, Science education, Socioscientific issues*

Öğrencilerin enerji santrallerine ilişkin bakış açılarının Q yöntemi ile araştırılması

ÖZ Q metodolojisi ile yürütülen bu araştırmada, bir sosyobilimsel konu olan güç santralleri konusuna yönelik ortaokul sekizinci sınıf öğrencilerinin bakış açılarının incelenmesi amaçlanmıştır. Faktör analizinde değişkenlerin kişilerle yer değiştirebileceğini ve böylece kişilerarası faktör analizinin yapılabileceğini ortaya koyan Q metodolojisi, genel bir tanımlamayla, bireylerin benlik referanslı bakış açılarını inceleyerek bu bakış açılarının farklılıklarını ve ortaklıklarını, diğer bir deyişle birbirlerine göre nerede konumlandıklarını bütüncül bir yapıda açığa çıkarmayı hedefleyen bir yöntem olarak ifade edilmektedir. Bu araştırmada, bir devlet ortaokulunun sekizinci sınıfına devam eden ve gönüllük esasına dayalı olarak belirlenen 19 öğrenciye Q dizgisi oluşturmaları için 35 adet Q ifadesi sunulmuştur. Araştırma bulguları öğrencilerin güç santrallerine yönelik iki bakış açısında gruplandıklarını göstermiştir ve bu bakış açıları ekonomi odaklı ve bilim ve teknoloji odaklı olarak adlandırılmıştır. Ekonomi odaklı bakış açısına sahip öğrenciler güç santrallerinin ekonomi üzerindeki olumlu etkisine dikkat çekerken, bilim ve teknoloji odaklı bakış açısına sahip öğrenciler santrallerin bilimsel ve teknolojik gelişmeye katkısını dile getirmişlerdir.

Anahtar Sözcükler: *Fen eğitimi, Güç santralleri, Karar verme, Sosyobilimsel konular, Q yöntemi*

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INTRODUCTION

Children are curious and explore the world around them and science begins with this curiosity. When children are engaged in science-related issues, they do science (Frejd, 2021), and make decisions. In the age we live in, social media has become people's primary source of news (Bronstein et al. 2020), and thus it has become common to share untested information and spread misinformation and conspiracy theories on various topics (Saribas, 2023). Such topics are ranging from climate change to vaccination as well as from genetically modified organisms to power plants [PPs].

PPs, as our energy sources, often appear as controversial issues that leave people in dilemmas. Children, as well as adults, encounter with positive or negative aspects of PPs on social media, in the news, and sometimes in protests; and they sometimes make decisions in the light of this information. Therefore, we think that it is important to examine children's perspectives on this issue. However, although the subject has been included in science curricula for a while (MoNE, 2013, 2018), research on middle school students' approaches towards PPs does not exist. There are many studies conducted in context of SSIs, where issues such as environmental problems (Kortland, 1996; Patronis et al., 1999), genetic engineering (Christenson Rundgren & Höglund, 2012; Kolarova et al., 2013), climate change (Dawson, 2015; Dawson & Carson, 2017), astrobiology (Hansson et al., 2011), and energy transmission lines (Kolstø, 2001) were examined. It is also seen that most research on PPs focus on *nuclear* power plants [NPPs] (Acar Şeşen & Mutlu, 2022), and these studies are generally conducted with teacher candidates (Ateş & Saracoğlu, 2013; Cansız, 2023; Cansız & Cansız, 2015; Eş vd., 2016; Kapıcı & İlhan, 2016; Yen & Wu, 2022), and a few with teachers (Lee & Yang, 2013; Öztürk & Bozkurt Altan, 2019). At this point, it is thought that the current research will contribute to the related literature with both the research group, and the originality of its method (the Q method). This research examines middle school students' perspectives on all power plants included in the science program, using the Q method to determine their viewpoints. The study is significant as it provides a comprehensive analysis of students' perspectives on power plants and applies a recently popularized methodology in determining individual perspectives on various subjects. Specifically, the aim is to investigate eighth-grade students' perspectives on PPs. For this purpose, answers to the following research questions were sought.
(1) What are eighth grade middle school students' perspectives on PPs?
(2) What are the characteristics of the perspectives that eighth grade secondary school students hold on PPs?

The following section includes a theoretical background that focuses on explaining scientific literacy and science-technology-society movements and Socioscientific Issues [SSIs] and decision-making.

Theoretical Background

Scientific and technological advances have brought various social problems to the agenda. SSIs (Sadler, 2004a) are scientific, open-ended, and contradictory issues that create dilemmas for individuals and bring society together with science and/or technology. According to Kolstø (2001), a fundamental aspect of scientific literacy is the capacity to make informed decisions about SSIs. This has been the goal of science education in the modern world for some time.

Scientific literacy and science-technology-society movements

Hurd (1958), one of the researchers who made the first studies on scientific literacy, characterized it as a concept in the literature and expressed this concept as the primary goal of science education. It is stated that the first introduction of scientific literacy into science education literature is the result of an effort to determine an appropriate science curriculum for students who do not plan a career in science in the United States [USA] (Johnson, 1962, as cited in Roberts, 2007). In 1980s, the National Science Foundation (NSF) in the USA stated that the content-oriented science program could not meet the needs of students who did not want to pursue a professional career in this field, and that a science education definition that would be valid for all students regardless of their future plans should be made (Hurd, 1998). It has been emphasised that individuals, as socially responsible and competent citizens, should be scientifically literate in order to participate in decision-making processes regarding social issues with scientific dimensions (Hurd, 1998; Jenkins, 1999). This idea remains valid today, and scientific literacy continues to be a term used to describe the goal of providing qualified science education for all students (Roberts, 2007). National Science Education Standards define scientific literacy as being aware of scientific issues in national and local decisions, and evaluating the reasons scientifically and technologically (NRC, 1996). Scientific literacy requires individuals to use scientific knowledge about daily life scientific events and social problems. In this way, individuals who make up the society can take an active role in taking decisions that affect the future of the countries by acting with a sense of responsibility (Burek, 2012; Stefanova et al., 2010).

In 1950s, the concept of scientific literacy was integrated to Science, Technology and Society (STS) dimensions (Chang et al., 2009; Sadler, 2004b). In 1970s and early 1980s, it was defined more strongly in the social context (DeBoer, 2000). In the late 1970s, many science education researchers introduced science, technology and society together, and reflected their combined effects (Zeidler et al., 2005). These efforts, also called as STS movements, are the most widespread and longest-lasting movements that emphasize the complexity and interrelatedness of science, technology, and society (Chang Rundgren & Rundgren, 2010; Sadler, 2004b). In 1990s, science educators drew attention to the necessity of adding environment dimension to the STS components and advocated a STS program in the form of Science-Technology-Society-Environment (STSE) education which focused more on the consequences of scientific and technological developments (Hodson, 1994; Pedretti, 1997). In 2000s, SSIs emerged as an appropriate and important context to address STSE dimensions and support scientific literacy in today's globalized world (Chang & Chiu, 2008; Driver, et al., 2000; Hughes, 2000; Zeidler et al., 2002; Zeidler et al., 2005; Zeidler & Keefer, 2003). The conceptual, principal, and pedagogical framework of SSIs is related to STS movements, and both movements emphasize the importance of scientific literacy by including informed decision making, analyzing, synthesizing, and evaluating information, the nature of science, and ethical and moral reasoning (Pedretti & Nazir, 2011). However, it is claimed that SSIs movement is also a reflection that goes beyond the STS movements (Sadler, 2011; Zeidler & Sadler, 2008). Although it is influenced by the way of thinking in the STS tradition, SSIs are defined as an educational structure fed by theories from philosophical and sociological traditions (Zeidler, 2014). In other words, this movement differs from the STS approach in its emphasis on individual's psychological and epistemological development and the development of character or virtue (Zeidler et al., 2005). Students' engaging in programs that employ them in social dimension of STS has been emphasized for some time (Zeidler et al., 2005), and the reflections of science and technology on society have been included in science curriculum reform movements in various countries, especially the USA, since 1990s (Yenilmez Türkoğlu, 2021). In Türkiye, STSE was included as a learning area in Science and Technology Curriculum (MoNE, 2005), while SSIs appeared for the first time as a new sub-field under the STSE learning area in the Science Curriculum (MoNE, 2013). Moreover, including socioscientific issues in teaching is also listed in the main goals of the latest science curriculum (Başar & Demiral, 2019; Deveci, 2018). Scientific literacy is the main goal of science education, and socioscientific decision making is an important aspect of science literacy; therefore, it is important to explore how students structure their decisions regarding SSIs and how they discuss and resolve SSIs (Ozden, 2020).

SSI and decision-making

A number of models that examine decision-making processes are offered in the literature (Carroll & Johnson, 1990; Cebesoy, 2021). It is stated that, the *prescriptive* model which emphasizes the cognitive aspect, and the *descriptive* model that take social dynamics and cognitive dimensions into account cannot adequately explain the complex decisions made on SSIs, and that, it is difficult to understand individuals' decisions on SSIs by using these models (Aikenhead, 1989; Cebesoy, 2021; Grace, 2009). SSIs include moral and ethical values (Bell & Lederman, 2003; Ratcliffe & Grace, 2003; Sadler, 2004b; Sadler & Zeidler, 2004; Sadler & Donelly, 2006), scientific social dilemmas (Sadler & Zeidler, 2005), social and political aspects of local, regional and global dimensions (Ratcliffe & Grace, 2003), economy (Chang Rundgren & Rundgren, 2010; Zeidler et al., 2005) and environment (Ekborg et al., 2013). It is thought that the reasons and inferences that individuals put forward regarding such dimensions while making decisions on these issues are important in their evaluations and final decisions. In addition, within the scope of SSIs, there are features such as having local, national and global dimensions in terms of social and political aspects, including cost-benefit analyzes in which the risk factor is important (Bakırcı et al., 2018), requiring sustainable development, including values and moral reasoning, and being subjects in the context of real life (Ratchliffe & Grace, 2003). Many researchers also state that moral and ethical dimensions have a significant impact on the decision-making process on SSIs (Sadler, 2004b; Zeidler et al., 2002).

Due to the industrial growth, digitalization, and the growing population, countries all over the world faced with safe and continous energy demand recently. To meet their needs, most countries depend on fossil fuel energy sources, such as natural gas, oil and coal, and some others use hydroelectric, wind, geothermal and nuclear PPs to fulfill their energy needs. However, problems like greenhouse gas emissions, pollutants, climate change, the problem of nuclear waste, health effects of nuclear radiation and especially the possibility of a nuclear accident, environmental and climatic effects of dam construction and the deterioration of human health raise questions about these energy sources. Such negative impacts and the ongoing energy dependency drive negotiations about the use of PPs, and force citizens to make decisions about them.

Like many other developing countries, Türkiye's energy demand is also on the rise, and the need is met through already constructed PPs and several others are under construction. Science courses seem to be important in the process of citizens being aware of PPs, conducting research on these issues, making decisions by evaluating social, environmental and financial effects, and being scientifically literate. Students are required to reach scientific information about PPs and other SSIs as well and make decisions in the light of the information they obtained. The basic element of this process is expected to be the science course within the scope of formal education. As a matter of fact, the importance of SSIs has been emphasized in the current Science Curriculum in Türkiye (MoNE, 2018). Considering the fact that SSIs are not only the subject of science classes but they concern almost all of the society in some way, students should attend science classes with some prior knowledge and judgments about these issues.

METHOD

Q methodology was used in the current research.

An Overview of The Q Method

Being introduced firstly by the British psychologist and physicist William Stephenson (1953) and suggesting that variables can be replaced by individuals in the factor analysis and that interpersonal factor analysis can be done, Q methodology is defined as a method examining the self-referenced perspectives of individuals (Brown, 1993). The method reveals the similarities and differences of the perspectives, -in other words, where they are positioned relative to each other-, in a holistic structure (Brown, 1993; Karasu & Peker, 2019; Stainton Rogers, 1995; Watts & Stenner, 2012). The method provides a conceptual framework and systematic process not only to incorporate participants' perspectives, but also place them at the center of the analysis (Durning & Brown, 2007). In this method, participants are presented with a number of statements about a topic and are asked to sort these statements according to some criteria like 'agree/disagree', 'like/dislike' or 'important/unimportant' (Van Exel & De Graaf, 2005). Data is analyzed as a whole by factor analysis. Unlike classical factor analysis, however, this method examines correlations between individuals. Methodically, this can be considered simply as a displacement of rows and columns in the data set; but as Stephenson points out, the Q method later became more than that. With Q methodology, Stephenson presented an approach emphasizing diversity and subjectivity, as opposed to the hypothesis-based deductive approach (Watts

& Stenner, 2005). He claimed that the outputs that stand out with diversity and subjectivity can be accessed by psychometric tools. Brown (1996), who made important contributions to the use and dissemination of Q methodology, stated that the method combines the strengths of quantitative and qualitative traditions. In other words, Q methodology is qualitative in that it reveals the subjectivity (i.e., personal point of view, idea, belief, attitude) of human as a subject, and is quantitative in terms of handling the items related to subjectivity as measurable (Karasu & Peker, 2019).

The Q-Statements

In this study, participants were presented with 35 Q-statements to construct their Q-sorts (see Table 2). In Q methodology, statements can be taken directly from existing research or measurement tools in the related literature, or they can be created by the researcher if the literature on the research topic is limited (Demir & Kul, 2011). Due to the limited literature, in the current study, Q-statements were created by the researchers. For this process, first, the related objectives in the Science Curriculum are examined (MoNE, 2018, p.54):

> "F.8.7.3.3. Explain how electrical energy is produced in PPs.
>
> Hydroelectric, thermal, wind, geothermal and nuclear PPs are mentioned as PPs.
>
> F.8.7.3.4. Generates ideas about the advantages and disadvantages of PPs.
>
> *Students are asked to generate and defend ideas about PPs in terms of benefits, harms and risks."*

In line with the objective 'F.8.7.3.3.', the research was limited to hydroelectric, thermal, wind, geothermal and NPPs, and Q-statements were created only for these PPs. In regard of the other objective (that is, F.8.7.3.4.), on the other hand, the related literature was examined; and the SEE-STEP model (Eş & Öztürk, 2021; Eş & Varol, 2019) developed on the basis of SEE-SEP model (Chang Rundgren & Rundgren, 2010) was used in the formation of statements. In this model, seven dimensions are defined: *sociology/culture, environment, economy, science, technology, ethics/morality* and *politics.* Considering the ages of the participants, it was deemed appropriate to create Q-statements for the initial six of the seven dimensions, and not to create statements for the *policy* dimension. In addition, again in line with the literature, Q-statements were created for the *risk* factor (Kolstø, 2006) that stands out for SSIs; and as a result, a total of 35 Q-statements were obtained for the PPs in accordance with the dimensions of *sociology/culture, environment, economy, science, technology, ethics/ethics* and *risk* (see Table 2).

In Q methodology, each participant has to make ½N (N – 1) choices, where N is the number of statements (Brown & Ungs, 1970). With the 35 statements generated in this study, each participant would have to make 595 choices, resulting in a much more complete picture of participants' decision-making processes, and revealing subjectivity. For the proposed statements, expert opinion was taken from two science education professionals who had studies on the multidimensional structure of SSIs, and after that, the statements were examined by a Turkish language expert. Afterwards, a pilot study was carried out with 10 eighth-grade students and the main study was started with the conclusion that the statements were understandable and appropriate for the purpose of the research. The statements can be seen in Table 2 or Table 3.

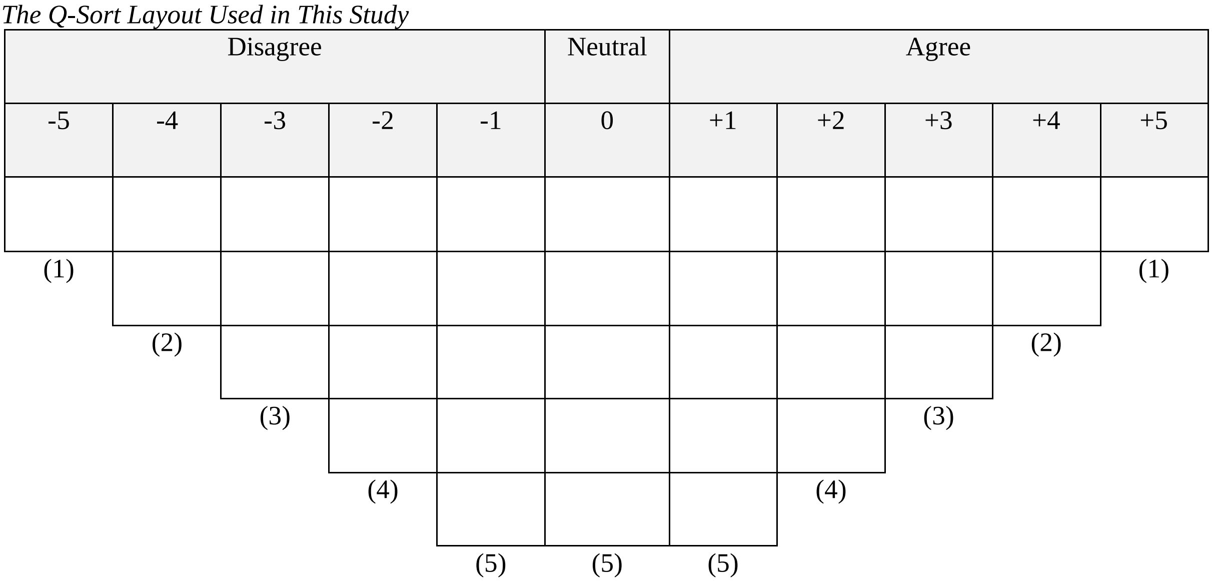
Participants

The participants of the study were determined on a voluntary basis from students attending the eighth grade of a state middle school in Sinop Province of Türkiye. The Ethics Committee approval was provided by the Human Research Ethics Committee at Sinop University (Number: 2020/47, Date: 27.04.2020). The study was conducted before the students had taken formal education covering the objectives F.8.7.3.3. and F.8.7.3.4. (See above). Demographic information about the students is presented in Table 1. In Q methodology, the number of participants is determined in relation to the number of statements, and a 2:1 ratio of statements to the number of participants is accepted (Webler et al., 2009). At this point, the suggested number of participants for this study, which included 35 Q statements, is around 18. The number of students participated in this study was 19. Throughout the study, the students were coded from 1 to 19, as S1, S2, S3, and so on.

Data Collection

The basic process in Q methodology is based on the fact that the perspectives about the subject are sorted separately by each participant on a positive to negative scale (Demir & Kul, 2011; Karasu & Peker, 2019). In this method, after the statements are created, a scale on which each statement will be placed (See Figure 1) and cards on which the Q-statements are written, are prepared. Two types of Q-sorts, either *forced distribution* or *free distribution*, can be created to get the perspectives, and which type to use is at the discretion of the researcher. If the researcher wants to crystallize -that is, to make clear- participants' perspectives on the research topic, then s/he should prefer the *forced distribution* model. On the other hand, if the researcher wants to identify the themes that stand out about the research topic, to understand and evaluate participant's approach, or to identify new topics for further research, s/he should use the *free distribution* model. In forced distribution, the number of Q-statements to be placed in each column is predetermined by the researcher, while in free distribution, participants can place as many Q statements in each column as they want (Brown, 1980; Demir & Kul, 2011). The forced distribution model was chosen for this study to capture participants' perspectives on power plants.

Figure 1.
The Q-Sort Layout Used in This Study



During data collection process, participants were handed out a sheet of paper having the Q-sort layout and the Q-statements as written on pieces of papers, and they were asked to group them as they agreed with the statement, disagreed with the statement, or if it was neutral or not applicable to them. After the statements are grouped, participants were asked to place these papers on the scale (Dennis, 1986). At this stage, participants were asked to find the statement they agreed the most and place it on the far right (that is, +5) on the scale, and continue to sort the others in +4, +3, +2 and +1 until the statements they grouped as 'agree' were finished. As this group of statements were completely finished, they repeated the same procedure for the statements in the 'disagree' group. Finally, the participants were asked to place the statements that they were 'undecided/neutral' about, on the middle column of the scale (that is, 0). By this way, all statements took their places on the scale. During the sorting process, participants were also told that if the number of statements that they dis/agree with is more or less than the spaces provided on the scale, this is not a problem in Q methodology because the ranking system of the method is relative. Moreover, the order of the statements within the same column is also unimportant since they all reflect the same degree. The important thing in the sorting process is that participants should rank each statement relative to each other. After the placement of the statements into the scale was completed, the participants were told that they could make any changes on the sorts they created and were given some time for that. As participants finished their sorting, the sorts were recorded (Demir & Kul, 2011; Karasu & Peker, 2019).

Analyses of Q-Sorts

In Q methodology, factor analysis is transformed to some extent. In quantitative research, factor analysis is done for the variables, while in Q methodology, it is done for the perspectives of the participants as a whole; in other words, for the Q-sorts (Karasu & Peker, 2019). In this method, instead of the correlation between variables, the correlation between the Q-sorts created by the participants is examined. In this study, PQ Method 2.35 software (Schmolck, 2014) was used for the statistical analysis of the Q-sorts.

Interviews and Their Analyses

In Q methodology, it is recommended to conduct interviews after the Q-sorts are created (Brown, 1993). The formulation of interview questions in accordance with the purpose of the research may vary but some of the Q-statements present in the research are generally used as interview questions. They are selected by the researchers for taking information from the participants and defining the perspectives; the more informative ones are chosen. The use of the most and the least agreeable statements of the participants (that is, the statements placed in the -5 and +5 columns for this study) is common in the literature, but no standard approach is actually defined for this process (Brown, 1993; Young & Shepardson, 2018). In this study, a number of statements were selected as interview questions, and students' views on these statements were tried to be examined in depth. One of the statements chosen to be used in the interviews was statement 35, which took +4 position in the first perspective and +5 in the second, and is a statement that both perspectives were in agreement. Similarly, statements 8 and 10, in which both perspectives were on consensus, were chosen to be used in the interview as well. The other statements (that is, statements 12, 15 and 16) chosen to be used in the interviews, on the other hand, were among the ones that distinguish the two perspectives.

Interview questions were directed to participants after the analysis of Q-sorts was done, and the obtained data were analyzed through content analysis. In the analysis process, each participant's answers to the interview questions, i.e., their thoughts on the Q-statements selected for the interview, were reviewed in a holistic way and in a way that allowed the comparative evaluation of especially repetitive concepts and statements. In this way, a valid coding system was ensured. During this process, each interview was first examined to form potential codes; and afterwards, interviews were reviewed based on the list of the codes reached, and the frequencies of the codes were determined until it was concluded that the codes fully met the answers (Bogdan & Biklen, 2007; Gay et al., 2006).

RESULTS

Analysis of the data revealed that the eighth-grade students participating in this study had two differing perspectives on PPs. Each of these perspectives had more than one person defining himself/herself in that perspective, and all of the participants (100%) were defined within a perspective (that is, no one is left behind). The distribution of the participants with respect to the emerging perspectives is presented in Table 1.

Table 1.
Demographic Information and Factor Loadings of Participants

Student	Gender	Academic standing		Parents' educational degree		Parents' income level	P1	P2
S1	Male	*HSEE point** *Science course grade*	406 89	*Mother* *Father*	Undergraduate Undergraduate	Medium	.3756	.6167X
S2	Female	*HSEE point* *Science course grade*	438 98	*Mother* *Father*	Undergraduate Associate	Medium	.8291X	.0468
S3	Male	*HSEE point* *Science course grade*	403 99	*Mother* *Father*	High school Graduate	Medium	.7042X	.0709
S4	Female	*HSEE point* *Science course grade*	443 100	*Mother* *Father*	Undergraduate Graduate	High	.7499X	.0303
S5	Female	*HSEE point* *Science course grade*	367 88	*Mother* *Father*	High school Undergraduate	High	.7747X	-.0023
S6	Male	*HSEE point* *Science course grade*	444 98	*Mother* *Father*	Undergraduate Undergraduate	Low	.7768X	-.3915
S7	Male	*HSEE point* *Science course grade*	425 100	*Mother* *Father*	Undergraduate Undergraduate	High	.7213X	-.1611
S8	Female	*HSEE point* *Science course grade*	300 73	*Mother* *Father*	Middle school Middle school	Low	.6157X	.4287
S9	Female	*HSEE point* *Science course grade*	410 100	*Mother* *Father*	Undergraduate Undergraduate	Low	.7232X	-.3270
S10	Female	*HSEE point* *Science course grade*	375 100	*Mother* *Father*	Undergraduate Graduate	High	.6158X	.5874
S11	Female	*HSEE point* *Science course grade*	387 97	*Mother* *Father*	Undergraduate Graduate	High	.3889	.6646X
S12	Male	*HSEE point* *Science course grade*	419 100	*Mother* *Father*	Graduate Undergraduate	Medium	.7518X	-.3248
S13	Male	*HSEE point* *Science course grade*	438 98	*Mother* *Father*	Undergraduate Undergraduate	High	.7808X	.1517
S14	Female	*HSEE point* *Science course grade*	361 92	*Mother* *Father*	Undergraduate Undergraduate	Medium	.4805	.5631X
S15	Female	*HSEE point* *Science course grade*	407 100	*Mother* *Father*	High school Undergraduate	High	.4360	.5583X
S16	Male	*HSEE point* *Science course grade*	448 100	*Mother* *Father*	Undergraduate Graduate	High	.7383X	.0954
S17	Female	*HSEE point* *Science course grade*	467 100	*Mother* *Father*	Undergraduate Undergraduate	Medium	.6732X	.1115
S18	Male	*HSEE point* *Science course grade*	265 64	*Mother* *Father*	Middle school Middle school	Low	.4896	.5481X
S19	Female	*HSEE point* *Science course grade*	411 92	*Mother* *Father*	High school High school	Low	.3546	.5340X
% expl.Var.							42	16

** High School Entrance Examination: a national examination in Türkiye that middle school graduates take.*

As seen in Table 1, thirteen participants (7 females, 6 males) are in Perspective 1, and six (4 females, 2 males) are in Perspective 2. The average HSEE point is calculated as 414 for the students in Perspective 1, while it is calculated as 373 for the students in Perspective 2. The science course grade point average, on the other hand, is 96.5 for students in Perspective 1, while it is 89 for students in Perspective 2.

Perspective 1: Economy-Oriented

The statements ordered based on the factor scores for *economy-oriented* perspective is presented in Table 2.

Table 2.

Statement Ranking Based on Factor Scores for Economy-Oriented Perspective

No:	Statement:	Z-Score	Grid Position	
10	NPPs harm environment.	2.377	5	Agree
35	NPPs threaten human health.	1.885	4	
7	TPPs harm environment.	1.526	4	
13	The WPPs boost economy.	1.230	3	
12	The TPPs develop economy.	1.087	3	
15	NPPs develop economy.	1.040	3	
32	TPPs threaten human health.	1.029	2	
14	GeoTPPs boost economy.	0.962	2	
6	HPPs harm environment.	0.624	2	
11	HPPs develop economy.	0.591	2	
19	The geoTPPs contribute to scientific developments.	0.462	1	
20	NPPs contribute to scientific developments.	0.346	1	
25	NPPs contribute to technological developments.	0.262	1	
30	NPPs have ethical/moral problems.	0.225	1	
18	The WPPs contribute to scientific developments.	0.142	1	
23	The WPPs contribute to the technological developments.	0.119	0	Neutral
24	The geoTPPs contribute to the technological developments.	-0.069	0	
16	HPPs contribute to scientific developments.	-0.112	0	
21	HPPs contribute to technological developments.	-0.150	0	
27	The TPPs have ethical/moral problems.	-0.164	0	
17	The TPPs contribute to scientific developments.	-0.178	-1	Disagree
22	The TPPs contribute to technological developments.	-0.203	-1	
26	HPPs have ethical/moral problems.	-0.340	-1	
31	HPPs threaten human health.	-0.537	-1	
3	The WPPs contribute to cultural development.	-0.577	-1	
4	The geoTPPs contribute to cultural development.	-0.713	-2	
1	HPPs contribute to cultural development.	-0.809	-2	
29	GeoTPPs have ethical/moral problems.	-0.822	-2	
9	GeoTPPs harm environment.	-0.875	-2	
2	The TPPs contribute to cultural development.	-1.070	-3	
28	The WPPs have ethical/moral problems.	-1.176	-3	
34	GeoTPPs threaten human health.	-1.297	-3	
33	WPPs threaten human health.	-1.492	-4	
5	NPPs contribute to cultural development.	-1.511	-4	
8	The WPPs harm environment.	-1.810	-5	

Upon examining Table 2, it becomes apparent that statement 10, followed by statement 35, have the highest z-scores. These two statements also have the highest z-scores in the opposite order in the other perspective (refer to Table 2). The interviews reveal that participants believe that 'NPPs threaten human health' and 'NPPs harm the environment' primarily due to waste (f=18, f=14, respectively). Sample interview excerpts are provided below.

> *"Yes, nuclear power plant threatens human health. For example, it is difficult and costly to store and preserve the wastes of NPPs, and if it is not stored properly, it will cause great harm to human and nature…" S3*

> *"Radioactive materials from NPPs are spread to environment by wind and rain. By spreading into the atmosphere, lakes, soil and vegetation, they both pollute environment and harm the living organisms there." S4*

Participants cited *accidental risks* as another reason why NPPs threaten human health and harm environment (f=8, f=6, respectively). Sample excerpts are as follows.

> *"…it is a fact that, like reactor accidents (Chernobyl disaster), it causes death, disability and cancer in humans depending on the type and dose of radiation exposed. Accordingly, as a result of the accident, NPPs will also affect environment and human health if the radiation spread to environment, water, soil and air receiving environment..." S2*

> *"…accidents that may occur in NPPs damage environment by polluting the atmosphere, water, soil and vegetation to a large extent." S16*

Warming of waters was also cited by participants as a harm that NPPs do to environment (f=4):

> *"The water used to cool the power plant is then released into the sea, affecting the ecosystem negatively…" S7*

In economy-oriented perspective, following the statements 10 and 35, and statement 7 which says that "Thermal power plant harms environment", statements related to *economy* are seen. In these statements (numbered 12, 13 and 15), it is mentioned that *thermal*, *wind*, and *NPPs* develop economy. Interviews with participants revealed that "Thermal power plants (TPPs) improve economy" because they provide *low-cost energy* (f=7), *meet energy needs* (f=4) and *reduce external dependency* (f=4). Sample excerpts from interviews are as follows:

> *"Coal is used in TPPs to turn water into steam. This coal is generally of poor quality. In this respect, we will both save money and obtain cheap electrical energy. Therefore, I agree with the idea that it will develop economy." S9*

> *"…It provides a great energy production and contributes to economy." S6*

> *"Because it not only provides job opportunities for many people, but also produces our own energy and reduces external dependency." S4*

Together with the supporting views, participants also mentioned that TPPs give *harm to environment* (f=5) and *human health* (f=2):

> *"TPPs may be attractive from an economic point of view, but their effects on human health and environment can never be ignored. The gases coming out of the chimneys of the PPs cause the formation of acid rain. The chemical structure of the soil deteriorates with the falling rain. There is also an increase in cancer cases because of the PPs." S19*

Besides TPPs, participants thought that "*NPPs develop economy*" since they *provide cheap energy* (f=6), *decrease foreign dependency* (f=5), *produce energy* (f=5), and *provide employment* (f=4). Sample excerpts are as follows.

> *"It is true because a high amount of energy is obtained from a very little raw material, and at this rate, it can be said that nuclear energy improves economy." S14*

"Yes, ... we wouldn't have to pay billions of dollars to import natural gas." S8

"... it [nuclear power] will reduce energy dependency and can be used as an alternative to other energy sources. It is beneficial to economy." S9

"Considering the amount of energy produced in a nuclear power plant, it is inevitable that it will contribute to economy." S6

"...It provides job opportunities for people who can work in PPs..." S11

Participants also mentioned about *foreign investment* (f=1), *waste storage cost* (f=1) and *construction cost* (f=1) as drawbacks of NPPs:

"In addition, even if it is built, the wastes of the nuclear power plant have to be preserved, which requires a huge financial resource. It is difficult to store the nuclear wastes, so as a result, the nuclear power plant does not develop economy." S3

"...How high is the construction cost of NPPs!" S9

In economy-oriented perspective, participants disagreed with statement 8 (position -5), that "Wind power plants (WPPs) harm environment". This statement, indeed, occupies the last place in both perspectives. In this perspective, participants mentioned that these PPs are *renewable energy sources* (f=5) but they also give harm to *bird migratory routes* (f = 9):

"...One of the reasons why it [wind power plant] does not harm environment is that it is a renewable energy source, and renewable energy sources can be used indefinitely provided that the necessary maintenance is done..." S1

"...but it has harmful aspects, for example, it can cause migratory birds to crash and die..." S3

Perspective 2: Science and Technology-Oriented

The statements ordered based on the factor scores for *science and technology-oriented* perspective are presented in Table 3.

As seen in Table 3, statements 16, 21, 18 and 23 come after the first two statements, and these statements emphasize the contribution that hydroelectric and WPPs make to scientific and technological developments. Interviews with participants revealed that "Hydroelectric power plants (HPPs) contribute to scientific development" because they *lead to scientific studies* (f=8) and provide *financial contribution* (f=5). With financial contribution, however, participants referred to the support of scientific studies with energy and money. Sample excerpts are as follows.

"Yes, hydroelectric power plants contribute to science because a country must be scientifically advanced to use a hydroelectric power plant, and during its use, some scientific studies can be done to develop this power plant, so that the country using this power plant will develop in that field." S1

"Scientific research is done and therefore people think; so, they contribute to scientific development." S11

"Considering that the electricity produced in these PPs is used in schools, universities, laboratories and all scientific institutions, it can be said that it contributes to scientific development." S5

"Yes, it can contribute indirectly. Money from the hydroelectric power station can be used for scientific research." S14

Another supporting idea in this perspective is the use of hydroelectric power plant as an *educational tool* (f=1). The excerpt is as follows.

> *"By teaching and showing students how energy is obtained from such systems and how they work, we can make them aware of this subject. After all, that too is a science." S6*

Table 3.
Statement Ranking Based on Factor Scores for Science and Technology-Oriented Perspective

No.	Statement	z-score	Grid Position	
35	NPPs threaten human health.	2.203	5	
10	NPPs harm environment.	1.821	4	
16	HPPs contribute to scientific development.	1.178	4	
21	HPPs contribute to technological development.	1.117	3	
18	The WPPs contribute to scientific development.	0.974	3	
23	The WPPs contribute to the technological development.	0.861	3	
3	The WPPs contribute to cultural development.	0.860	2	
24	The geoTPPs contribute to the technological development.	0.839	2	Agree
30	NPPs have ethical/moral problems.	0.826	2	
19	The geoTPPs contribute to scientific development.	0.819	2	
7	TPPs harm environment.	0.540	1	
4	The geoTPPs contribute to cultural development.	0.489	1	
1	HPPs contribute to cultural development.	0.484	1	
14	GeoTPPs boost economy.	0.442	1	
13	The WPPs boost economy.	0.259	1	
2	The TPPs contribute to cultural development.	0.248	0	
22	The TPPs contribute to the technological development.	0.222	0	
11	HPPs develop economy.	0.004	0	Neutral
20	NPPs contribute to scientific development.	-0.026	0	
25	NPPs contribute to technological development.	-0.107	0	
17	The TPPs contribute to scientific development.	-0.163	-1	
5	NPPs contribute to cultural development.	-0.247	-1	
27	The TPPs contain ethical/moral problems.	-0.397	-1	
6	HPPs harm environment.	-0.510	-1	
9	GeoTPPs harm environment.	-0.581	-1	
15	NPPs develop economy.	-0.708	-2	
12	The TPPs develop economy.	-0.737	-2	
32	TPPs threaten human health.	-0.764	-2	Disagree
29	GeoTPPs have ethical/moral problems.	-0.793	-2	
28	The WPPs contain ethical/moral problems.	-1.182	-3	
31	HPPs threaten human health.	-1.360	-3	
26	HPPs have ethical/moral problems.	-1.382	-3	
34	GeoTPPs threaten human health.	-1.396	-4	
33	WPPs threaten human health.	-1.853	-4	
8	The WPPs harm environment.	-1.979	-5	

As opposing views to the statement, participants stated that HPPs *do not require scientific studies* (f=3). The excerpts are as follows:

> *"The HPPs transform the power of water into electrical energy, which is not a contribution to scientific development. After all, their working principle is to transmit the water that has reached a level to the lower turbines. There is no scientific development in this process, so the hydroelectric power plant does not contribute to scientific development." S3*

> *"I think it's not possible because HPPs are structures that convert the power of water into electrical energy, I couldn't find anything to do with scientific development." S4*

The last two statements that participants holding this perspective do not agree with the most are about

WPPs. The related statements are statement 33 "WPPs threaten human health", and statement 8 "WPPs harm the environment", which is similar in the first perspective.

DISCUSSION, CONCLUSION, AND SUGGESTIONS

In this research, two perspectives that eighth grade students participating in this study hold towards PPs were identified. Thirteen of the students had *economy-oriented* perspective, while six of them had *science and technology-oriented* perspective. It was seen that five of the top ten statements with the highest degree of agreement in *economy-oriented* perspective were related to the positive impact of PPs on economy. In line with this finding, the perspective was named "economy-oriented". In the debates on SSIs, the economic subject area emerges as an important factor (Chang Rundgren & Rundgren, 2010). For example, in decision-making processes related to many SSIs such as NPPs (Eş & Varol, 2019) and fishing ban (Eş & Öztürk, 2021), the decisions of individuals are affected by the subject area of economy. Economic needs can cause support for many SSIs despite the threat to human health and environment. In the first ten expressions of the *science and technology-oriented* perspective, on the other hand, the intensity of the expressions regarding scientific and technological development stands out. In line with this finding, the perspective was named "science and technology oriented". Although it is difficult to draw and even define its boundaries, science has ceased to be a field of study that only concerns scientists, and has become an important factor shaping even our social life. It is claimed that discussions cannot be made without scientific views in all areas from economic and political problems to the aims of education and even human values (Hurd, 1998). Despite this undeniable role in our lives, however, its impact on decision-making on controversial issues is not at the desired level. Studies point out the importance of high levels of science subject area in making effective discussions and decisions on SSIs (Eş & Yenilmez Türkoğlu, 2021). At this point, teaching science in the context of SSIs emerges and is recommended by various researchers. Teaching science with SSIs allows students to make meaningful use of science by making real-world decisions, rather than simply learning isolated science facts, so that teachers would provide students with focused opportunities to explore social aspects of SSIs beyond science content (Foulk et al., 2020). Studies also point out that scientific reasoning and scientific arguments do not come to the forefront in discussions on SSIs (Demircioğlu & Uçar, 2014; Kolstø 2006; Ratcliffe, 1997; Yolaçtı Kızılkaya & Öztürk, 2022). For example, it is stated that even preservice teachers get information about nuclear power from informal sources such as the media rather than scientific sources (Eş et al., 2016). In addition, intellectual accumulation was also found to be effective in the decision-making processes of individuals on SSIs (Chang Rundgren and Rundgren 2010; Christenson et al., 2012; Eriksson & Rundgren 2012; Eş & Öztürk, 2021; Kolstø, 2006; Rundgren et al., 2016). In some studies, values were found to come to the forefront in decision-making processes (Christenson et al., 2012; Christenson et al., 2014; Grace & Ratcliffe 2002; Eş & Öztürk, 2021; Jiménez-Aleixandre & Pereiro-Muñoz, 2002). Kolstø (2006) states that even if the same information is used, individuals make different decisions because of the differing values they have. They may also base their decisions on emotional responses (Cebesoy & Chang Rundgren, 2023). In addition to all these, it is stated that in some cases, the personal experiences of individuals are important in the decision-making processes on SSIs (Chang & Chiu, 2008; Sadler & Zeidler, 2004; Tytler et al., 2001).

Obtaining demographic information that may be in relation to the perspectives of participants is a common practice in Q methodological studies (e.g., Yenilmez Turkoglu et al., 2022; Young & Shepardson, 2018). If any demographic characteristic of the participants holding a perspective comes in view, this characteristic is associated with the perspective, or it sheds light on further studies. In the current study, participants' gender, academic standing, parents' educational degree and their income level were examined in this context. When the perspectives emerging in the current study are examined comparatively, it is seen that 7 of the students in *economy-oriented* perspective are girls and 6 of them are boys, while 4 of the students in the *science and technology-oriented* perspective are girls and 2 are boys. With this finding, it may be said that gender is not effective on the perspectives of the participants about PPs. In the literature, there are differing findings about the effect of gender on the processes related to SSIs. For example, in line with the current research findings, Keefer (2003) and Cebesoy and Şahin Dönmez (2013) found that gender does not affect the decision-making processes and attitudes towards SSIs. Despite these findings, gender was found to be a significant contributor to performance, attitudes, and interest in science, as well (e.g., Brotman & Moore, 2008; Lauer et al., 2013; Wright et al., 2016). There are studies in the literature stating that gender affects attitudes towards SSIs (Fiedler et al., 2024; Ishiyama et al., 2012, Qin & Brown, 2007). For example, Sadler and Zeidler (2004) mention that gender has an effect on undergraduate students' willingness to participate in discussions on the moral dimension of genetic engineering. In another study, it was found that women support abortion more than men (Edwards et al., 2022). In the light of these findings, it may be recommended to conduct more research on the effect of gender on reasoning, decision-making and attitudes towards SSIs.

In the current study, parental education level or socioeconomic status do not seem to affect participants' perspectives on PPs, as well. However, when academic achievements of students are examined, it is seen that both the HSEE point average and the science course grade average are higher for the students in *economy-oriented* perspective than the ones in *science and technology-oriented* perspective. Studies examining the effects of academic achievement, parental education level and socioeconomic level on socioscientific decision-making processes are limited. It is seen that studies generally focus on undergraduate programs and state that the courses taken in undergraduate programs affect individuals' decisions about SSIs (Eş et al., 2016; Eş & Varol, 2019; Özdemir & Çobanoğlu, 2008). In a study, on the other hand, content knowledge, socioeconomic level and gender were found to be effective in the moral reasoning of university students (Seiter & Fuselier, 2021). In addition to this, it is also stated that although participants reach the same information, there are differences in their decisions about SSIs as they handle the information in differing ways (Rundgren et al., 2016). It can be said that this is a result of the differences in the basic beliefs (Kolstø, 2006) and intellectual accumulation of individuals (Zeidler, 1997). With the current research finding, it is not possible to draw a clear conclusion on the impact of parents' education level or socioeconomic status on the participants' perspectives. However, need on further studies on the effect of these variables on students' decisions regarding SSI is revealed.

The findings of this study showed that, statements 10 and 35, that is, "NPPs harm environment" and "NPPs threaten human health" respectively, shared the first two places in both perspectives. In the interviews about these statements, it was seen that all students participated in this study strongly agreed with the statement "NPPs threaten human health"; and except for one undecided student, most were sure that "NPPs harm environment". A review of the literature reveals similar results in studies with preservice teachers (Eş et al., 2016; Eş & Varol, 2019). In addition, it is stated that secondary school students also take the risks related to health in their decisions about local SSIs into account (Rundgren et al., 2016). Despite the negative effects of NPPs on human health and environment, it is seen that a significant amount of supportive reasons was produced on the positive effects of NPPs, such as the contribution to economy. When the literature is examined, it is stated that the warrants of the individuals who support NPPs are mostly concentrated in the field of economy (Eş & Varol, 2019). In the light of the literature and the statistical analysis and the interview data obtained in the current study, it can be concluded that students hold negative attitudes towards NPPs in terms of their potential risk on human health and environment.

In conclusion, the findings of this study showed that the eighth-grade students participated in this study developed perspectives on PPs, although they had not been formally taught about the issue yet. At this point, it may be appropriate for curriculum developers to place PPs subject in lower grades. Teachers may organize their instruction according to the perspectives that students hold (i.e., missing/limited points could be tackled). Not being formally taught about PPs but holding understandings about them, students would have limited, biased and resistant understandings. Teachers may advance students' understandings when they know what students think about the issue. With a further study, on the other hand, the possible change in students' perspectives about PPs after a formal education can be examined. Considering the fact that new information is constructed on prior knowledge, it is also suggested that science teachers consider the emerging perspectives of students and their thoughts about PPs while they organize the educational practices they will do with their students. The participants of this study were selected from a region where a NPP construction is in progress; other samples from other regions having other characteristics can be selected for a similar study. The PPs in this study are chosen from the science curriculum are limited to thermal, wind, hydroelectric, geothermal and nuclear PPs. Further studies with other power sources can be conducted. Lastly, although the Q method, which is preferred as a method in this study, has been used in social sciences for many years, its use in science education is limited. For this reason, the use of this method in research on SSIs is recommended.

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TÜRKÇE GENİŞLETİLMİŞ ÖZET

İnsanlık tarihinin çok da uzak olmayan zamanlarında başlayan ve giderek etkisini artıran çok sayıda bilimsel ve teknolojik ilerleme beraberinde bilim veya teknoloji ile ilişkili çeşitli sosyal sorunları gündeme getirmiştir. Toplumu ilgilendiren bilimsel, açık uçlu, bireylerde ikilem oluşturan ve toplum ile bilim ve/veya teknolojiyi bir araya getiren bu konular *Sosyobilimsel Konular (SBK)* olarak tanımlanmaktadır (Sadler, 2004a). Modern dünyada fen eğitiminin hedefi olan fen okuryazarlığına (Hurd, 1998) sahip vatandaşların temel bir özelliğinin sosyobilimsel konular ile ilgili bilinçli kararlar verebilme yeteneği olduğu iddia edilmektedir (Kolstø, 2001). Öğrencilerden sosyobilimsel konulara ilişkin bilimsel bilgilere ulaşmaları ve zihinlerinde yapılandırdıkları bu bilgiler ışığında kararlar vermeleri beklenmektedir. Bu sürecin temel unsuru olarak ise örgün eğitim kapsamında fen bilimleri dersi karşımıza çıkmaktadır.

Ülkemiz Fen Bilimleri Dersi Öğretim Programı'nda da sosyobilimsel konuların önemine işaret edilmektedir (MEB, 2018). Ancak sosyobilimsel konuların sadece fen derslerinin konusu olmadığı toplumun hemen her kesiminin bir şekilde ilgisini çektiği ve toplumda tartışıldığı gerçeği de dikkate alındığında öğrencilerin fen derslerine bu konular ile ilgili bir takım ön bilgiler ve yargılarla geleceği de göz önüne alınmalıdır. Buna rağmen alanyazında yer alan güç santralleri ile ilgili çalışmaların çoğunlukla nükleer santralleri konu aldığı ve bu çalışmaların genellikle öğretmen adayları ile (Ateş & Saracoğlu, 2013; Cansız & Cansız, 2015; Eş vd., 2016; Kapıcı & İlhan, 2016), az sayıda çalışmanın ise öğretmenler ile (Lee & Yang, 2013; Öztürk & Bozkurt Altan, 2019) gerçekleştirildiği; ve konunun uzun süredir ülkemiz fen programında (MEB, 2013, 2018) yer alıyor olmasına rağmen, ortaokul öğrencilerinin güç santrallerine yönelik yaklaşımlarını inceleyen bir çalışmaya rastlanılmadığı görülmüştür. Bu noktada gerek çalışma grubu gerekse de yönteminin (Q yöntemi) özgünlüğü ile çalışmanın alanyazına katkı sunacağı düşünülmektedir. Bu gerekçelerle bu araştırmada, bir sosyobilimsel konu olan güç santralleri konusuna yönelik ortaokul sekizinci sınıf öğrencilerinin bakış açılarının incelenmesi amaçlanmıştır.

Öğrencilerin güç santralleri ile ilgili yaklaşımlarını incelemek amacıyla tasarlanan bu çalışmada Q yöntemi kullanılmıştır. İlk olarak İngiliz psikolog ve fizikçi William Stephenson'ın (1953) faktör analizinde değişkenlerin kişilerle yer değiştirebileceğini ve kişiler arası faktör analizinin de yapılabileceğini önermesi ile ortaya çıkan Q yöntemi genel bir tanımlamayla, bireylerin benlik referanslı bakış açılarını inceleyerek bu bakış açılarının farklılıklarını ve ortaklıklarını, diğer bir deyişle birbirlerine göre nerede konumlandıklarını bütüncül bir yapıda açığa çıkarmayı hedefleyen bir yöntem olarak ifade edilebilir (Brown, 1993; Karasu & Peker, 2019; Stainton Rogers, 1995; Watts & Stenner, 2012). Bu çalışmada katılımcılara Q dizgisi oluşturmaları için 35 adet Q ifadesi sunulmuştur. Q yönteminde ifadeler alanyazında mevcut araştırma ya da ölçme araçlarından hazır olarak alınabileceği gibi eğer araştırma konusu ile ilgili alanyazın sınırlı ise araştırmacı tarafından da oluşturulabilir (Demir & Kul, 2011). Bu araştırmada alanyazının sınırlı olması nedeniyle Q ifadeleri araştırmacılar tarafından oluşturulmuştur. İfadelerin oluşturulması sürecine ilk olarak, araştırmanın amacına uygun olacak şekilde Fen Bilimleri Dersi Öğretim Programının aşağıdaki kazanımları dikkate alınarak başlanmıştır (MEB, 2018, s.54). Bu araştırmadaki katılımcılar Sinop İli Merkez İlçesinde bulunan bir devlet ortaokulunun sekizinci sınıfına devam eden öğrencilerden gönüllük esasına dayalı olarak belirlenmiştir.

Bu araştırmada, araştırmaya katılan sekizinci sınıf öğrencilerinin güç santrallerine yönelik iki bakış açısına sahip oldukları bulunmuştur. Bu bakış açıları "ekonomi odaklı" ve "bilim ve teknoloji odaklı" olarak adlandırılmıştır. Katılımcıların on üçü "ekonomi odaklı" altısı ise "bilim ve teknoloji odaklı" bakış açısında yer almaktadır. Araştırmada ortaya çıkan bakış açıları karşılaştırmalı olarak incelendiğinde, "ekonomi odaklı" bakış açısında yer alan öğrencilerin 7'sinin kız, 6'sının erkek olduğu görülürken, "bilim ve teknoloji odaklı" bakış açısında yer alan öğrencilerin 4'ünün kız, 2'sinin ise erkek olduğu görülmektedir. Bu bulgu doğrultusunda araştırmaya katılan ortaokul öğrencilerinin güç santralleri konusuna yönelik sahip oldukları bakış açılarının cinsiyetlerinden etkilenmediği söylenebilir. Çalışmaya katılan öğrencilerin akademik başarıları incelendiğinde "ekonomi odaklı" bakış açısında yer alan öğrencilerin LGS puan ortalamasının 414, "bilim ve teknoloji odaklı" bakış açısında yer alan öğrencilerin ortalamasının 373 olduğu "ekonomi odaklı" bakış açısında yer alan öğrencilerin fen bilimleri dersi not ortalamasının 96,5, "bilim ve teknoloji odaklı" bakış açısında yer alan öğrencilerin not ortalamasının ise 89 olduğu görülmektedir. Bu bulgu doğrultusunda "ekonomi odaklı" bakış açısındaki öğrencilerin, "bilim ve teknoloji odaklı" bakış açısındaki öğrencilerle kıyaslandığında akademik başarılarının bir miktar daha yüksek olduğu ifade edilebilir. Araştırma bulguları dikkate alındığında 10 numaralı "Nükleer santral çevreye zarar verir." ifadesi ve 35 numaralı "Nükleer santral insan sağlığını tehdit eder." ifadelerinin her iki bakış açısında da ilk iki sırayı paylaştığı görülmektedir. Katılımcılar ile yapılan görüşmelerde tüm katılımcıların nükleer santrallerin insan sağlığını tehdit ettiği görüşünde hem fikir oldukları, nükleer santrallerin çevreye verdiği zarar konusunda ise sadece bir katılımcının kararsız diğerlerinin ise hem fikir oldukları görülmüştür. Bu bağlamda gerek istatiksel analiz gerekse de görüşme verileri doğrultusunda araştırmanın çalışma grubunda yer alan ortaokul sekizinci sınıf öğrencilerinin nükleer santrallerin çevre ve insan sağlığı üzerinde olumsuz etkilerinin olduğu görüşünde oldukları söylenebilir.