


Gold mines as a local socio-scientific issue: Middle school students' informal reasoning

Ayşenur Eker 

Uşak University, Graduate of Science Teaching, Uşak, Türkiye, aysenurekerr123@gmail.com

Ahmet Taşdere 

Uşak University, Department of Science Education, Uşak, Türkiye, ahmet.tasdere@usak.edu.tr



ABSTRACT The purpose of this study is to determine the awareness and informal reasoning of 7th-grade middle school students regarding a local socio-scientific issue (L-SSI) related to gold mining. In this context, the Kışladağ Gold Mine Operations (KGMO) in Uşak province was examined as an L-SSI. The study, designed as a case study, was conducted with 43 seventh-grade students enrolled in schools near the mine and in distant regions. Data were collected through a questionnaire consisting of open-ended questions. The responses were analyzed according to three informal reasoning modes: economic, ecological, and social. According to the findings, the majority of students in the mining region were aware of the KGMO through their families and relatives, while most students in the distant region were not aware of the KGMO. When examining the students' informal reasoning, it was found that most students expressed undecided views, with economic reasoning being a significant determinant. Specific recommendations are provided for the inclusion of L-SSI in current science education studies.

Keywords: Gold mine, Informal reasoning, Local socio-scientific issues

Yerel bir sosyobilimsel konu olarak altın madenleri: Ortaokul öğrencilerinin informal muhakemeleri

ÖZ Bu çalışmanın amacı, ortaokul 7. sınıf öğrencilerinin yerel bir sosyobilimsel konu (Y-SBK) olan altın madeni hakkında farkındalıklarını ve informal muhakemelerini tespit etmektir. Bu kapsamda Uşak ilinde yer alan Kışladağ Altın Madeni İşletmesi Y-SBK olarak ele alınmıştır. Maden çevresindeki bölgelerde ve madenden uzak bölgedeki okullarda kayıtlı 43 yedinci sınıf öğrencisiyle durum çalışması desenine göre gerçekleştirilen çalışmada veriler açık uçlu sorulardan oluşan anket yoluyla toplanmıştır. Anket sonucunda öğrenciler kendilerine sunulan farklı rollere göre görüş ve muhakemelerini ortaya koymuşlardır. Öğrencilerin cevapları ekonomik, ekolojik ve sosyal olmak üzere üç informal muhakeme moduna göre analiz edilmiştir. Elde edilen bulgulara göre, altın madeni bölgesindeki öğrenciler büyük çoğunlukla aileleri ve yakınları aracılığıyla Kışladağ Altın Madeni İşletmesi'nden (KAMI) haberdar olduklarını, madene uzak bölgedeki öğrencilerin çoğunluğu ise KAMI'den haberdar olmadıklarını belirtmişlerdir. Öğrencilerin informal muhakemeleri incelendiğinde ise çoğunlukla kararsız görüşler ortaya çıkarken ekonomik modlu muhakemelerin önemli belirleyici olduğu tespit edilmiştir. Bu sonuçlara göre, Y-SBK'lerin güncel fen eğitimi araştırmalarında yer verilmesine yönelik spesifik öneriler sunulmuştur.

Anahtar Sözcükler: Altın madeni, Informal muhakeme, Yerel sosyobilimsel konular

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INTRODUCTION

In recent years, the primary competencies targeted for development in science education, which have been the subject of recent research, are the 21st-century skills. These competencies, defined across different disciplines and thus having an interdisciplinary character, include social skills such as multi-communication, problem-solving, decision-making, collaboration, effective reasoning, teamwork, creativity, and risk-taking (Akgündüz & Ertepinar, 2015). These skills are particularly emphasized in science education literature and are incorporated into current Science Curriculum (SC) (known also as Ministry of National Education (MoNE, 2018). Specifically, these skills, directly expressed and defined in the SC's learning domains, are reflected in various units and topics from grades 3rd to 8th. Among these competencies, which are aimed to be imparted by considering the students' readiness levels, are skills such as argumentation, decision-making, ethical-moral reasoning, and communication (Topçu, 2015). It is highlighted that the most effective and appropriate topics for developing these skills through activities like group discussions, developing arguments, and presenting opposing views are SSI (MoNE, 2018; Sadler, 2009). Addressing SSI in the context of everyday life problems, Atabey et al. (2018) emphasized the importance of incorporating these issues into course content to learn science and technology and integrating them into teaching processes. Similarly, Dawson (2015) highlighted the importance of SSI, noting that they help students establish a connection between daily life and school, thus facilitating meaningful learning. Simonneaux (2008) underscored the role of SSI in fostering conscious individuals, emphasizing their contribution to enabling students to make informed decisions through reasoning in decision-making processes and overcoming encountered problems.

SSI, which fundamentally possess a scientific nature, also has a social dimension. These issues frequently appear in the media, can be observed and evaluated from multiple perspectives, and are characterized by being open-ended, with no definitive correct answer and multiple possible solutions. The primary reason for this is their direct or indirect relationship with fields such as economics, ethics, biology, sociology, politics, environmental impacts, and values (Sadler, 2004; Zeidler et al., 2009). In recent years, the increasing human-environment interaction, the social grounding of inter-group communication and interaction, and the acceleration of this process by technology have made opinions on these fields more visible. Peoples, societies, and different cultural groups participate and present alternative ideas for numerous issues that may affect their immediate or distant surroundings (Çapkinoğlu, 2015; Topçu, 2015). Herman (2018) who addresses this situation on a sociocultural basis, draws attention to the impact of the perceptions, traditions, livelihoods, beliefs and identities of local and indigenous communities on the solution of these controversial environmental problems. Although political and civil society movements are the most significant platforms for this participation, educational environments are also influenced by these processes. This influence is particularly evident in science education environments where SSI are introduced through learning activities, considering the social context of learning, since SSI fundamentally pertain to scientifically characterized problems (Atabey et al., 2018; Zeidler et al., 2009).

Despite being grounded in scientific arguments, Sadler (2004) emphasizes that society cannot be considered separate from science, defining SSI as complex, dilemma-laden, open-ended topics without definitive answers due to their inclusion of certain social factors. These open-ended issues are informed by cultural (Herman, 2018; Ladachart & Ladachart, 2021), societal-political (Kim et al, 2020; Ottander & Simon, 2021), emotional (Herman et al., 2020), medical (Han Tosunoglu & Ozer, 2022; Subiantoro, et al., 2023), technological (Wahono et al., 2021) and ecological (Jack et al., 2022; Ladachart et. al, 2020) dynamics. This nature also provides individuals with the opportunity to develop unique perspectives on SSI, approach them from different angles, and consequently produce various solutions (Sadler & Zeidler, 2005). With the rapid impact of technology on daily life and the increased visibility of these diverse viewpoints through social interaction and communication tools, many controversial topics have begun to be addressed within the context of SSI in educational environments and curricula. These situations, which affect the entire globe and humanity, include environmental issues such as soil, water, and air pollution, energy production/consumption, the consumption/production of healthy foods and food safety, the use of underground resources, the preservation/extinction of species, the climate

crisis, and genetic interventions-issues that are universally relevant to all humanity (Ghazal et al., 2023; Sadler & Zeidler, 2005; Zeidler et al., 2009). Historically, these issues were initially addressed through the relationships between Science-Technology-Society-Environment (STSE), but with the emergence of global/universal issues also appearing on national and local levels in recent years, they have started to be considered within the context of SSI (Zeidler et al., 2005).

Local Socio-scientific Issues

Ratcliffe and Grace (2003) emphasize that SSI are issues arising from everyday life that require individuals to make judgments, highlighting that these issues exist not only on a universal level but also at local and national levels. Addressing this point, Atasoy et al. (2019) underline that perceptions, views, and arguments about local SSI concerning the immediate environment/region can significantly impact the learning process. Therefore, local SSI, which is more visible and directly impactful on daily life practices, can enhance student participation in classroom discussions. Similarly, Avsar Erümit et al. (2024) emphasized the importance of including regional-local issues in educational processes, thus diversifying students' argumentative perspectives. Herman et al. (2023) stated that students can develop functional science literacy through place-based pedagogical approaches that focus on real-world SSI. According to Topçu (2015) these issues, which can facilitate the integration of SSI into learning environments, can enable teachers who are aware of local issues to create effective classroom discussions, even if these topics are not directly included in the curriculum. Similarly, Çapkınoğlu (2015) notes that students use mass media to become aware of distant SSI, limiting their understanding to what they hear and see rather than experiencing it firsthand. Thus, selecting SSI that directly concern and involve students can be more meaningful. Due to the advantages of local Socio-scientific Issues (L-SSI) in science learning and discussion environments, and considering the case of the Kışladağ Gold Mine Operations (KGMO) in Uşak province, which is a L-SSI within Türkiye, the relevant literature has been examined within this context. These issues are situated in different geographical and cultural regions and are particularly those where the local populace participates through civil society movements, social media, and other processes. Despite the diverse and rich background, Çapkınoğlu (2015) notes that these topics are addressed in a limited number of studies in the context of science education at the local level. They emphasize the existence of numerous contemporary L-SSI in Türkiye that should be incorporated into science learning environments and highlight the need for their inclusion in the SC. In one of their studies, they examined the quality of arguments made by 7th-grade students in the context of five L-SSI specific to Bolu province: the Seben Taşlıyayla Irrigation Pond, chicken coops, leather production, base stations, and the Köprübaşı Dam and hydroelectric power plants (HEPP). They also investigated the factors considered by students in their decision-making process. The study revealed that the content where students struggled the most to produce quality arguments was HEPP, indicating that the subject matter influenced students' participation in discussions and the quality of their verbal arguments. Tekgöz and Ercan Yalman (2020) explored the views of science teachers regarding the Akkuyu Nuclear Power Plant, a L-SSI located in Gülnar district of Mersin province. Their research, conducted during the plant's establishment phase, found that teachers had positive views about the plant's contribution to meeting energy needs and reducing the country's energy dependency. However, they also expressed negative views due to the potential severe damage to the ecosystem in case of a plant explosion. Atasoy et al. (2019) investigated the informal reasoning of middle school students regarding L-SSI in Rize province, such as river-type HEPP, organic tea, and the Green Road. Their study found that students' reasoning levels regarding HEPP were higher compared to other SSI. Additionally, they discovered that students' reasoning levels varied when they assumed different roles concerning the SSI, with the highest reasoning levels observed when students reasoned as themselves.

Kışladağ Gold Mine Operations in Uşak as a Local Socio-scientific Issue

Individuals' engagement with SSI, especially those from nearby regions, can influence their personal moral positions and elicit various emotional responses (Cebesoy, 2024). This is because these issues, which directly affect and are of close concern to local populations, carry societal and cultural values alongside their scientific aspects (Ersoy, 2019; Ladachart & Ladachart, 2021). Sadler (2011) points out

that for such problems, which do not have a definite solution, there can be multiple reasonable solutions, and it is not always possible or necessary to base these solutions on scientific principles. Additionally, the dynamic relationships between corporations, the media, and social/environmental movements make these issues more complex, presenting them as significant social phenomena alongside their scientific nature (Ruggie, 2013). Explaining this complex process through the language of environmental valuation, Özberk (2022) emphasizes the conflict between social valuations such as justice, human rights, and health against economic valuations like benefit, cost, and pricing for nature. One of the L-SSI in Türkiye, which involves the participation of local communities, local media, non-governmental organizations, and others, is the Kışladağ Gold Mine Operations in Uşak.

An examination of KGMO's corporate page highlights contributions at the national level such as international competitiveness, social security, and the tax system, as well as impacts on import-export balance. It also emphasizes regional contributions such as educational opportunities/investments, worker health and safety, regional projects, and infrastructure (TÜGRAG, 2024). However, local media reports and some civil society organizations' actions have also pointed out potential harms. Since the gold mine began operations, various environmental and social damages have been reported at different times and platforms. These include the risk of cyanide used in gold mining contaminating soil and water sources, harm to the local population, animals, trees, and vegetation, and the destruction of fertile and extensive lands in the region (Gülsün, 2021). Although the debates on KGMO activities have remained regional/local, they have been the subject of some scientific studies over the years. These studies mostly focus on the technical, environmental, and social aspects of the operation (Gülsün, 2021; Özberk, 2022; Yılmaz et al., 2020), while the number of studies conducted from a pedagogical perspective is quite limited (Cebesoy, 2024). Consequently, this study on KGMO as an L-SSI is expected to make a significant contribution to the science education literature focusing on gold mines. Given the limited number of L-SSI studies involving middle school students in the Turkish context (Atasoy et al., 2019; Çapkinoğlu et al., 2020; Tekgöz & Ercan Yalman, 2020), it can also be said that this research will pioneer studies examining local/environmental issues in different regions within the context of science education. The issues examined in this study are as follows:

I) What is the level of awareness about KGMO among 7th-grade middle school students who live in the KGMO area compared to those who do not?

II) What are the informal reasoning perspectives of 7th-grade middle school students who live in the KGMO area compared to those who do not?

METHOD

Research Design

This study, which aims to reveal the news sources and informal reasoning of middle school students regarding KGMO as an L-SSI, adopts a qualitative research approach through a case study. According to Yin (1992), a case study is a research method used to examine a contemporary phenomenon within its real-life context, particularly when the boundaries between the phenomenon and context are not clearly defined and multiple sources of evidence or data are available. Yıldırım and Şimşek (2021) state that a case study is an appropriate method to deeply explore how students affect and are affected by a situation. Therefore, considering KGMO is a highly current, popular, and debated topic at the regional level with diverse viewpoints, a case study is deemed suitable for investigating student perspectives.

Research Group

The study was conducted with 43 7th-grade middle school students enrolled in different schools in Uşak province. The selection of students considered their proximity to KGMO. Accordingly, the study included students from middle schools in the city center of Uşak and those from middle schools near the rural area where the gold mine operates.

Table 1*Region and Schools Where Data was Collected*

Region and School	Characteristics of the Region and School	Grade Level of Data Collection
KGMO-S+ Region/Village	This village is close to KGMO. The population of the region consists of retired people and has a constantly decreasing structure. The economy is based on agriculture and animal husbandry. The region, about 11 km from KGMO, is generally pro-mining. Therefore, a significant proportion of the villagers work at KGMO. There is a middle school with a small number of students. Eleven 7th-grade students from this school form the research group. All students live in this region with their families. Students living with their families in the region, where there is no education such as boarding and transportation courses, dormitories, etc., stated that they sometimes help their families with their agricultural and animal husbandry activities. They also stated that at least one member of their family (mostly their father) or relatives worked at KGMO. It is a region where economic difficulties are experienced, especially when the income from agriculture and animal husbandry is at a low economic level. In his research in this region, Özberk (2022) stated that the villagers living in this region are pro-mining for reasons such as monetary income and economic benefits.	7th grade
KGMO-S- Region/Village	Approximately 9 km from KAMI is another nearby village in the region. Generally, the village population opposes the mine's operation and shows disapproval towards the few villagers working at the mine. In the region, where in the past years a patriarchal family structure was traditionalized in the form of crowded farmer families, where earnings were gathered together and a patriarchal family structure was traditionalized, in recent years there has been outward migration, especially due to the inability of agricultural lands to meet the needs of crowded families. Thus, the small (mother, father and child) family lifestyle continues. Similar to the KGMO-S+ village, there is a middle school with a small number of students. Seventeen 7th-grade students from this school form the research group. Only two of the students reported that some of their relatives had previously worked as drivers for the gold mine for a short period of time. A significant number of villagers have relatives working abroad and supporting them economically. Özberk (2022) indicated that villagers oppose the mine due to concerns about individual and community health, agriculture, water, food security and sovereignty, and wildlife. Some local-civilian protests and newspaper articles in which they publicized these convictions were covered in the local media (Damcı, 2018; Uşak Gündem, 2022). The important sources of income of the region are agriculture and animal husbandry. Industry and trade life has not developed much. Therefore, children of families with limited economic income are educated in the schools in the region.	7th grade
KGMO-S0 Region	This school is located in Uşak city center, far from KGMO. It is one of the leading schools in the city socioeconomically. In the selection of the school, the relevant units of the provincial directorate of national education were consulted. In addition, the administrators of the school were interviewed prior to data collection. The selection of this school aims to capture a broader diversity in awareness about KGMO (internet, social media, family awareness, etc.). Therefore, more comprehensive and rich data is targeted. Fifteen 7th-grade students from this school form the research group. Since this school was also used for the pilot study, it was deemed appropriate to collect the main data from here as well.	7th grade

This allowed for a comparison of data obtained from students studying near the gold mine with those from more distant areas. Additionally, the schools located in the vicinity of the gold mine (village schools) were selected based on various characteristics relevant to the study's

objectives. The first village comprises residents who support the gold mine operation (KGMO-S+), while the second village consists of residents who oppose the gold mine operation and want it to cease (KGMO-S-). These villages are settlements with a small population and only one secondary school. Therefore, a small number of students from these schools constituted the research group. The peoples of the region, who were mostly socioculturally similar in character, experienced political, economic and partial-cultural divisions, especially after the operation of the gold mine. This situation was revealed through interviews with the villagers in the region (Özberk, 2022). The third area is within the city limits but farther from the mine, including residents of the city center (KGMO-S0). The characteristics of these regions and schools are detailed in Table 1.

Data Collection Instruments

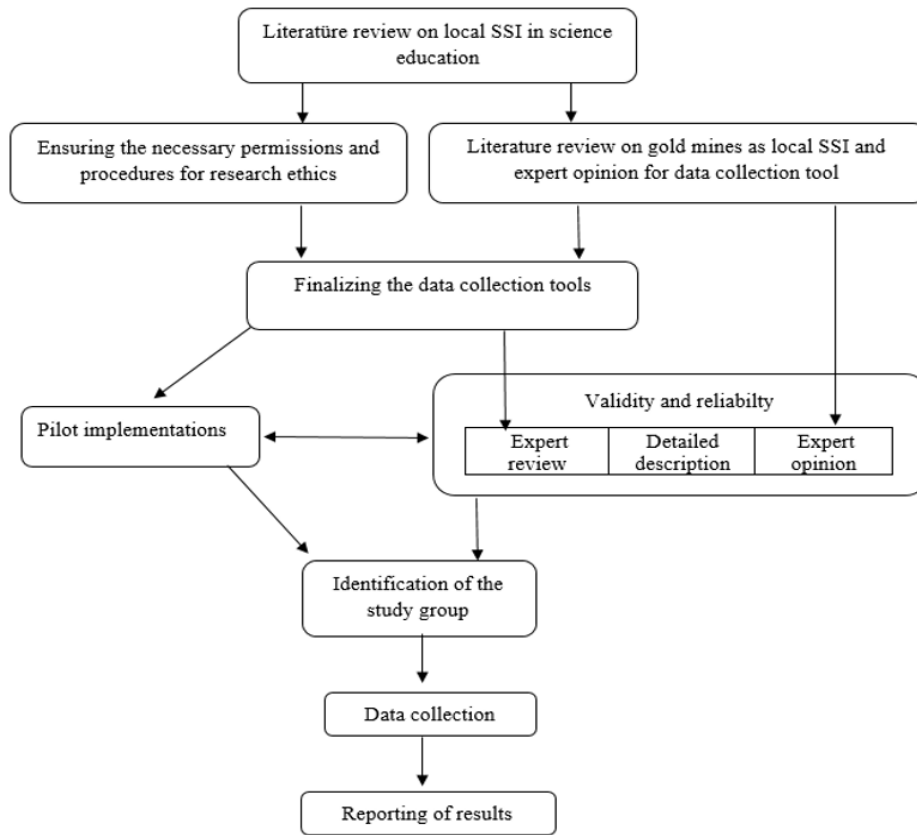
A survey consisting of open-ended questions, which students would answer in writing, was used as the data collection instrument. During the development process of the survey, studies related to L-SSI were reviewed, and the questions posed to participants in those studies were analyzed (Atasoy et al., 2019; Çapkinoğlu et al., 2020; Tekgöz & Ercan Yalman, 2020; Yüca, 2019). Draft questions were written to create a pool of questions for the survey. To finalize the survey, feedback was obtained from two academic experts in science education with publications related to L-SSI and one expert in assessment and evaluation. Based on the feedback from these experts, the survey was finalized and a pilot study was conducted to determine the functionality of the survey items. The pilot study was administered to all middle school grade levels (5th, 6th, 7th, and 8th grades). It was determined that the items were suitable for the 7th and 8th-grade levels, and the study group was selected accordingly. The final version of the survey was prepared based on the data obtained from the pilot study, taking into account repetitive answers, unanswered questions, irrelevant responses, etc. (Appendix 1). The survey began with a brief introduction about gold mines, followed by questions about the students' awareness of this L-SSI. Subsequently, students were asked to state their decisions and justifications regarding KGMO from the perspectives of different roles such as environmental scientist, Minister of Economy, gold mine worker, engineer, and local resident. Students were asked to reconsider and respond to KGMO based on the roles they assumed.

Data Analysis

In analyzing the data, three categories of informal reasoning modes—economic, ecological, and social were considered to identify the informal reasoning modes of students assuming different roles. These categories are widely recognized in the literature (Atasoy et al., 2019; Sakamoto et al., 2021; Wu & Tsai, 2007). According to Atasoy (2018), explanations related to production/consumption cost, income amount, product quantity, and tourism revenue are classified as economic mode. Explanations related to the effects on plant species and wildlife, natural beauty and resources, environmental degradation, and eco-friendly energy are classified as ecological mode. Explanations related to human/society health, benefits, and national interests are classified as social mode. Two researchers were responsible for determining which mode the students' arguments fit into. The modes identified by both researchers were compared, and a final decision was made. For student statements where researchers were uncertain, the opinion of a science education expert consulted during the survey development process was sought. Tables include sample statements from students whose reasoning modes were identified, with each student anonymized as S1, S2, S3, and so on. Descriptive analysis was used to determine students' awareness of L-SSI. This involved identifying the sources of information that students knew, heard about, or learned regarding KGMO. The number and types of these information sources are shown in Table 2. The figure 1 below outlines the comprehensive data collection and analysis process.

Figure 1.

Data Collection and Analysis Process



Researcher Roles

According to Creswell (2021), the initial positions and potential biases of researchers conducting qualitative research are crucial and should be disclosed before the study to understand how these factors might influence the research. This study is supported by ‘The Scientific and Technological Research Council of Türkiye’ (TÜBİTAK) 2209 A university students' project call, with the first author as the project leader. The first author has experience in project proposal preparation and reporting. To further develop these skills, the author has participated in training sessions on project preparation, academic writing, and similar topics offered by national organizations, thus acquiring high-quality academic writing and reporting training. The second author has previously conducted studies on SSI (Kurşun et al., 2019) and has been actively involved in qualitative data collection and analysis processes in many studies. Therefore, the second author possesses extensive experience in both SSI and qualitative data analysis.

Validity and Reliability of the Study

Since the data collection process was conducted using open-ended qualitative questions, validity and reliability criteria were established according to the qualitative research approach. Expert review was sought to ensure the credibility of the research. Three experts were consulted in the preparation of the data collection tool and data analysis. These experts included an associate professor of science education with previous SSI research, an associate professor of assessment and evaluation, and a doctoral academic with extensive qualitative research experience in science education. To ensure the transferability of the research, detailed descriptions were provided. Student statements representing the categories identified by the researchers were included in the tables, and the number of these statements was increased. This

detailed description process was also considered in forming the research group, reaching out to both urban and rural schools. This approach allowed for the collection of comparative data by engaging with students from regions close to and distant from KGMO. To ensure the consistency of the research, a consistency check was performed. Two researchers analyzed the student responses according to the informal reasoning modes and compared their analyses. The agreed-upon categories were included in the analysis and tabulated. Categories with disagreements were reviewed, and a concordance percentage was calculated for each question. The lowest concordance percentage was 92% (for question 5), and the highest was 100% (for question 1).

Ethical Approvals for the Research

Ethical approval for the research was obtained from the Scientific Research and Publication Ethics Committee of Social and Human Sciences at Uşak University, with the decision dated 17.11.2022 and numbered 2022-153.

RESULTS

Middle School Students' Awareness of Local L-SSI

The information about whether middle school students are aware of KGMO and the sources through which they are informed is presented in Table 2.

Table 2.

Middle School Students' Awareness of KGMO

News Sources	KGMO-S- Region	KGMO-S+ Region	KGMO-S0 Region
School	1	-	-
Internet	-	-	1
Environment	3	1	-
Family	13	6	1
Television	-	-	2
Academic	-	-	2
Not aware	-	4	9

All 7th-grade students living in the KGMO-S- region, who generally oppose the mine's operation, are aware of the gold mine. They most frequently mentioned that they learned about the mine from their families. S3 expressed this as *"We heard about the Kışla Gold Mine from our family,"* while S1 said, *"I learned from my family. My father used to work there."*

In the KGMO-S+ region, where the population generally supports the mine's operation, the majority of 7th-grade students (7 students) are aware of the gold mine, although four students indicated that they were not aware of it. S6, who learned about KGMO from family, stated, *"I don't know much, but I heard from my father."* S2, who learned from their close environment, said, *"I heard from my relatives."*

Most 7th-grade students living outside the KGMO region indicated that they were not aware of the gold mine operation. S12, enrolled in a school far from KGMO in the city center, stated, *"I had never heard of it before. I have no information."* A few students mentioned that they learned about the mine through television, academics, family, and the internet. S5 cited the internet as their source, saying, *"I heard about it online, but I don't believe it because it could be fake news."* S10 mentioned seeing it on a local TV channel, stating, *"I saw it on television, but it didn't catch my attention."*

Middle School Students' Informal Reasoning about KGMO

The informal reasoning modes and example statements used by middle school students when making decisions about KGMO in different roles are presented in the tables below. Table 3 presents findings from students attending schools in the region that do not support KGMO.

Table 3.
Informal Reasoning and Example Statements of 7th-Grade Students in the KGMO-S- Region

Roles	Decision	Reasoning/Informal Reasoning Modes	Example Statements
Themselves	+	NR (2)	
	-	Ecological (2), Social (1)	S2: "It damages the fields - Ecological" S16: "Some machines are dangerous - Social"
	0	Undecided (9), NR (2)	S1: "While it contributes to the economy, people can be disturbed by the noise- Undecided (Economic/Social)" S13: "Positive because my dad works there, negative because our village's water is depleted - Undecided (Economic/Ecological)"
Environmental Scientist/Volunteer	+	Economic (3), Ecological (1), NR (1)	S8: "Environmental scientist, as the name suggests, protects the environment, keeps it clean - Ecological" S11: "It would benefit Türkiye's economy - Economic"
	-	Ecological (4), NR (1)	S13: "It harms the environment with cyanide - Ecological"
	0	Undecided (5), NR (1)	S1: "While the economy improves, it negatively impacts people - Undecided (Economic/Social)"
Minister of Economy	+	Social (1), Economic (2), NR (2)	S4: "No, it ensures justice for everyone, provides their money - Social/Economic" S9: "It significantly contributes to the economy - Economic"
	-	NR (2)	
	0	Undecided (4), NR (3)	S8: "It contributes to the economy, but also has its harms - Undecided (Economic/-)"
Local resident	+	NR (1)	
	-	Social (6), Ecological (4), NR (2)	S1: "People and I would be disturbed by the noise - Social" S3: "It damages the fields - Ecological"
	0	NR (4)	
Gold mine worker	+	Economic (1), NR (2)	S13: "I would bring money to my family - Economic"
	-	NR (2), Social (3)	S8: "We could get very tired - Social" S15: "It could be dangerous - Social"
	0	Undecided (6), NR (2)	S6: "I would earn money but it would also negatively affect my health - Undecided (Economic/Social)" S9: "While providing opportunities for workers, it harms the environment - Undecided (Economic/Ecological)"

Themselves: 7th-grade students attending schools in the region that do not support KGMO were mostly undecided about the operation of the gold mine. Students expressed their indecision for various reasons. For instance, S1 experienced a dilemma between the economic contribution and the potential noise pollution. S13 supported the mine because his father worked there but opposed it due to the damage to the local water sources. Additionally, two students opposed KGMO for ecological reasons, and one student opposed it for social reasons. S2 explained his ecological reason as damage to the fields, while

S10 explained his social reason as the danger posed by heavy machinery.

Environmental Scientist/Volunteer: Students in the region that do not support KGMO presented differing views when assuming the role of an environmental scientist/volunteer. Three students supported KGMO for economic reasons, with S11 justifying his view by highlighting the contribution to the national economy. Four students opposed KGMO for ecological reasons, with S13 explaining the potential environmental damage caused by cyanide. Five students were undecided in this role. S1 highlighted the dilemma between economic benefits and potential harm to people, describing his economic-social dilemma regarding KGMO.

Minister of Economy: When assuming the role of Minister of Economy, most students in the region that do not support KGMO were either undecided or did not express an opinion. Four students were undecided, and a total of seven students could not provide a justified opinion. S8 noted that while KGMO contributes to the economy, it also has some harms. One student supported KGMO economically and socially.

Local Resident: As local residents, students in the region that do not support KGMO largely expressed negative views based on social and ecological reasons. S1 cited noise pollution, and S3 mentioned damage to the fields as their reasons for opposing KGMO. Six students did not provide a justified opinion.

Gold Mine Worker: Students from the region that do not support KGMO, when assuming the role of a gold mine worker, mostly did not express an opinion or were undecided. S6 highlighted the economic-social dilemma, noting that he could earn money but that his health would be negatively affected. S9 described an economic-ecological dilemma, acknowledging the job opportunities but also the environmental damage. Three students opposed KGMO for social reasons, with S8 mentioning the strenuous nature of the work and S15 highlighting the danger. One student supported KGMO for economic reasons, while five students did not provide a justified opinion.

Table 4 presents findings from students attending schools in the region that support KGMO.

Themselves: 7th-grade students attending schools in the region that support KGMO have diverse views on the operation of the gold mine. Three students expressed support for KGMO for economic reasons. S10 explained this by highlighting the mine's contribution to the economy and the job opportunities it provides. Two students opposed KGMO for ecological reasons, with S9 explaining their opposition by citing the damage to forests and mountains. Three students were undecided about KGMO. S7 expressed a social-economic dilemma, noting that while it is dangerous work, it could provide for their livelihood. Two students did not provide a justified opinion on KGMO.

Environmental Scientist/Volunteer: Students in the region that support KGMO presented different views when assuming the role of an environmental scientist/volunteer. They supported KGMO for economic reasons and opposed it for ecological reasons. S10, explaining their positive view, emphasized the job opportunities provided by KGMO. S8, explaining their negative view, highlighted the potential for soil erosion due to mining activities. Two students did not provide a justified opinion on this role.

Minister of Economy: When students assumed the role of the Minister of Economy, they mostly expressed positive views based on economic reasons. S5 justified their view by mentioning job opportunities and the value of gold. One student remained undecided due to an economic-ecological dilemma, while three students did not provide a justified opinion in this role.

Table 4.

KGMO-S+ Region: Informal Reasoning and Example Statements of 7th-Grade Students in the Region Supporting KGMO

Roles	Decision	Reasoning/Informal Reasoning Modes	Example Statements
Themselves	+	Economic (3), NR (1)	S10: "It supports the economy and provides job opportunities - Economic"
	-	Ecological (2), NR (1)	S9: "The forest and mountains are being destroyed - Ecological"
	0	Undecided (3)	S6: "It has both positive and negative effects. I don't know much about the mine and what's true, so I'm undecided - Undecided" S7: "Because it's dangerous work but it can provide our livelihood - Undecided (Social/Economic)"
Environmental Scientist/Volunteer	+	Economic (3), Ecological (1), NR (1)	S6: "It helps nature and I don't think it's harmful or negative - Ecological" S10: "As I said, it supports the economy and provides job opportunities. My answer wouldn't change - Economic"
	-	Ecological (4)	S8: "Mining can cause landslides and other soil disturbances - Ecological"
	0	NR (1)	
Minister of Economy	+	Economic (5), NR (1)	S5: "It's good for employment, and gold is a valuable material, especially pure gold - Economic"
	0	Undecided (1), NR (2)	S9: "Money comes in, but the forest is also being destroyed - Undecided (Economic/Ecological)"
Local resident	+	Economic (2), NR (1)	S8: "If the extracted gold leads to new job opportunities and sectors, that's positive - Economic"
	-	Ecological (3), Social (2)	S3: "It damages the fields - Ecological" S6: "If there was an accident at the mine, many people could be harmed. So I think it's negative - Social"
	0	Undecided (2), NR (2)	S10: "It provides job opportunities and supports the economy, but the noise from the machinery could bother me - Economic/Social"
Gold mine worker	+	Economic (6)	S2: "It provides a place to work. Without this job, many people might be unemployed - Economic" S10: "It provides job opportunities, supports the economy, and helps us earn money - Economic"
	-	Social (1)	S6: "There could be harmful chemicals and accidents, which are negative - Social"
	0	Undecided (2)	S4: "I'm undecided because of the risk of truck accidents - Undecided (Social/-)" S5: "It's good for employment, but I don't know the exact wages, so it's hard to give a clear answer - Undecided (Economic/-)"

Local Resident: When students assumed the role of local residents near KGMO, they expressed different views. Two students supported KGMO for economic reasons, with S8 explaining it through the creation of new job opportunities. Two students opposed KGMO for ecological reasons, and three students opposed it for social reasons. S3 highlighted potential damage to fields, while S6 pointed out the risk of

accidents. Two students were undecided due to various dilemmas. S10 expressed an economic-social dilemma, noting that while KGMO provides job opportunities and economic support, the potential noise pollution could be a concern. Three students did not provide a justified opinion in this role.

Gold Mine Worker: When students assumed the role of a gold mine worker, they predominantly expressed support for KGMO for economic reasons. S2 justified their view by highlighting the job opportunities provided by KGMO, while S10 mentioned the overall contribution to the national economy. One student opposed KGMO for social reasons, citing harmful chemicals and potential accidents. Two students expressed undecided views. S5 noted that while the job opportunities are beneficial, the uncertainty about the wages left them undecided.

Table 5 presents findings from students attending schools in the region far from KGMO.

Themselves: 10 students living outside the KGMO region were undecided about the operation of the gold mine. Their indecision was often due to economic-ecological dilemmas. S10 explained this by noting that while the mine is economically beneficial, it harms human life and ecological balance. Four students opposed the operation of the gold mine for ecological reasons, and two opposed it for social reasons. S4 explained their opposition by citing the damage to nature caused by the use of hazardous materials, while S1 pointed to the negative impacts on human life. Conversely, three students supported KGMO for economic reasons, with S2 explaining this by highlighting the contribution to the national economy.

Environmental Scientist/Volunteer: When assuming roles such as environmental scientist/volunteer, students mostly expressed negative views about KGMO due to ecological and social reasons. S14 justified their negative view by highlighting the harm cyanide causes to the environment and humans. Four students were undecided in this role. S9 mentioned that their indecision depended on whether the positive or negative aspects of KGMO were more significant. Two students, even in the role of environmental scientist/volunteer, supported KGMO for economic reasons.

Minister of Economy: When students assumed the role of Minister of Economy, they predominantly expressed positive views based on economic reasons. S5 justified their view by pointing to the economic value of gold, and S3 emphasized the contribution of gold to international trade. However, two students, even in the role of Minister of Economy, expressed negative views about KGMO for ecological reasons. S1 explained that the potential harm to human life and nature is more important than money. Three students remained undecided due to potential negative ecological and social consequences despite economic gains.

Local Resident: When assuming the role of local residents near KGMO, students predominantly expressed negative views based on economic, social, and ecological reasons. Eight students opposed KGMO for social reasons, and four opposed it for ecological reasons. S3 explained their opposition by citing the damage to agricultural products, while S9 pointed to the potential noise pollution. Two students remained undecided. S11 expressed their dilemma by noting that while landslides and loss of life are concerns, KGMO should not be viewed entirely negatively.

Gold Mine Worker: When students assumed the role of a gold mine worker, they expressed a roughly equal number of differing views. Four students supported KGMO for economic reasons. S13 emphasized the idea of becoming an engineer at KGMO and thus providing economic support to their family. Conversely, four students opposed KGMO for social reasons, and two opposed it for ecological reasons. S5 explained their opposition by noting that working at the mine is a difficult and tiring job. Three students remained undecided about KGMO.

Table 5.*Informal Reasoning and Example Statements of 7th-Grade Students in the KGMO-SO Region (Far from KGMO)*

Roles	Decision	Reasoning/Informal Reasoning Modes	Example Statements
Themselves	+	Economic (3)	S2: "It contributes to the national economy - Economic"
	-	Ecological (4), Social (2)	S1: "It negatively affects human life - Social" S12: "Landslides can cause loss of life - Ecological/Social"
	0	Undecided (10)	S7: "There are both good and bad sides - Undecided" S10: "It harms human life and disrupts the ecological balance, but it's good for the economy - Undecided (Social/Ecological/Economic)"
Environmental Scientist/Volunteer	+	Economic (2), Ecological (1)	S3: "I would continue its operation for the development of my country and even accelerate it if necessary - Economic" S5: "I don't think it has a significant negative impact on the environment - Ecological"
	-	Ecological (8), Social (2)	S14: "Cyanide used in gold production harms people and nature - Ecological/Social"
	0	Undecided (4)	S9: "I would evaluate it based on which aspect, good or bad, is more prevalent - Undecided"
Minister of Economy	+	Economic (9)	S3: "I would strengthen the economy by exporting gold - Economic" S5: "It is expensive but widely used in trade - Economic"
	-	Ecological (2)	S10: "I couldn't ignore the harm to human life and nature for money - Ecological"
	0	Undecided (3)	S8: "It has contributions to the economy, but also has its harms - Undecided (Economic/-)"
Local resident	+		
	-	Social (8), Ecological (4)	S3: "I would complain because the crops are damaged - Ecological" S9: "If there was a baby or a sick person at home, the noise from the mine would be disturbing - Social"
	0	Undecided (2), NR (2)	S11: "Landslides can cause loss of life, but this does not necessarily mean the operation is entirely negative"
Gold mine worker	+	Economic (4)	S3: "I need to work there to earn my salary. Therefore, I wouldn't complain - Economic" S13: "If I were an engineer, I would earn money and support my family - Economic"
	-	Social (4), Ecological (2)	S5: "It's a tiring and tough job for workers - Social"
	0	Undecided (3)	S11: "I would earn money, but since there are negative aspects, I would be undecided - Undecided (Economic/-)"

DISCUSSION and CONCLUSION

In the study, the first research question examined whether 7th-grade students were aware of KGMO, an L-SSI. Considering all schools in the villages/regions, it was found that the majority of students cited their families as their primary source of information. This was most evident among students in the KGMO-S- region. This might be due to the strong opposition voiced by families in this region across various societal sectors (social life, schools, protests, etc.) (Damcı, 2018; Özberk, 2022; UşakGündem,

2022). Similar findings were obtained by Atasoy et al. (2019) regarding a local SSI about organic tea in the Rize region, where they identified families as a significant news source for students. In the KGMO-S+ region, students also indicated that they were mostly informed by their families. This region has a high number of KGMO employees, which might explain why students are aware of the issue through their family members' work experiences. Sadler and Zeidler (2004) highlighted that students often make decisions based on their personal experiences in their study on a different SSI. Students enrolled in schools in the KGMO-S0 region reported that they were mostly unaware of KGMO. Those who were aware mentioned sources such as television and the internet. This might be due to the news about KGMO being covered in local/regional media, internet sites, and television (UşakGündem, 2022; Şenbakkavacı, 2022). Similar results were found by Eş et al. (2016) in their study with pre-service teachers, identifying media as an important news source for SSI. The reason for the majority of students in the KGMO-S0 region being unaware might be that they follow new media and communication tools (social media) rather than traditional and local media. Additionally, since these students are educated in a socioeconomically upper-level area in the city center, it can be said that a local issue may not have reached a societal dimension affecting these students.

In the study, the second research question examined the informal reasoning of 7th-grade students living in different regions. Students in the KGMO-S- region struggled to make decisions and often faced dilemmas. These dilemmas primarily focused on economic reasons (economic-ecological and economic-social). Atasoy (2018) found a similar result regarding hydroelectric power plants (HPP) as an L-SSI, while students produced more social arguments concerning organic tea and the Green Road. Therefore, it can be said that when making decisions about environmental SSI, especially those involving nature components, participants often cannot agree on a common reasoning mode, with economic reasons being the most decisive factor even if not the final decision. A similar economic emphasis was also found in Atasoy et al. (2019)'s study on HPPs. When students assumed the role of environmental scientist/volunteer, they expressed diverse views. This diversity was also observed in Atasoy's (2018) study, where arguments based on both economic and ecological reasons were identified regarding HPPs. Additionally, the number of students who were undecided in the role of environmental scientist/volunteer was notable, with their dilemmas often involving ecological and social concerns. The emphasis on human health in social concerns was particularly striking. When assuming the role of the Minister of Economy, students mostly refrained from expressing opinions. This hesitation could be explained by the dilemma they experienced between living in the KGMO-S- region and assuming the role of the Minister of Economy. In this role, four students indicated that they were undecided. According to Atasoy et al. (2019), this can be explained by the different contexts influencing the reasons students produce when making decisions about SSI. Students generally expressed negative views when assuming the role of local residents. Öztürk and Leblebicioğlu (2015) found similar results, identifying that people living in areas with HPPs had negative views about continuing the operation of the plants. It can be inferred that students living in the KGMO-S- region have a similar perspective. When students assumed the role of a gold mine worker, they mostly refrained from expressing opinions or were undecided. The reason for students' hesitation, similar to the views expressed by local residents, might be the conflict between the high economic income earned by KGMO workers and issues such as workplace accidents and decreased quality of life. They also mentioned social reasons, highlighting some dangers associated with working at KGMO.

Students in the KGMO-S+ region, like those in the KGMO-S- region, have differing views. However, some students in this region more clearly express their support for KGMO for economic reasons. A likely strong reason for this is that their families and relatives work at KGMO, providing economic income. Atasoy (2018) found similar results regarding HPPs, noting that one of the most significant factors influencing the decisions of those living near the region was the economy. Kalın and Namdar (2022), who reached a different conclusion about HPPs, found that pre-service science teachers mostly used the ecologically oriented informal reasoning mode. A possible reason for this different result may be that HEPPs are more widely discussed in public opinion than gold mines and are located in every geographical region. Similar findings emerged when students assumed the role of environmental scientist/volunteer. While some students opposed KGMO for ecological reasons consistent with their

roles, others supported it for economic reasons. This can be explained by the economic needs and livelihood challenges of the local population. Atasoy et al. (2019) similarly found that students' decisions about HPPs were primarily based on economic reasons. In the role of Minister of Economy, students strongly supported KGMO for economic reasons. This support aligns with the views and work preferences of the KGMO-S+ population and suggests that these factors influence students' decisions. When assuming the role of local residents, some students supported KGMO for economic reasons, while others opposed it for ecological and social reasons, or remained undecided. Atasoy (2018) found partially similar results with participants developing different modes of informal reasoning for SSI like the Green Road and organic tea. Possible reasons for these results include the conflict between the economic income provided to their families and relatives and the negative social-ecological risks such as workplace accidents, noise pollution, and damage to fields and soil. When students assumed the role of a gold mine worker, they primarily supported KGMO for economic reasons. This can be attributed to their empathy with family members and relatives working at KGMO, as well as their own concerns about individual economic futures. Atasoy et al., (2019) found similar results in their study on HPPs, emphasizing that economic livelihood issues are a significant determinant in contexts affecting the local population.

7th-grade students living in the KGMO-S0 region mostly hold undecided views. This indecision, particularly highlighting multiple uncertainties (social/environmental/economic), may be due to the students' lack of familiarity with the local dynamics and structure of the region. Kolstø (2006) emphasized that students tend to avoid taking a stance on issues they are not well-informed about. Similarly, Atasoy et al., (2019) found that students struggled to make decisions about the Green Road project, an L-SSI, when they were not fully informed. According to Demircioğlu and Uçar (2014), another reason might be that students cannot relate what they learn in science classes to SSI. Therefore, students in the KGMO-S0 region may have struggled to connect a local issue outside their region to their science-related knowledge. While students expressed undecided views in the roles of environmental scientist/volunteer and local resident, they mostly indicated that they did not support KGMO for ecological and social reasons. Atasoy (2018) found similar results, noting that participants living outside the region primarily provided social reasons for the local SSI of organic tea and ecological reasons for the Green Road. In the role of Minister of Economy, as in other regions, students mainly expressed support for KGMO based on economic reasons. Atasoy et al. (2019) found that students frequently referred to economic reasons when making decisions about SSI in a similar role to the Minister of Economy. Thus, even when a local SSI with economic benefits poses potential environmental and ecological risks, students can still produce positive views based on economic reasons. When assuming the role of a gold mine worker, students expressed differing views. The likely reason for this is their comparison of the economic benefits of working at KGMO with the potential ecological-social risks that might arise.

SUGGESTIONS

Based on the results obtained, the following recommendations are provided for new/upcoming local SSI studies and science curricula:

Recommendations for New/Upcoming L-SSI studies:

The number of studies examining gold mines as local SSI can be increased. Beyond the roles used in this study, different professional fields related to the mining region (e.g., journalist), civil society organizations (e.g., TEMA representative), and various branch experts (e.g., mining engineer) can be considered to analyze informal reasoning, reasoning modes, argument quality, etc. This can allow for a comparison of roles that develop the strongest reasoning.

The selection of samples is crucial for local SSI studies because decisions may vary according to the

different local components and elements of the region, such as values, interests, and perspectives. Considering these differences in the context of science education, studies with diverse and unique samples can be included. This approach can provide a variety of data to the science education literature and enhance argument quality by presenting multiple perspectives.

Recommendations for Science Curricula

Examples related to local/regional and national elements in science can be included in the science curriculum. For instance, local SSI from each geographical region (e.g., Uşak - gold mine, Bolu - leather factories, Rize - Hydroelectric power plants, Mersin - nuclear power plant) can be integrated into different learning outcomes. Direct emphasis can be made on which science content these local SSI are related to. This is important because, as found in both the literature and this study, students tend to avoid taking a stance on SSI due to their inability to relate what they learn in science classes to SSI and their lack of information (Demircioğlu & Uçar, 2014; Kolsto, 2006).

Roles assumed by students can be utilized in teaching activities. In argumentation activities (e.g., competing theories, concept cartoons), different roles can be assigned to characters, and students can be asked to explain their arguments, data, and justifications. Examples of such role-based activities can be included in textbooks and curricula.

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APPENDICES

Appendix 1: Informal Reasoning Questionnaire for Gold Mining

Dear Students,

This form aims to gather your opinions about gold mines.

Remember, there are no right or wrong answers to these questions. You are expected to write the statements that best explain your thoughts and views in the provided spaces. Thank you in advance for your contributions.

Gold Mines: Gold, one of the most valuable and important minerals on Earth, is of volcanic origin. Known for its softness and malleability, as well as its beauty and durability, gold has been sought after and valued throughout history. Although its valuable properties make it significant economically and aesthetically, the processes of extraction and operation are supported by some and criticized by others for various reasons. These reasons are outlined below:

Advantages of Supporting Gold Mines:

1. The economic contribution of gold.
2. Creation of new job opportunities and industries through the processing of extracted gold.
3. Provision of employment opportunities to the local population in the mining regions.

Disadvantages of Supporting Gold Mines:

1. The negative impacts of cyanide used in the extraction process on human life and the environment.
2. Disruption of the ecological balance due to the environmental damage caused by cyanide.
3. Potential for soil erosion and other geological disturbances during gold mining operations.

1. What do you know about the activities of the gold mine operated in Kışladağ? Did you know its location beforehand?
2. If you have any information about the Kışladağ Gold Mine Operations, what are the sources of this information (television, internet, books, newspapers, family, etc.)? What specific information did you obtain from these sources?
3. What do you think about the operation of the Kışladağ Gold Mine in your region/environment? It has negative impacts because... It does not have negative impacts because... I am undecided because...
4. If you were an environmental scientist , would your answer to question 3 change? Please explain your decision with reasons. It has negative impacts because... It does not have negative impacts because... I am undecided because...
5. If you were the Minister of Economy , would your answer to question 3 change? Please explain your decision with reasons. It has negative impacts because... It does not have negative impacts because... I am undecided because...
6. If you were a local resident living near the gold mine , would your answer to question 3 change? Please explain your decision with reasons.. It has negative impacts because... It does not have negative impacts because... I am undecided because...
7. If you were working at the gold mine (engineer, worker, truck driver, health worker, etc.), would your answer to question 3 change? Please explain your decision with reasons. It has negative impacts because... It does not have negative impacts because... I am undecided because...

TÜRKÇE GENİŞLETİLMİŞ ÖZET

SBK'lerin bireylerin muhakeme yapmasını gerektiren, yaşamın içinden gelen sorunlar olduğunu vurgulayan Ratcliffe ve Grace (2003), evrensel düzeyde olmasının yanı sıra yerel ve ulusal boyutlarının da olduğunu belirtmiştir. Bu duruma değinen Atasoy ve diğ., (2019), yakın çevreyi/bölgeyi ilgilendiren SBK'ler hakkındaki algı, görüş ve argümanların öğrenme sürecine önemli etkileri olabileceğini vurgulamıştır. Bundan dolayı belirli bir bölgeyi ilgilendiren yerel SBK'ler günlük yaşam pratiklerinden dolayı daha görünür ve hayatı doğrudan etkileyebilen yapıda olduğu için öğrenme ortamlarındaki tartışmalarda da öğrenci katılımını daha yüksek düzeye taşıyabilir. Topçu'ya (2015) göre, SBK'lerin öğrenme ortamına entegre edilmesini de kolaylaştırabilecek bu sorunlar, öğretim programları da doğrudan yer almasa bile yakın çevresindeki sorunları bilen öğretmenler için etkili sınıf içi tartışmaları oluşturmalarını sağlayabilir. Benzer durumun öğrenciler içinde geçerli olabileceğini belirten Çapkinoğlu (2015), öğrencilerin kendilerine uzak olan SBK'lerden haberdar olmak için kitle iletişim araçlarını kullandıklarını, bizzat yaşamadıkları için duydukları ve gördükleri ile sınırlı kaldığını ve bundan dolayı kendilerini doğrudan ilgilendiren ve katılımcı olabilecekleri SBK seçiminin daha anlamlı olacağını belirtmiştir. Bölge halklarının, yerel medyanın, sivil toplum kuruluşlarının vb. katılımcı olduğu ve Türkiye'de yer alan yerel SBK'lerden birisi de Uşak ilinde yer alan Kışladağ Altın Madeni İşletmesi'dir (KAMİ). Bu araştırmada KAMİ'ye yönelik 7. sınıf öğrencilerinin haberdar olma durumları ve informal muhakemeleri incelenmiştir. Bu bağlamda araştırmada incelenen sorunlar aşağıdaki gibidir: I) KAMİ bölgesinde yaşayan ve yaşamayan ortaokul 7. sınıf öğrencilerinin KAMİ'den haberdar olma durumları nedir? II) Kami bölgesinde yaşayan ve yaşamayan ortaokul 7. sınıf öğrencilerinin KAMİ ile ilgili informal muhakemeleri nedir?

Araştırmada nitel araştırma yaklaşımlarından durum çalışması benimsenmiştir. Uşak ilinde farklı okullarda kayıtlı 43 ortaokul 7. sınıf öğrencisi araştırma grubunu oluşturmaktadır. İl merkezindeki ortaokullarda ve altın madeni işletmesinin olduğu kırsal bölgeye yakın ortaokullarda öğrenim gören öğrencilerle çalışma yürütülmüştür. Öğrencilerin yazılı şekilde cevap verecekleri, açık uçlu sorulardan oluşan bir anket kullanılmıştır. Anketin geliştirilme sürecinde, Y-SBK ile ilgili yapılmış çalışmalar incelenmiş ve katılımcılara yöneltilen sorular analiz edilmiştir. Farklı roller üstlenen öğrencilerin informal muhakeme modlarını ortaya koymak için alan yazında farklı çalışmalarda ekonomik, ekolojik ve sosyal olmak üzere kategorize edilen üç informal muhakeme modu dikkate alınmıştır. Öğrencilerin Y-SBK'lere yönelik haberdar olma durumlarını belirlemek için betimsel analiz kullanılmıştır.

KAMİ-D- bölgesinde yaşayan öğrencilerinin tamamı bölgelerinde altın madenin işletildiğinden haberdardır. KAMİ-D+ bölgesinde yaşayan öğrencilerinin çoğunluğu bölgelerinde altın madenin işletildiğinden haberdar olmasına rağmen dört öğrenci haberdar olmadığını belirtmiştir. KAMİ-D0 bölgesinde yaşayan öğrencilerinin ise çoğunlukla altın madeni işletmesinden haberdar olmadıklarını belirtmişlerdir.

KAMİ-D- bölgesindeki öğrenciler farklı roller üstlendiklerinde; Kendisi rolünde, öğrenciler altın madenin işletilmesi ile ilgili çoğunlukla kararsız kalmışlardır. Çevre bilimci/çevre gönüllüsü rolünde farklı görüşler ortaya koymuşlardır. Ekonomi bakanı rolünde çoğunlukla kararsız kalmış ya da görüş belirtmemişlerdir. Yerel halk rolünde, büyük oranda sosyal ve ekonomik gerekçelere bağlı olarak olumsuz görüşler belirtmişlerdir.

KAMİ-D+ bölgesindeki öğrenciler farklı roller üstlendiklerinde; Kendisi rolünde, KAMİ-D+ bölgesinde yer alan öğrenciler altın madenin işletilmesi ile farklılaşan görüşlere sahiptir. çevre bilimci/çevre rolünde ekolojik gerekçelerle KAMİ'yi desteklemeyen görüşler ekonomik gerekçelerle ise destekleyen görüşler sunmuşlardır. Ekonomi bakanı rolünde, ekonomik sebeplere bağlı olarak çoğunlukla olumlu görüşler belirtmişlerdir. Yerel halk rolü üstlendiklerinde farklı görüşler dile getirmişlerdir.

KAMİ-D0 bölgesindeki öğrenciler farklı roller üstlendiklerinde; Kendisi rolünde, öğrenciler altın madenin işletilmesi ile ilgili çoğunlukla kararsız kalmışlardır. Çevre bilimci/çevre gönüllüsü rolünde büyük çoğunlukla ekolojik ve sosyal sebeplerle olumsuz görüşler bildirmişlerdir. Ekonomi bakanı rolünde büyük çoğunlukla ekonomik sebeplere bağlı olarak olumlu görüşler belirtmişlerdir. Yerel halk rolü üstlendiklerinde ekonomik, sosyal ve ekolojik sebeplere çoğunlukla olumsuz görüşler belirtmişlerdir.

Tüm köylerdeki/bölgelerdeki okullar dikkate alındığında öğrencilerin çok büyük çoğunluğunun haber kaynakların aileleridir. Bu durumun en belirgin olduğu bölge KAMİ-D-’deki öğrencilerdir. Bu durumun sebebi, bölgedeki ailelerin karşıt tepkilerini toplumun her kesiminde (sosyal yaşam, okullar, eylemler vb) sert bir şekilde dile getirmeleri olabilir (Özberk, 2022; UşakGündem, 2022). Benzer bulguyu Rize bölgesindeki yerel bir SBK olan organik çay hakkında da elde eden Atasoy, Tekbıyık ve Yüca (2019), öğrenci ailelerinin önemli bir haber kaynağı olduğunu tespit etmişlerdir.

KAMİ-D- bölgesindeki öğrenciler kararlarını vermekte zorlanmış ve ikilemler yaşamışlardır. Bu ikilemlerin odağında ekonomik sebepler tespit edilmiştir (ekonomik-ekolojik ve ekonomik-sosyal). Atasoy (2018), Y-SBK olarak HES ile ilgili benzer bir sonuca ulaşırken organik çay ve yeşil yol ile için ise öğrencilerin daha çok sosyal argümanlar ürettiklerini tespit etmiştir. Dolayısıyla özellikle doğa bileşeni olan çevresel SBK’lerle ilgili karar verirken katılımcıların ortak bir muhakeme modunda ortaklaşmadığı ve özellikle ekonomik sebeplerin son karar olmasa da en belirleyici faktör olduğu söylenebilir.

KAMİ-D+ bölgesindeki öğrenciler KAMİ-D- bölgesindeki öğrenciler gibi farklılaşan görüşlere sahiptir. Ancak bu bölgedeki öğrencilerden bir kısmı ekonomik sebeplerle desteklerini daha net bir şekilde ortaya koymuşlardır. Bu durumun olası bir güçlü sebebi öğrencilerin ailelerinin ve akrabalarının KAMİ’de çalışarak ekonomik gelir sağlamaları olabilir. Benzer bulguyu HES’lere yönelik olarak ortaya koyan Atasoy (2018), bölgeye yakın yerde yaşayanların kararlarını etkileyen en önemli faktörlerden birinin ekonomi olduğunu tespit etmiştir. HES’lerle ilgili farklı bir sonuca ulaşan Kalın ve Namdar (2022), fen bilgisi öğretmen adaylarının en çok ekolojik odaklı informal muhakeme modunu kullandıklarını tespit etmişlerdir. Bu farklı sonucun olası bir sebebi HES’lerin altın madenlerine göre kamuoyunda daha yoğun tartışılan bir SBK olması olabilir.

KAMİ-D0’da yaşayan öğrenciler çoğunlukla kararsız görüşlere sahiptir. Özellikle çoklu kararsızlıkların (sosyal/çevresel/ekonomik) dikkat çektiği bu bölgede yaşayan öğrencilerin, bölgenin yerel dinamiklerini ve yapısını bilmemesi bu sonucun olası bir sebebi olabilir. Bu duruma vurgu yapan Kolstø (2006), öğrencilerin bilgi sahibi olmadıkları için herhangi bir görüşü savunmaktan kaçınma eğilimine dikkat çekmiştir. Demircioğlu ve Uçar’a (2014) göre, öğrencilerin fen derslerinde öğrendiklerini SBK ile ilişkilendirememeleri ise farklı bir sebep olabilir. Buna göre, KAMİ-D0 bölgesindeki öğrencilerde yaşadıkları bölgenin dışındaki yerel bir sorunu fen konu alan bilgileriyle ilişkilendirememiş olabilir. Elde edilen sonuçlara göre aşağıdaki önerilere yer verilmiştir;

Çalışmada kullanılan roller dışında maden bölgesiyle ilgili farklı meslek alanları (örn: gazeteci), sivil toplum kuruluşları (örn: TEMA temsilcisi), farklı branş uzmanı bilim insanları (örn: maden mühendisi) gibi rollere dayalı olarak informal muhakemeler, muhakeme modları, argüman kaliteleri vb incelenebilir.

FBDÖP’te yerel/bölgesel ve ulusal Y-SBK’lere örnek verilebilir. Örneğin her coğrafi bölgeye ait bir Y-SBK’ye (Uşak ili – altın madeni, Bolu ili –deri fabrikaları, Rize ili –HES’ler, Mersin ili –nükleer santral vb.) kazanımlarda yer verilebilir.

Öğrencilerin üstlendikleri roller öğretim etkinlikleri için kullanılabilir. Argümantasyon etkinlikleri kapsamında (yarışan teoriler, kavram karikatürleri vb.) karakterlere farklı roller verilerek argümanlarını, verilerini ve gerekçelerini açıklamaları istenebilir. Bu rollere dayalı etkinlik örneklerine ders kitaplarında ve müfredatlarda yer verilebilir.