# INVESTIGATING THE ARGUMENT QUALITY OF MIDDLE SCHOOL STUDENTS ON A SOCIOSCIENTIFIC ISSUE: EFFECT OF LOCAL VERSUS GLOBAL CONTEXT

by

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# ABSTRACT


## INVESTIGATING THE ARGUMENT QUALITY OF MIDDLE SCHOOL STUDENTS ON A SOCIOSCIENTIFIC ISSUE: EFFECT OF LOCAL VERSUS GLOBAL CONTEXT

The purpose of this study is to investigate the effect of the socioscientific issue (SSI) context (local vs global) on the argument quality of 8$^{th}$ grade middle school students. The participants of the study are 69 eighth graders in a public school in Kocaeli. Quasi-experimental design was used in this study. Argument quality of 8$^{th}$ grade students was determined via argument quality task which includes texts about plastic topic and argument quality questions. In this study, there are two different argument producing tasks. The two groups were engaged with the same SSI topic with two contextually different texts (local and global) in different order. Before the tasks, all groups were evaluated based on the argument quality questions to determine the prior argument quality of students. Then Group 1 engaged with local SSI text and asked to develop an argument based on the guiding questions while the Group 2 did the same with global SSI text. Two weeks later, texts were engaged to both groups in reverse order with the same manner. Students were given 40 minutes to complete prior argument questions, to read the text and to develop claim, reasoning, and rebuttal based on the guiding questions. After data collection process, the answers of students were converted to numeric values via argument quality evaluation rubric. *Mann-Whitney U test* for different group and *Wilcoxon signed-rank test* for the same group comparisons were performed. In the study, overall argument quality scores of local and global contexts were compared both in group and between groups. Additionally, the reasoning scores and rebuttal scores were analyzed separately for Group 1 and Group 2. The upper and lower groups have been created and their scores also were analyzed. Based on the SPSS results, there is no statistically significant difference between the local and global contexts both in group' and between groups' overall, reasoning and rebuttal scores. Furthermore, the specific data citation frequency of all participants was analyzed for total, reasoning and rebuttal components. Based on the comparison, results showed that the number of students who use specific data citation in their local text answers are higher than the number of students in global context.

# ÖZET

## ORTAOKUL ÖĞRENCİLERİNİN SOSYOBİLİMSEL KONULARDAKİ ARGÜMAN KALİTELERİNİN İNCELENMESİ: YEREL VE KÜRESEL BAĞLAMLARIN ETKİSİ

Bu çalışmanın amacı, sosyobilimsel konu (SBK) bağlamının (yerel vs. küresel) ortaokul 8. sınıf öğrencilerinin argüman kalitesi üzerindeki etkisini incelemektir. Araştırmanın katılımcıları Kocaeli'nde bir devlet okulunda okuyan 69 sekizinci sınıf öğrencisidir. Bu çalışmada yarı deneysel tasarımlı nicel araştırma modeli kullanıldı. 8. sınıf öğrencilerinin argüman kalitesi, plastik konusu ile ilgili metinler ve metinlere göre yanıtlanan argümantasyon soruları ile belirlendi. Bu çalışmada iki uygulama grubu bulunmaktadır. İki grup, aynı SBK konusu için bağlamsal olarak farklı hazırlanmış iki metinle (yerel ve küresel) farklı sıralarda çalışmıştır. Metinlerin uygulanmasından önce, öğrencilerin ön argüman kalitelerini belirlemek için tüm gruplar argümantasyon sorularına göre değerlendirildi. Grup 1'den yerel SBK metniyle çalıştıktan sonra yol gösterici sorulara dayalı bir argüman geliştirmesini istenirken, Grup 2 aynı işlemi küresel SBK metniyle yaptı. İki hafta sonra metinler her iki gruba da ters sırayla aynı şekilde sunuldu. Öğrencilere, ön testte yer alan argümantasyon sorularını tamamlamaları, metni okumaları ve yönlendirici sorular ve sunulan metine göre iddia, veri/gerekçe ve çürütücü oluşturmaları için 40 dakika verildi. Öğrencilerin cevapları seçilen argümantasyon kalite değerlendirme rubriği ile sayısal değerlere dönüştürüldü. Bağımsız gruplar karşılaştırması *için Mann-Whitney U testi* ve bağımlı grup karşılaştırması için *Wilcoxon işaretli sıra testi* yapıldı. Çalışmada, yerel ve küresel bağlamlardaki genel argüman kalite puanları hem grup içi hem de gruplar arası karşılaştırıldı. Ek olarak, Grup 1 ve Grup 2 için veri/gerekçe puanları ve çürütücü puanları ayrı ayrı analiz edildi. Üst ve alt gruplar oluşturuldu ve bu grupların puanları da analiz edildi. SPSS sonuçlarına göre, yerel ve küresel bağlamlar arasında hem grup içinde hem de gruplar arasında toplam puan, veri/gerekçe ve çürütme puanlarında istatistiksel olarak anlamlı bir fark bulunamadı. Ayrıca, tüm katılımcıların spesifik veri atıf durumları total, veri/gerekçe ve çürütme bileşenleri için analiz edildi. Karşılaştırmaya dayalı olarak, sonuçlar yerel metin cevaplarında belirli veri alıntılarını kullanan öğrenci sayısının küresel bağlamdaki öğrenci sayısından daha yüksek olduğunu gösterdi.

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# LIST OF ACRONYMS/ABBREVIATIONS

SSI: Socioscientific Issues

NRC: National Research Council

CCC: Crosscutting Concepts DCI Disciplinary Core Ideas

MEB: Ministry of National Education (Millî Eğitim Bakanlığı)

NGSS: Next Generation Science Standards

NOS: Nature of Science

OECD: Organization for Economic Co-operation and Development PISA Programme for International Student Assessment

SP: Scientific Practices

SSI: Socio-Scientific Issues

STS: Science–Technology–Society

TAP: Toulmin's Argument Pattern

# 1. INTRODUCTION

With the world getting complicated day by day, the competencies and requirements expected from students change in order to keep up with the times complex issues such as critical thinking, problem solving, collaboration, communication and analyzing information to create a person who can use technology to meet these expectations. These changes not only affected the society, but also brought about the restructuring of the education curricula in many fields in the world.

Scientific literacy has been an object of science education curriculum since the first use of the concept in 1950 (DeBoer, 2000). Scientific literacy is defined generally as the knowledge and comprehension of scientific concept and processes for decision making, argumentation and, scientific discussions about issues that affect society. In the Unites States, National Science Education Standards (NRC, 1989) revised the curriculum and emphasize the importance of both knowing science content and scientific practices and use them in the complex issues. The trace of this effect is also emphasized in the objectives of the Turkish science curriculum (MEB, 2018) as it also includes special aim about the scientific literacy by expecting students to analyze the issues in scientific context, to make decision about societal issues and produce arguments to support their positions. PISA also suggested four domains to discuss scientific literacy as below:

> "Scientific contexts, scientific competencies, the domains of scientific knowledge, and the student attitudes toward science" (OECD, 2006: p. 26).

With the development of technology, science and society, questions and issues requiring people to investigate had emerged, and these topics were sometimes simply not scientifically scrutinized. The necessity to deal with these issues from social, moral and ethical perspectives has emerged. The issues which are controversial and open to social and scientific debate called socio-scientific issues (SSI). SSI have created effective environments per se for scientific literacy that require investigation, analyzing and, decision making. There are many examples of SSI having an influence on nature, public health such as global warming, genetic modifications. In this study, plastic use was chosen as SSI since it creates

crucial problems. In this point, students are expected to use both scientific competencies and scientific attitudes aspects of scientific literacy to analyze and evaluate evidence about plastics use and, to make decisions in this topic. As a result of this process, students can demonstrate their reasoning skills in different ways such as decision making, argumentation in written or oral forms. The study on the eighth-grade students in Philippines conducted by Gutierez (2015) shows that there is significant improvement in argumentation skills of students who are engaged with SSI than students in conventional group.

The science education approaches have evolved towards an understanding that allows the internalization of knowledge and the establishment of a relationship with the real world, rather than isolated knowledge. Hence, meaningful learning contexts has turned into an indispensable necessity to keep the interest and attention alive for participants in class such as argumentation. SSI enable students' different contexts to enrich interest towards topic since these topics can be framed around real-life examples, environment and context in which the student lives.

Scannel and Gifford (2013) support the idea about message framing with the results of study showing that local message framing engages adult residents when compared to the no message group based on the personal relevancy point of view in British Columbia. This framing can also support the test scores and other competencies of students in certain context. Çapkınoğlu (2015) conducted study with the seven graders who are presented with five local SSI in three different learning contexts; The outdoor, the newspaper groups and the presentation group. The result of this study also backs the idea that choosing the topics that are interesting for students can trigger their discussion and decision-making ability about these topics.

Topçu et al. (2014) suggest that using local topics in Turkey will help students to integrate these topics with their daily lives. For this purpose, in this research two different contexts as local and global are designed on the text-based task and argument quality of students will be evaluated and compared when they are presented with different contexts about SSI.

# 2. LITERATURE REVIEW

## 2.1. Scientific Literacy

The term "scientific literacy" is widely used educational terminology since it appeared in 1950s (DeBoer, 2000). This term was used in printed format for the first time by the Paul Hurd in the publication named as "*Science Literacy: Its Meaning for American Schools*" (Laugksch, 2000). Even though the term is accepted as a desired outcome of science education at the international level, the meaning of it is not crystal-clear for the science educators. Although it is basically used to emphasize the "public understanding of science" (Roberts, 2007), the more elaborate definitions and different point of views aroused for the term.

According to the Miller (1983), scientific literacy will be explained in two ways which former is "to be learned" and latter is "to be able to read and write". While the first part asserts the importance of science content knowledge, the second part emphasize the skills as understanding science content knowledge or scientific events and express what is understood. Congruently, Roberts (2007) states two visions to define the scientific literacy which are "*Vision I* and *Vision II".* On the one hand, Vision I deal with the products and processes of science which means that enabling set of scientific knowledge and skills for students so that they approach the situations scientifically. On the other hand, Vision II considers the science related situations rather than directly the science itself such as thinking the situations as citizens or making decisions about the society related issues.

Science literacy was defined as multifaceted concept by the American Association for the Advancement of Science (AAAS) in Project 2061 for all Americans. According to their definition, being acquaintance with the natural world; having consciousness about the connectedness of technology, science and mathematics one another; understanding science concepts and principles; being able to think issues in accordance with the scientific thinking and, comprehending the power and constraints of science, technology and mathematics (AAAS, 1989).

National Science Education Standards (NRC, 1989) define the scientific literacy as:

> "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (p. 22).

It is expected certain traits to be a scientifically literate person such as being able to answer the questions emerged from their own curiosity; to explain or interfere the natural events; to read, comprehend and analyze the scientific writings; to conceive the scientific issues about local and global decisions; to question the scientific information in the light of evidence by NRC (1989). Furthermore, The NRC report "Taking Science to School" (1989) suggested four strands to support the successful science learning and scientific literacy; first one is about comprehending and interpreting the scientific explanations about natural phenomena, the second is producing scientific evidences and judging the others', third is about the formation of scientific knowledge and its systems, and the last one is in regard to engage the scientific debates or processes. These strands are extended with two additional aspects which are science-linked interest and identity (NRC, 2012).

Next Generation Science Standards (NGSS) updated scientific literacy understanding for K-12 in the United States by explaining that science is not just about having knowledge, but also having skills that enable to use and develop that knowledge (NGSS Lead States, 2013). NGSS expect to ensure that students can reach the expectation of scientific literacy by integrating knowledge and practice through the three dimensions of NGSS framework: Science and engineering practices, crosscutting concepts and disciplinary core ideas. The two sub-categories of science/engineering practices, which are data interpretation and engaging argumentation according to the data, align with the scientific literacy perspective targeted in this study.

Program for International Student Assessment (PISA) which a world-wide event is developed by Organization for Economic Co-operation and Development (OECD) defined the scientific literacy as:

> "The capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity."

In terms of the scientific literacy, PISA grounds on the four components, which are scientific contexts, scientific competencies, the domains of scientific knowledge, and the student attitudes toward science (Bybee et al., 2009) summarized in Table 2.1. Scientific literacy components of PISA.

Table 2. 1. Scientific literacy components of PISA.

| Name of the domain | Explanation of domain |
|---|---|
| Scientific contexts | The issues that can be confronted in daily life. Such as environmental issues, health issues, technological issues. |
| Scientific competencies | To reason the issues in scientific contexts, to make-decision about societal issues and to produce arguments while supporting their decisions about scientific contexts. |
| The scientific knowledge | "Knowledge of science" is about having the knowledge of natural world as scientific content knowledge. "Knowledge about science" is about having the knowledge about how science works. Such as scientific processes, nature of science (NOS). |
| Student attitudes toward science | The way of responding toward scientific issues. Such as attitudes, beliefs, interests, engagements and motivation of students. |

To show the clarity of why science literacy is important and required for science education, four rationales have been propounded which are economic, the personal, the democratic, and the cultural rationale (Snow and Dibner, 2016). According to the economic

rationale, developed economies requires the scientifically and technologically skilled society for the science related occupations. This perspective is mostly related with the "scientific knowledge" and "scientific competencies" aspect of PISA as most of the science related occupations requires these certain skills. In terms of the personal rationale, humans could respond to issues about their lifestyles, health and other issues based on their knowledge, competencies and attitudes. As a similar manner, the democratic rationale suggests that civic decision making could be possible with the scientifically literate people who could manage public goods or could mind the public well-being among the controversial choices such as socio-scientific issues. The person requires to reason the issues and to produce argument as scientific competencies of PISA for the democratic rationale. The last one is about the cultural perspective which value the science to understand the world and science itself.

Although different definitions have been made in the literature, most of the scientific literacy definitions deal with nature and form of knowledge, scientific competencies and personal approaches toward science in terms of their purpose and values (Norris et al., 2014). Furthermore, the ability to discuss and evaluate the evidences to make informed decisions about social and scientific contexts addressing students' daily lives is one of the crucial competencies that are emphasized jointly (Engels et al., 2019). This common goal carries the study to the *Vision II* of Roberts about intertwining the scientific ideas and processes in meaningful issues (Sadler and Zeidler, 2009).

As today's world has put a heavy burden on the students' shoulder regarding distinguish between facts and fictions, making decisions, with the acceptance of scientific literacy as a central goal in science education from the 1980s (Snow and Dibner, 2016). With these expectations, designer and policy makers have tried to embed scientific literacy to the science education. For this reason, the middle school science curriculum in Turkey is also revised by The Ministry of National Education (MEB) in 2018 to support students so that they can handle with these needs and ultimately be scientific literate person. In the middle school grades, science curriculum expects students to reach the scientific knowledge and to think and to decide the ways of using this knowledge. It is especially expected in the topics which includes both the science and society aspects and those influenced by the political and societal regulations called as SSI (Lin et al., 2012). It is stated in the special aims of science

curriculum in Turkey that students are expected to develop reasoning, scientific thinking and decision-making skills by using socio-scientific issues (MEB, 2018). For example, every member in a society should evaluate the situations such as constructing power plants, using antibiotics, hunting the unpermitted animals whether these actions will create a problem socially, politically, ecologically and ethically by using their basic science knowledge and science process skills. For these aims, SSI are very rich and powerful context to engage students for science.

### 2.2. Socio-scientific Issues

The basis of socioscientific issues (SSI) has started with the STS "Science-Technology and Society" approach which supports that science cannot be explained by ignoring the influence of social, political and technological perspectives by the late 1970s (Tal and Kedmi, 2006; Zeidler et al., 2005). With this idea, STS approach was popularized in the science education curriculum with its two main purposes, which are; presenting scientific knowledge and decision -making ability about both science and society related issues (Tal and Kedmi, 2006). Aikenhead (1994) explained the STS curriculum as:

> "STS science teaching conveys the image of socially constructed knowledge. Its student-oriented approach . . . emphasizes the basic facts, skills, and concepts of traditional science . . . but does so by integrating that science content into social and technological contexts meaningful to students. (p. 59)"

Even though STS teaching considers the effects of science and technology related decisions on society, it was criticized by educators in the belief that STS does not stress the ethical concerns which supports the students' moral reasoning (Zeidler et al., 2002). In addition to this it also disregards the emotional aspect of science learning (Sadler and Zeidler, 2005). In the STS approach, some teachers think that moral issues should be discussed in social classes or out of class activities even if scientific literacy expect students to develop their own value system and views in science class. Additionally, it was supported that STS approach could not be used in the development of educational strategies or teacher education with reference to absence of strong theoretical framework. Therefore, it has become necessary to create a more inclusive theoretical framework that allows different perspectives to support the moral development of children named as SSI (Zeidler et al. 2005). In contrast to the STS, SSI movement encourage students to make decisions by

reflecting their ethical principles about their life, the society and world they live in. SSI are usually defined controversial and open-ended issues that are discussed in the light of science and social aspects together. It means that people will engage in challenging debates as it contains both moral concerns and evidence-based information in itself (Zeidler and Nichols, 2009). For instance, cloning, global warming and genetically modified foods can be given as examples of SSI since they divide the society to different sects (Sadler, 2004).

Zeidler (2014) defined the SSI characteristics as follow;

- Ill structured problems that require to critical thinking and reasoning to decide about them.
- Include the problems which will be supported by different approaches.
- Considering the ethical concerns that will supports the moral reasoning of students.
- Promote the character development personally, cognitively, morally.

With the addition of SSI to the science curriculum, Zeidler et al. (2005) defined "the socio-scientific elements of functional literacy" which can be seen in the Figure 2.1. According to this model, cultural issues, case-based issues, nature of science issues (NOS issues), and discourse issues supports the personal, cognitive and moral development of students. Cultural issues can be explained as what students bring to the learning environment as all of them have different lifestyles, backgrounds and cultural environments. Case based issues supports the use of socio-scientific issues as a context to support discourse and critical thinking skills by promoting moral developments. Nature of science issues focus on the epistemological understanding of students since they analyze issues and make decisions based on this understanding. Classroom discourse issues are related with sharing and discussing the idea and values of each other which supports also the self-reflection of students (Zeidler and Keefer, 2003). As a conclusion these elements cumulatively lead to development of functional literacy.

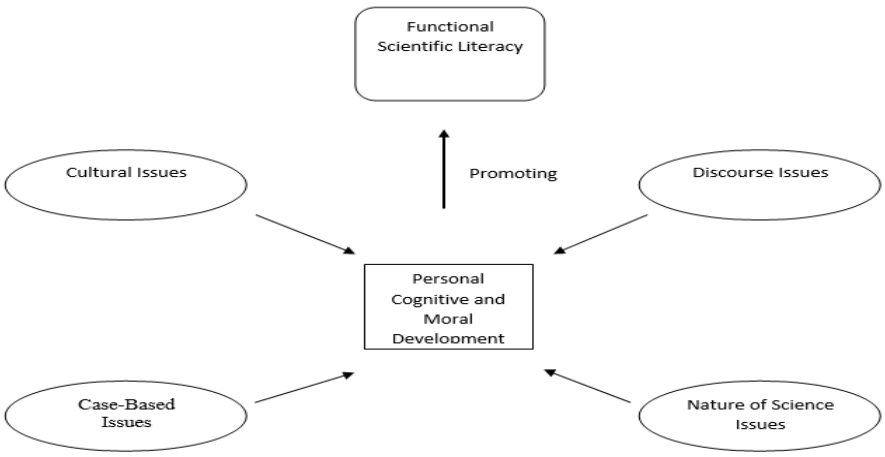


Figure 2. 1. Component of functional socio-scientific literacy (Adapted from Zeidler & Keefer, 2003, p.12).

Even though many studies have been published in the last decade that examine the connections of socio-scientific learning environments with subjects such as students' attitudes, argumentation skills, and moral development in order to achieve the intended educational goals of scientific literacy, the issue of how socio-scientific issues should be handled in learning environments has not been discussed properly (Sadler et al. ,2017). Additionally, lack of sufficient explanation on how to integrate socio-scientific issues into the curriculum may cause teachers to practice incorrectly or incompletely and prevent reaching the targeted scientific literacy achievement. The frameworks and methods developed to eliminate the deficiencies of practitioners in creating socio-scientific learning and teaching environments and to enrich these environments has been considered as a guide. As this study seeks the ways of supporting students' complex skills such as producing argument and to enhance these skills through SSI perspective by proposing certain methods or materials. In the section below, the teaching approaches that guide our study and the basis of it are discussed.

### 2.2.1. Learning Through SSI

To support the students' expected cognitive skills in scientific literacy definition, it is important to design effective learning environment based on the SSI. Although, almost all

of the learning approaches emphasize that learning should take place in contexts in which content knowledge becomes meaningful, SSI based learning depends on contexts that are directly related with the societal issues. There are many different perspectives about the SSI teaching and learning. In the decision-making model of Ratcliffe (1997), it is important for the student to understand the decision-making process and to be aware of how scientific knowledge affects the decision-making process in order to make an informed decision. For this purpose, determining alternative ideas for SSI, developing standards to compare alternatives, explaining scientific indication for the criteria, evaluation the pros and cons of all alternative ideas compatibly with the specified standard, conducting decision making practices, evaluating this process and finding the alternatives to enrich this compelling process should be conducted respectively.

In the Dawsons' bioethic model (2001), it is aimed that students gain awareness of socioscientific issues, make decisions within the framework of bioethical rules, and respect and accept the opinions of others. During this process, the teacher has a responsibility about sharing the necessary information about issue, guide the discussion, providing the environment that students can share their ideas without pressure. Similar to bioethics model, the model of Eilks expects teachers to provide knowledge about SSI and to guide the discussion but, this model focus on the learning of SSI content knowledge and metacognitive thinking abilities of students (Tosunoğlu and İrez, 2019).

In the model of Sadler, while design elements, learner experiences are located in the center, classroom environment and teacher characteristics are categorized under complementary aspects (Tosunoğlu and İrez, 2019). However, Presley et al. (2013) developed the model of Sadler and focus on three main and two supplemental aspects as. design elements, learner experiences and teacher facet are accepted as main aspects and classroom environment and circumferential affects are accepted as complementary aspects. From the design perspective, teachers are expected to use focal challenging issues to start the lesson and scaffold students through the lesson to the peak point of lesson. From the learner perspective, use of higher order practices, analyzing social and scientific dimensions of the issues are expected from the students. There are qualifications expected from teachers as well as students such as content knowledge about topic, social and scientific dimensions

of issue, giving flexibility to students for discussions and accepting possible limitations or deficiency about the issue. Active participation, respecting each other and assuring class environment constitute the classroom environment aspect. The last circumferential aspects emphasize the importance of society, social community and national levels of SSI based instructions. Sadler supports that organizing SSI-based materials, using the issues belong to the local community and integrating them to the curriculum will help students to connect the issues with the real life (Sadler, 2011).

Before integrating the SSI into science learning, depending on the curriculum followed, it should be decided which topics can be considered as socioscientific issues initially. After choosing socioscientific issues, it should be decided whether the socioscientific issue will be taken as the guiding question of a unit or only discussed in a certain part of the unit to support previous learning (Güven and Muğaloğlu, 2020).

By virtue of social and scientific characteristics of socio-scientific issues, SSI based instruction can promote the cognitive understanding of students since they can analyze science ideas through the SSI issues by internalizing them in an authentic learning environment. Apart from this, students can practice scientific competencies by engaging in discussions or argumentations via SSI based instruction because of the controversial aspect of SSI. In addition to the scientific aspects, motivating nature of SSI help students to analyze the social, political, economic and moral perspectives while they are engaging the SSI based instruction (Topçu et al., 2018). It is obvious that there is complex process for the understanding of SSI like analyze the issue, compare and contrast evidences, counting the social and moral perspectives into account, decision-making about certain issues for the benefit of society or individuals. These attributes also belong to the main components of science education: Argumentation.

Students can construct their own scientific understanding and take a place in the decision of societal issues by discussing the issues and presenting logical arguments orally or written ways (Dawson and Venville, 2010). Driver et al. (2000) advocate that science curriculum should promote students' ability to analyze different arguments about the

science. Students also need to discuss and engage in argumentation about the issues to develop scientific literacy.

Puig and Jiménez-Alexandre (2011) back the idea that argumentation about socio-scientific issues help high school students by presenting meaningful context that links science and the daily life problems since they are expected to actively participate in the decision-making process. Another study revealed that disadvantaged students can improve their argumentation and decision-making ability with scientific evidences on the socioscientific issue of climate change (Dawson and Carson, 2018).

### 2.3. Socio-scientific Argumentation

The science context defined reasoning as a total of mathematical and logical rules which it actually refers to the formal reasoning. Although the formal reasoning contributes to the scientific investigations in some degree, it could not be sufficient as its principles are unchanging (Sadler, 2004). While analyzing or considering the socio-scientific issues, the informal reasoning emerges since these issues are open-ended and controversial in nature. According to the Kuhn (1991), informal reasoning is used to solve problems that are

> "ill structured … with no definitive correct answers, the number and kinds of possible responses are open ended, and the information an individual can bring to bear on the problem is similarly unconstrained" (p.10)

As an individual or a society, we are faced with the issues that have to be analyzed based on risk and benefits, ethical rules and we try to make decisions about these issues such as genetic engineering, climate change. In this point, argument and argumentation are evaluated as "an external expression of informal reasoning" (Dawson and Venville, 2009).

The ability of person to understand the events, their causes and results and to produce logical arguments and to support them with the scientific knowledge is one of the desirable success of science education. To reach this ultimate aim, the meaning of "argument" should be clearly stated. In the definition of Angell (1964), argument is defined as closure about

topic which is supported with minimum one reason. Also, Kuhn (1991) defines an argument as;

> "an assertion with accompanying justification" (p. 12).

While scientific argumentation is used to discuss scientific issues with evidence-based claims, socio-scientific argumentation includes the discussion and decision-making process for the solution of sociological problems like SSI. The use of argumentation in science education has grounded with the study of Toulmin (1958) which divides the argument to different segments. They are claims which are the assertions about cases, data which are supportive information for the claims, warrants which are the explanation of how the claim and the data are related, backings which are acceptances to support the warrants; qualifiers which are definitive states that makes the claim is true; and rebuttals which disprove the contrary claims, data and warrants.

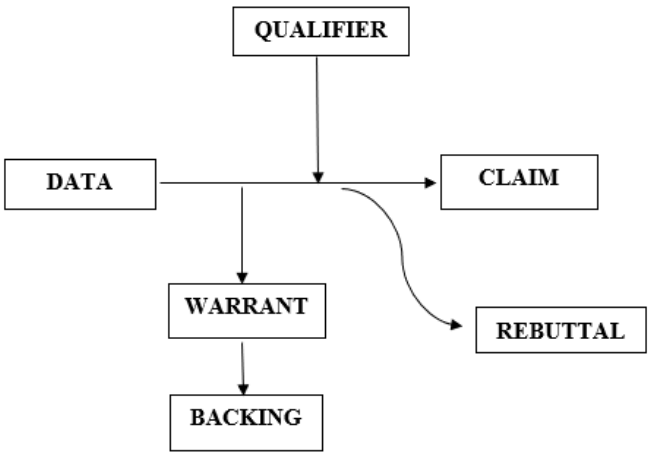


Figure 2. 2. Toulmin's argument pattern-TAP (Adopted from Toulmin, 1958).

Although the continual use of TAP framework, this model was criticized in terms of its ambiguity caused by the categorization of data, warrants and backings by Erduran et al. (2004). As an alternative, Erduran et al. (2004) develop analytical framework to assess the argument quality which has five levels from simple claim to extended argument.

Then, Erduran and Jiménez-Alexandre (2007) advocate that argumentation in science classroom will support students to gain such qualifications;

- Meaningful learning as a conclusion of participation to cognitive and metacognitive processes,
- Enriching communication skills of students,
- Reflective thinking and reasoning skills
- Scientific culture and practices
- Promoting scientific literacy and use of scientific language in both writing and speaking.

It will be deduced that end products of argumentation also supports scientific literacy (Cavagnetto, 2010). Although the significant contributions of argumentation for science learning, there is limited number of argumentation applications in school environments. (Means and Voss, 1996; Newton et al., 1999). As a result of these situations, it is obvious that argumentation is undervalued in schools (Zohar and Nemet, 2002) and students are not properly encouraged to produce arguments and use of argumentation even if they have necessary cognitive skills and abilities to produce arguments (Perkins at al., 1993). For this reason, the effect of different factors on argumentation process is investigated in depth in the literature. While most of the studies focus on the effect of certain traits such as knowledge, morality, attitudes on socioscientific argumentation, some of them give importance to the teaching ways of socio-scientific argumentation in science classroom.

It is assumed that argumentation practice is also linked with what students transfer about science concepts. To explain the effect of content or domain knowledge on argument quality, Sadler and Fowler (2006) designed a model named as Threshold model of content knowledge transfer for socio-scientific argumentation.

According to the model, with the increase of content knowledge, the argument quality also increases depending on the content knowledge. It is obviously seen that science majors' argument quality is higher than then non-science majors as their content knowledge is correlated with the argument quality. The effect of scientific content knowledge was commonly investigated through the literature. While some studies support the strong relationship between the content knowledge, other disregard the effect of it on the argument quality and quantity. In the study of Eşkin and Ogan-Bekiroglu (2008), the relationship

between the science content knowledge and tenth-grade students' argumentation through the ten-week physic courses. Five argumentations were used in the chapters and students' argument quality were measured by Toulmin's Argumentation Framework. Based on the research, it was supported that there is no consistent relationship between the student's contribution to scientific argumentation and scientific knowledge. Furthermore, the study with seventh graders conducted by Can (2017) supported the idea that the argument quality will be increased with the increase in the level of knowledge about topic by showing that there is highest argument quality in experimental group students who have highest understanding.

However, the study conducted by Sadler and Donnelly (2006) examined the effect of content knowledge and morality on quality of socio-scientific argumentation with high school students in United States through the test and interviews. The study concluded that there is no statistically significant relationship among content knowledge, morality and argumentation based on the regression analysis supported with the qualitative result as well.

Students' ability level was also examined as a factor affecting the argument quality as in the study of Lin and Mintzes (2010). In this study, researchers classified students as high, low and middles achievers according to their mean scores of midterm and final exams in different disciplines in the preceding year. The unit plan was designed based on the socio-scientific issue about the construction of Ma-Guo National Park. In the unit design, students were taught with the necessary content knowledge about the settlement of national park and then they were assessed via the rubric. The result of study proposes that there are statistically significant differences found in the scores of high achievers and low achievers in favor of high achievers but no other comparisons were significant.

For the design of argumentation research environment and the professional development of teachers, case study of Dawson and Venville (2010) highlighted four factors which are the role of teacher, the use of writing frame, the role of students and the context of socio-scientific issue as a result of the study with high school students on the genetic topics. In this study, teacher is placed to the professional development program about the delivery of argumentation, promotion of argumentation in class about socio-scientific issues

before s/he teaches the topic to the students. As a result, unless the argumentation is supported with the teacher and learning environment in classroom, students will face with difficulties to produce arguments (Jiménez-Aleixandre et al., 2000; Sadler, 2009; Sampson and Clark, 2008).

In addition to having difficulties about producing arguments, researchers focused on the argument quality of students and concluded that students could not produce high quality arguments as a result of some difficulties in argumentation process (Erduran et al., 2004; Pereiro-Munoz, 2002).

These difficulties can be listed as below;

- Students are not ready to evaluate the claims (Ratcliffe, 1997)
- Having difficulties to find supporting evidence to the claims. (Ratcliffe, 1997),
- Resisting about their claims even if their evidence contradicts with their claims (Evagorou et al., 2012)
- Inability to make connection between claims and evidences (Acar et al., 2010),
- Failure to evaluate evidences (Sadler, 2004a)
- Failure to confute the claims or arguments of others (Kuhn, 1993).

To cope with these difficulties and to foster student learning and contribute to the 21st century skills such as argumentation, decision making and critical thinking, learners need incentives to empower them to communicate these certain skills both internally and externally. For this reason, asking correct questions, presenting appropriate materials and guiding classroom in a supportive way will reinforce the producing arguments. To support this view, socio-scientific issues are used as "context" for students to participate in the argumentation process (Acar et al., 2010; Cavagnetto, 2010; Evagorou and Osborne, 2013). Sadler (2004a) supports that socio-scientific issues are used as a context in the argumentation process since students can produce arguments about these issues from multiple perspectives. Osborne et al. (2004), on the other hand, explain that it is easier for students to form more complex arguments as they are familiar with the public debate about these socio-scientific issues which supports the student interest and personal relevancy aspects of these issues.

SSI will be engaging for students since they are personally meaningful. It is suggested that student's interest is not aligned directly with the educational objectives since these objectives are presented as complex theoretical knowledge such as Newton laws or chemical reactions (Zeidler and Nichols, 2009). Students expect personally relevant materials to deal with as they attract attention of students. For this reason, SSI will be effective starting point which enable students to make connections with the daily life.

In this study, as the eighth-grade students in Kocaeli are engaged with a socio-scientific issue from various aspects, they can produce arguments about them by thinking both well-being of their environment and themselves. As a matter of fact, students use their argument skills to analyze the socio-scientific issues by taking their interest into consideration which coincide with the scientific competencies and personal attitude perspectives of PISA.

## 2.4. Interest

Loss of interest toward science is a widely encountered problem which generally emerges after students start to school due to the lack of knowledge about making science learning environment interesting to the students. On the contrary to meet the needs of students, some learning environments block the probability of interest development (Renninger and Bachrach, 2015). Since this decrease may prevent students to be scientifically literate person and to contribute to the next generation science, researchers have started to analyze the needs of students and learning environments so that students' interest can be supported.

Before investigating the effect of interest on the student's certain skills, especially in producing arguments, the term should be defined and carefully explained. Interest can be defined as more than simply liking or disliking the one or another type of activity in research area. It was defined by the Hidi and Renninger (2006) and, Renninger and Hidi (2011) as

> "interest as a psychological state, as well as a predisposition to reengage particular disciplinary content over time."

The research contextualizes the interest below two subcategories which are situational and individual interest. While the personal (individual, text) interest emerge based on the personal value, individually activated and topic specific, the situational interest refers to the information which is activated with the contribution of context rather than the internal situation of the learners. Whereas the individual interest would persist over time, the effect of situational interest will be limited based on the context, tasks or situations. As shown in the Figure 2.5., both personal and situational interests can be divided to the subcategories based on the literature of interest (Schraw and Lehman, 2001).

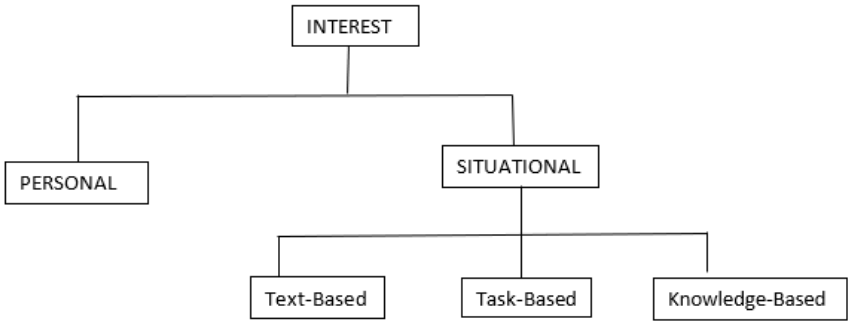


Figure 2. 3. A taxonomy of personal and situational interest (Adapted from Schraw and Lehman, 2001; p.28).

Personal interest is categorized as latent and actualized in the study of Schiefele et al. (1992). The latent interest is continuing tendency developed inherently and it has two subcategories: feeling-related component which occurs as a result of positive emotions toward a particular activity or issue and, value related component which occurs as a result of attribute a personal importance toward a particular activity or issue. The actualized interest is defined as topic specific motivational state.

In addition to the personal interest, there is situational aspect of interest which can be divided into three main categories: text-based, task-based and knowledge-based interest. The text-based interest develops based on the characteristics of what is learned in a text. Although there are different text-based factors, it will be categorized under three characteristics; seductiveness which is about the degree of interesting but distracting text segments; vividness which is fancy and surprising text segments; coherence is about the extent of

meaningfulness depending on the organization of text content. The task-based interest can be referred as a total of encoding task which is about bringing a different approach to the reader towards the text and, change-of-text is about the changing the text itself. The last component of situational interest is knowledge based which mentions the effect of initial knowledge on the interest level of students (Schiefele et al., 1992).

Hidi and Renninger (2006) proposed "Four-Phase Model of Interest Development" to show the phases of interest development in the learner. In the first phase which is called as triggered situational interest, means that certain knowledge about phenomena can grasp the learner's attention so that they may return to this information or benefit from it. In the second phase which is maintained situational interest, learner's attention may be caught by the task so that student can use the knowledge to complete it or by the persons. However, this situation may not be a voluntary action all the time. In the third phase which is emerging individual interest, the learner can extend the classroom discussion and can be an active participant by communicating their own questions about the certain topics with the others or searching answers for the questions in classroom voluntarily. In the last phase called as well-developed individual interest, students could produce alternate approaches to their own problems and even they can communicate with different complementary information. As seen in the trigger model, the phases are constructed on top of each other.

According to the Dewey (1913), interest allow students to be realize themselves and to satisfy their active learning. Furthermore, he proposed that interest is internal construct that has to be supported with the learning environment by presenting materials or methods according to the personal preferences of students. In terms of the learning environment and design of it, situational interest aspect can be observed. In addition to the learning approach of him, interest toward one area or topic may give energy to students so that they can comprehend the information as it recalls more pleasant emotions.

As the interest is abstract construct, many researchers have studied effect of it on students learning, understanding and achievement; and also, the effects of knowledge, contexts on the interest level of students. The personal interest will create problem in terms of having to measure the student's unobservable and personal emotions or feeling, so

situational interest is most appropriate version of interest to observe the effects. Moreover, based on the definitions of situational and personal interest, researchers focused mostly on the situational interest since it is hard to take all students' personal interest into consideration while planning the learning activities or designing learning environments. Even if situational interest is explained as short term and context based, some research studies supposed that situational interest can be supported to the long-term interest and it will be helpful for students who have no initial interest. Apart from this, the study on college level science students conducted by Palmer (2004) defended that situational interest has an impact on students' enjoyment, motivation, anxiety level and their impressions about science teacher. Familiarization of the chosen topic with students' lives is also important in terms of increasing interest, motivation and participation (Jarvela and Reninger, 2014).

There is limited number of studies about situational interest (Palmer, 2009). The study conducted by Mitchell (1993) determined two different grounds for the improvement of students' interest in math learning: Content and form of the activities. Former means that students find content which is personally relevant or associated with daily life more interesting. Latter means that student interest can be influenced by the type of activity that guides the learning environment. Furthermore, Palmer (2009) investigated the students' interest in an inquiry-based science lesson after each phase which are demonstration, proposal, experiment and report. Student interest was higher in demonstration and experiment part since they actively participate to these phases. Students also propose three sources for interest which are novelty, autonomy and social involvement. The research of Swarat et al. (2012) also investigated the effect of content topic, activity and learning goal on students' interest through the instructional episodes and concluded that students focused mostly on activity type which is in favor of hands-on activities than content topic and learning goal.

There are different research studies in the area of interest which includes text-based interest that aims to present text in interesting ways. This term emerges based on the idea that texts are very common way of information delivery and the result of Schiefele's study (1999) which asserts the clear correlation between interest and text learning. Apart from the correlation, it has been argued that interest of person will be affected by the degree of

content's unlikelihood, involvement of characters familiar to readers and personally relevant subjects in addition to the factors related with the text content such as "text coherence, intensity, concreteness and vividness." One study conducted by Hidi and Anderson (1992) specifically focused on science learning by investigating the science textbooks and proposed that students find texts in narrative story category more interesting than explanatory texts.

While the study of Zahorik (1996) focused on the teachers' perceptions about triggering situational interest, Laukenmann et al. (2003) studied with students and supported the relation between the situational interest and test results in middle school science class. Based on the text-based interest studies, certain sources of situational interest have been determined such as novelty, surprise, autonomy, suspense, social involvement, ease of comprehension of text and initial knowledge (Palmer, 2009).

### 2.4.1. Interest in Local and Global Contexts

According to the study of Scannell and Gifford (2013), there are two significant but untouched issues about the engagement level of people towards climate change which has socio-scientific nature; framing of the message (local or global) and place attachment (affinity toward the one's local area). To support the effect of local and global context, psychological distance frame which support that perceptions can be changed based on the direct or indirect experiences of person with the events, places and objects was emphasized. For this aim, spatial dimension was investigated by focusing on the locality or globality of issues. To cope with the psychological distance, personally relevant ways will be used to convey the messages. Researchers support that personal relevancy can change the attitudes or feeling of person. In that point, Kruglanski and Sleeth-Keppler (2007) argued that subjective relevance, task demands, and order of presentation have an impact on message instead of text content and knowledge type. Additionally, with the personal relevancy, interest of students and their ability to analyze the given messages can be enriched. Localization of the messages will decrease the perceived distance and thus there will be substantial increase in the interest and engagement of students. In terms of the place attachment, the study of Scannell and Gifford (2013) consider the place attachment which is developing affectional and conceptional connections to the one place. The results of this

study show that there is difference between engagements of student who had message in local frame than student who had no message which congruent with the personal relevancy of the context (Scannell and Gifford, 2013).

According to the study of Çapkınoğlu (2015), there will be different reasons of choosing local socio-scientific issues. Students are limited to what they hear and see about socio-scientific issues away from them because they do not experience the event or events themselves. It is considered that it would be more meaningful to choose the topics that are of interest to them and to participate in the discussions and decision-making on these issues. It is believed that this can only be achieved through sociological issues at the local level. Furthermore, it is not as sincere and realistic for students to comment on issues or events that they have never encountered in their lives. From this point of view, it is thought that it will be more meaningful for students to enter the process of discussion and decision-making on socio-scientific issues that occur in the city they live in.

It is also stated in the study of Topçu et al. (2014) that the number of studies on local SSI context in Turkey should be increased as these topics allow students to blend their socio-cultural background with these topics which trigger the interest and engagement of student towards them. Another study that agrees with Topcu et al. (2014) advocate that the responses of individuals will change according to the emotionally involved place and situation by examining the relationship between the socioscientific reasoning and place attachment of high school students on local and foreign socio-scientific issues (Villarin, 2020).

# 3. SIGNIFICANCE OF THE STUDY

With the changing educational skills in 21st century, argumentation which start with the critical thinking ability of students gains significant place in the classroom, curriculum planning and reform activities all over the world. Critical thinking and argumentation skills are embedded to the different learning areas from science to art and students are expected to question the problems both in classroom and daily life, to support their positions and explain their arguments.

In literature, the effect of content knowledge, epistemological understanding (Mason and Scirica, 2006), morality (Sadler and Donnelly, 2006), ability level (Lin and Mintzes, 2010), inquiry based instructions (Dawson and Venville, 2010; Chen et al., 2011), informal reasoning (Dawson and Venville, 2009) on argument quality of students based on socio-scientific issues mostly have been studied and highlighted, however with only a few studies focus on the effect of local and global context of socio-scientific issue. Although the study conducted by Topçu et al. (2010) examined the influence of issue context, they directed their attention to the topic categories such as health issues or environmental issues. The study of Durmaz and Karaca (2019) examined the effect of constructivist teaching method in two local SSI topics on the middle school students 'attitude, reasoning and reflective thinking. Despite to the fact that there is no significant difference of students' reasoning and reflective thinking, it supports the effect of local SSI on the attitude of students. Another research conducted by Çapkınoglu et al. (2020), five local SSI topics was chosen to compare the argument quality of middle school students since the local topics will increase the interest of students to topics from their hometown. However, there is limited number of studies that examines the local and global contexts in Turkey. Furthermore, the studies that emphasize the inclusion of SSI in science education mostly focus on high school and college students or teacher and teacher candidates (Durmaz and Karaca, 2019).

In this study, it will be aimed to investigate the argument quality of $7^{th}$ and $8^{th}$ grade students based on the change of contexts as local or global. Since this study develop their own SSI learning material according to the SSI learning and text-based learning principles

and apply their materials to test the differences between student scores based on the contextual changes, the research findings might be fruitful for the teachers, curriculum designers in terms of producing the learning materials or programs for high quality arguments.

# 4. STATEMENT OF THE PROBLEMS

The purpose of this study is to investigate the effect of the presentation of socio-scientific issues in local and global contexts on the argument quality of middle school students. The effects of the context of socio-scientific issues are explored by comparing the argument quality of eighth grade students who engaged with the socio-scientific issues from global perspective with the ones who participated in the local perspective of socio-scientific issue. By designing local and global learning context, it is aimed to address the change of students' interest depending on the personal relevancy and message framing of the context.

For this aim, an SSI based texts which explain the plastic use issue locally and globally are designed and presented to 69 middle school students in total two class hours in a middle school in Kocaeli. The total argument quality of eighth grade students engaged with the both local and global versions of SSI based texts are examined based on the rubric which most appropriate the data collected from students. Additionally, components of their arguments are also examined separately to decide changes in the quality of reasoning.

On the basis of the purpose of the study, the following research question and hypothesis are composed.

## 4.1. Research Questions

1. Is there statistically significant difference between the argument quality of the middle school students who are engaged with the local based SSI text and with the global based SSI text in the plastic usage topic?

Concerning the first question, it was hypothesized that;

The middle grade students who are engaged with the local based SSI text would have significantly higher scores in their argument quality in the plastic usage topic than the global based SSI text.

**Subproblems:**

1.1. Is there statistically significant difference between the argument quality of students in group 1 after local and global plastic usage tasks?
1.2. Is there statistically significant difference between the argument quality of students in group 2 after local and global plastic usage tasks?

2. Is there statistically significant difference between the argument quality of middle school students based on the order of priority in terms of context type (local vs. global) in the plastic usage topic?

Concerning the second question, it was hypothesized that;

The middle school students who are firstly engaged with the local based SSI text would have significantly higher scores in their argument quality levels in the plastic usage topic than students who are firstly engaged with the global based SSI text.

**Subproblems:**

2.1. Is there statistically significant difference between the argument quality of Group 1 local and Group 2 global?
2.2. Is there statistically significant difference between the argument quality of Group 2 local and Group 1 global?
2.3. Is there statistically significant difference between the argument quality of Group 1 local and Group 2 local?
2.4. Is there statistically significant difference between the argument quality of Group 1 global and Group 2 global?

3. Is there statistically significant difference between reasoning quality of the middle school students who are engaged with the local based SSI text and with the global based SSI text in the plastic usage topic?

Concerning the question, it was hypothesized that;

The quality of reasoning components of middle school students who are engaged with the local based SSI text would be higher in the plastic usage topic than the global based SSI text.

**Subproblems:**

3.1. Is there statistically significant difference between the reasoning quality of Group 1 local and Group 2 global?
3.2. Is there statistically significant difference between the reasoning quality of Group 1 local and Group 1 global?
3.3. Is there statistically significant difference between the reasoning quality of Group 2 local and Group 2 global?
3.4. Is there statistically significant difference between the reasoning quality of Group 2 local and Group 1 global?

4. Is there statistically significant difference between rebuttal quality of the middle school students who are engaged with the local based SSI text and with the global based SSI text in the plastic usage topic?

Concerning the question, it was hypothesized that;

The quality of rebuttal components of middle school students who are engaged with the local based SSI text would be higher in the plastic usage topic than the global based SSI text.

**Subproblems:**

4.1. Is there statistically significant difference between the rebuttal quality of Group 1 local and Group 2 global?
4.2. Is there statistically significant difference between the rebuttal quality of Group 1 local and Group 1 global?
4.3. Is there statistically significant difference between the rebuttal quality of Group 2 local and Group 2 global?
4.4. Is there statistically significant difference between the rebuttal quality of Group 2 local and Group 1 global?

5. Is there a statistical difference between the local and global scores of the group with the highest score in the pretest and the group with the lowest score?

Concerning the question, it was hypothesized that;

The local argument quality of students who have highest pretest score would be higher in the plastic usage topic than their global argument quality based on SSI text.

**Subproblems:**

5.1. Is there a statistical difference between the local and global scores of the group with the highest score in the pretest?
5.2. Is there a statistical difference between the local and global scores of the group with the lowest score in the pretest?

6. What is the difference between specific data citation cases of local and global groups for argument components?

**Subproblems:**

6.1. What is the difference between local context and global context argument produced by the students in terms of specific data citation for reasoning component?
6.2. What is the difference between local context and global context argument produced by the students in terms of specific data citation for rebuttal component?
6.3. What is the difference between local context and global context argument produced by the students with the highest score in terms of specific data citation?
6.4. What is the difference between local context and global context argument produced by the students with the lowest score in terms of specific data citation?

## 4.2. Variables and Operational Definitions

### 4.2.1. Dependent Variable

The argument quality of the students after they were presented with local and global versions of the socioscientific plastic use issue is the dependent variable. In this study, the argument quality framework is chosen based on students' ability to produce claim, reasoning and rebuttal based on questions for the both local and global versions of the socioscientific issue. The claim aspect in the argument quality expects students to choose their positions to the presented problem; the evidence aspect supposes that students can distinguish between the supportive data and biased one; the warrant aspect awaits students making accurate connections between the evidence and claim; the backing aspect expect student to support the reasoning; as a last composition rebuttal aspect about providing multiple views about topic. To evaluate the argument quality of students, written argument forms are used after they were presented with the socioscientific issues and they were evaluated via the rubric which will be chosen based on the data.

### 4.2.2. Independent Variable

The independent variable of the study is the type of socioscientific issue contexts which are local and global. While local context means that contexts relating or restricted to a particular area or one's neighborhood, global context means that contexts relating to the whole world. For this aim, local and global SSI based texts are prepared for the plastic waste issue which include advantages, disadvantages based on the resources in this field. In this point, the effects of two significant conditions are considered; Order of priority in terms of context type and order of priority in terms of data presented in text itself. It means that two local and global texts are created by changing the order of advantages and disadvantages in the text. Furthermore, these texts were presented in different orders to the two groups of students to eradicate the effect of orders except for context. The details are mentioned in the method part of the study.

# 5. METHODOLOGY

The purpose of the study is to investigate the effect of socio-scientific issue contexts on the argument quality of 69 grade middle school students. This chapter provides detailed information about methodology which explains the way of conducting this study to achieve the purpose in an appropriate way. In this sense, research design, participants, instruments, procedure and, data analysis of experimental research are presented in detail.

## 5.1. Research Design

This study has a quantitative research design. Argument quality of eight grade students will be determined via argument quality task which yields a quantitative data as a result of evaluation rubric. As there is an external manipulation in the design, the experimental research design will be appropriate. As the random selection and assignment is not feasible, this study can be classified as the quasi-experimental design (Cohen et al., 2002). This research design poses a significant problem for the outcome of the study: Order of interventions. To cope with the carry-over effects of sequential treatments, two classrooms will be engaged with two different treatments in different orders. Different orders of the treatment are assigned to the subjects. The subjects serve as their own control groups.

## 5.2. Participants

Participants were all eighth graders in public middle schools in Kartepe, a district of Kocaeli. The convenience sampling method is used to choose the sample group as to control the ability, achievement and other demographic conditions.

Eighth grade students were especially chosen as the sample group for this study as the topic of “plastic waste” discusses at the “Domestic Waste and Recycling” unit of 7th grade science curriculum of MEB (2018) and students can link the materials such as global and local SSI based texts in this study with their former learnings. Moreover, the age level of students is appropriate for producing argument based on the texts in limited time when

compared with the lower grades. However, the texts in this study can be adapted to the students in different grades.

All eight graders are included at the chosen school to get extended data as a result of quantitative nature of study. The sample of the study will consist of 69 students. In total there are five classes of eight grades. The two classes are treatment group 1 and the other classes are treatment group 2.

### 5.3. Instruments

The learning materials in this research were developed by the researcher according to the text-based factors (Schiefele et al., 1992). It can be defined as written argument task which include information about the related topic area and the questions that aim to assess the argument quality of students based on the given text. There are two types of texts which are local text and global text. Although both texts include three main parts as the general characteristics of plastics, the effects of plastics on human health and, the effects of plastics on environment; in local text, plastic use issue based upon Turkey and Kocaeli context and the given information includes the data specific for Turkey and Kocaeli. Additionally, the global text includes data and information about the plastic use in the world. Furthermore, order of priority in terms of data presented in text itself will be considered since presenting positive or negative aspects first may affect students' perceptions in these directions, attention will be paid to balance between disadvantages and advantages. It means that local and global texts will be created with an equal number of points by changing the order of advantages and disadvantages in the text. For example, if there are two advantageous points in terms of the effects of plastics on environment, there should be two disadvantageous points also to support the balance in each parts of texts.

This instrument was developed by three researchers (Can, Büçkün and Güven, 2021). As a first step, the studies, papers about plastic use in local and global were investigated and the available data were collected and recorded. After general search, the researchers have prepared the initial version of text by classifying them under four main parts; the general characteristic of plastics, the economic aspects of plastic use, the health aspect of plastic use

and the environment aspect of plastic use. In order for the texts to be clear in terms of readability and understandability, and considering the length of the text, the economic aspect was removed from the texts. All aspects related to the subject were arranged in a way that their advantages and disadvantages include equal information. At this point, the local and global texts were compared, considering that they contain equal information too. Afterwards, flow of the text, spelling and grammar rules, punctuation marks were arranged and the instruments were updated approximately 20 times to give the final draft version. As the last step, the rubric with the following statements was developed to evaluate the texts;

Table 5. 1. The text evaluation rubric.

| |
|---|
| • There is a clear difference between local and global texts. |
| • The text content is appropriate for the age group in terms of reading and understandability. |
| • The text presented on the use of plastics is balanced in terms of advantages and disadvantages. |
| • Health and environment sub-dimensions in the text are presented in a balanced way compared to each other. |
| • The use of plastics in the text is appropriately addressed as a socio-scientific issue. |
| • The advantages and disadvantages of the use of plastic in the text are given objectively. |
| • The text provides sufficient content for students to form arguments from different positions. |

According to these statements, researchers analyzed the text whether they are appropriate or not. If the texts are not appropriate based on the statements, reasons explained and recommendation were made before sending the text to subject matter experts. The texts were analyzed by four science experts through developed rubric to ensure the comprehensibility of texts afterwards, the pilot study conducted with students to finalize texts.

Apart from the text, questions were created by researcher. It is expected students to create claim, reasoning, and rebuttal based on four questions. The claims of students will be

taken via four-point scale by considering the possibility that students may not have mastered argument formation skill before. By doing this, researcher aims to prevent students from confusion about what is expected with the claim. In the second question, students are expected to give evidence and warrant at the same question since it will be difficult to discriminate between data and warrant as similar with the study of Venville and Dawson (2010). With the third question, students will support their reasoning with additional information. As a last step, students are questioned to support data and reasoning to persuade themselves from the different point of view. Although the argument questions to be asked before and after are same, in the worksheet containing the questions to be asked after the text, a confirmation will be made that students have read the text in detail. The questions in the instrument were re-organized to increase understandability when we consider the grade level of students. The questions are shortened with clear and understandable expressions as below since the participants are not are not very familiar with argument statements.

### 5.4. Procedure

Before the data collection process, the necessary permissions have been obtained from the ethical committee of Bogazici University. With this permission, the researcher has applied to the Ministry of National Education for necessary permits for data collection. As a conclusion all consent has been received from necessary institutions, schools and school administrators. Five eight grade classes are chosen, and one class from each grade is non-randomly assigned to one of two conditions, others study in the remaining condition. Group 1 is firstly engaged with text free argument questions, local SSI text and the argument questions based on text. After two weeks, they are engaged with global SSI text and the argument questions based on text. Students in group 1 answer text free argument questions, read local text and answer the questions again based on this text in 40 minutes. Same process is applied for global text two weeks later. Group 2 is firstly engaged with text free argument questions, global SSI text and the same argument questions based on text. After two weeks, they are engaged with local SSI text and the argument questions based on text. Students in group 2 answer the text free argument questions, read global text and answer the same questions based on this text in 40 minutes. Same process is applied for local text two weeks later. The total duration of data collection is one class hour in a week. By doing this, order

of priority in terms of context type controlled to investigate the effect of context of SSI clearly. The following figure includes the grouping of students.

Table 5. 2. Presentation of texts and questions.

| ARGUMENT PRODUCING TASK | GROUP 1 | GROUP 2 |
|---|---|---|
| First Task | Text Free Questions +Local Text + Questions | Text Free Questions +Global Text+ Questions |
| Second Task | Global Text +Questions | Local Text +Questions |

### 5.5. Data Analysis

As was pointed out in the argumentation part of this paper, argumentation process is handled in different frameworks. In addition to frameworks of Toulmin (1958) and Erduran et al. (2004), Venville and Dawson (2010) constructed analytical scheme by supporting that it is compelling to separate data and warrant under certain conditions. Moreover, Zohar and Nemet (2002) examined the justification, both in number and quality for argument, counterargument and refutation. Lizotte et al. (2003) assess the argumentation under claim, evidence and reasoning components. In this study, the data were collected via written argument task in an open-ended form. The total argument quality of eight grade students engaged with the both local and global versions of SSI based texts were examined based on claim, reasoning, and rebuttal. Therefore, post-test analysis was applied to students after they took two different task and answers of students were scored via below evaluation rubric adopted from Şahin (2014) and the scores were transferred to numeric data.

Table 5. 3. Argument quality evaluation rubric.

| Components | Sub-Dimensions | Explanation | Points |
|---|---|---|---|
| **Reasoning** | Detailed Scientific Explanation / Data | Use more than one scientific warrant and data. | 3 |
| | Scientific Explanation / Data | Support the explanation with one data and warrant | 2 |
| | General Explanation | Does not provide data, but provides warrant | 1 |
| | No | Provide no data or warrant | 0 |
| **Rebuttal** | Present (Strong) | Counteracts with more than one rebuttal. | 3 |
| | Present (Clear) | Produces rebuttal by justifying or supporting the claim it defends. | 2 |
| | Present (Weak) | Only rebuttal against the defended claim. | 1 |
| | No | No rebuttal. | 0 |

The data gathered via written argument task will be analyzed with statistical analysis means that this study constructed on quantitative analysis only. Quantitative analysis aims to examine students' argument quality after the treatment and compare the different treatment types to decide the effect of learning context on the argument quality of students. To decide the type of test for the data analysis, results should be investigated in terms of certain assumptions. For this aim, scores were testified whether the data was normally

distributed or not by *Kolmogorov-Smirnov Test*. Based on the results, non-parametric tests were chosen for the analysis. In addition to normal distribution of data, random selection of sample and level of measurement are also another assumption of parametric test.

In order to answer first research question *"Is there statistically significant difference between the argument quality of the middle school students who are engaged with the local based SSI text and with the global based SSI text in the plastic usage topic?"*, the difference between the local and global scores of Group 1 and the difference between the local and global scores of Group 2 were calculated with *Wilcoxon signed-rank* test.

In order to answer research question two *"Is there statistically significant difference between the argument quality of middle school students based on the order of priority in terms of context type (local vs. global) in the plastic usage topic?"*, it is necessary to measure their initial argument skills in order to make a comparison between two different groups. Otherwise, it may be misleading to show statistically whether the changes in different groups at the end of the study occurred depending on the prior argument quality of the students or depending on the local/global contexts. To compare the similarity between the prior argument quality scores of two groups, non-parametric The Mann-Whitney U test was performed. As the test result shows that there is no significant difference between the groups based on their prior argument quality, it was stated that skills of groups about producing argument are similar. In this point, *Mann-Whitney U* test was used for the between groups comparisons.

Third research question *"Is there statistically significant difference between reasoning quality of the middle school students who are engaged with the local based SSI text and with the global based SSI text in the plastic usage topic?"* was examined according to the sub-problems. To answer sub-problems 3.1 *"Is there statistically significant difference between the reasoning quality of Group 1 local and Group 2 global?"* and 3.4 *"Is there statistically significant difference between the reasoning quality of Group 2 local and Group 1 global?"*, the groups' initial argument quality was evaluated. As the test result shows that there is no significant difference between the groups based on their prior argument quality, it was stated that of groups about producing argument. In this point, to analyze difference

between the scores of argument components, *Mann-Whitney U* test was used for the between groups comparisons.

To answer sub-problems which 3.2 *"Is there statistically significant difference between the reasoning quality of Group 1 local and Group 1 global?"* and 3.3 *"Is there statistically significant difference between the reasoning quality of Group 2 local and Group 2 global?" Wilcoxon signed-rank* test was used to examine the difference between local and global scores of argument components in groups.

Fourth research question, *"Is there statistically significant difference between rebuttal quality of the middle school students who are engaged with the local based SSI text and with the global based SSI text in the plastic usage topic?"* was examined according to the sub-problems. To answer sub-problems 4.1 *"Is there statistically significant difference between the rebuttal quality of Group 1 local and Group 2 global?"* and 4.4 *"Is there statistically significant difference between the rebuttal quality of Group 2 local and Group 1 global?"*, the groups' initial argument quality was evaluated. As the test result shows that there is no significant difference between the groups based on their prior argument quality, it was stated that skills of groups about producing argument. In this point, to analyze difference between the scores of argument components, *Mann-Whitney U* test was used for the between groups comparisons.

To answer sub-problems which 4.2 *"Is there statistically significant difference between the rebuttal quality of Group 1 local and Group 1 global?"* and 4.3 *"Is there statistically significant difference between the rebuttal quality of Group 2 local and Group 2 global?" Wilcoxon signed-rank* test was used to examine the difference between local and global scores of argument components in groups

Fifth research question "*Is there a statistical difference between the local and global scores of the group with the highest score in the pretest and the group with the lowest score?"* was analyzed by Wilcoxon signed-rank test. First of all, the pre-test scores of students were ranked from highest to lowest and 15 students from both lower and upper group were chosen. The difference between local and global scores of students who have

highest pretest score were analyzed. The same process was applied for students who have lowest pretest score.

For the sixth research question "*What is the difference between specific data citation cases of local and global groups for argument components?"*, all students' answers were classified whether they include specific data citations for both reasoning and rebuttal components. If the answers have these citations, this answer is marked with a plus sign. " +". Additionally, if these citations were made from the presented texts, text-based citation is stated with TBC letters. As a conclusion a participant can get two pluses in total, one from the reasoning component and one from the rebuttal/component. After this, four subproblems were analyzed for the fifth question. For the sub-problem 6.1 "*What is the difference between local context and global context argument produced by the students in terms of specific data citation for reasoning component?"* and 6.2 *"What is the difference between local context and global context argument produced by the students in terms of specific data citation for rebuttal component?"*, the frequency of students' specific data citations in reasoning component were calculated and compared for the local and global scores. The same calculation and comparison were performed for rebuttal component. For the sub-problems 6.3 *"What is the difference between local context and global context argument produced by the students with the highest score in terms of specific data citation?"* and 6.4 *"What is the difference between local context and global context argument produced by the students with the lowest score in terms of specific data citation?* total local argument quality of students was listed, top 15 students and below 15 students were taken and, total specific data citation points of these students were calculated from zero to two. The score of zero means that neither the reasoning nor the rebuttal provided specific data citation. The score of one means that the one specific data citation is presented either in the reasoning component or in the rebuttal component. The score of two means that specific data citation is presented in both the reasoning and the rationale components. The same calculation was conducted based on the global scores. After calculations, the number of specific data citation was compared for both the upper group and the lower group in two contexts.

# 6. RESULTS

In this part of the study, the results of the quantitative study will be presented in two section. The first section shows the preliminary analyses for the reliability of data evaluation rubric and the normality assumptions and analyses of data set. In the second section, the analyses of each research question were presented respectively.

## 6.1. Reliability and Normality

Selecting or creating a data analysis tool is essential to derive the most meaningful result from the data. For this purpose, the data set and the characteristics of the data has been analyzed by the researcher. In the light of these studies, the existing literature was examined and the rubric thought to be the most suitable for the data set was selected. The interrater reliability test was required to ensure that the selected rubric was interpreted objectively and meaningfully by the researcher. For this purpose, all the students' answers were analyzed and scored by the researcher according to the chosen rubric. The same process was applied by another field expert independently. After the scoring of two researchers, Cronbach alpha coefficient for the overall scoring was calculated as 0.96 which means that the interrater reliability of scoring is excellent. (George and Mallery, 2003).

Before selecting the appropriate test, the normality test for all data set was performed. After entering all the dataset in SPSS 21, the test of normality was conducted for pretest scores, posttest scores of group 1 and posttest scores of group 2. The test results for each variable in groups computed as following:

Table 6. 1. Test of normality – pretest scores of all groups.

*Tests of Normality*

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Prerest local | .315 | 34 | .000 | .817 | 34 | .000 |

Table 6. 1. Test of normality – pretest scores of all groups (cont.).

| | | | | | | |
|---|---|---|---|---|---|---|
| Pretest global | .246 | 35 | .000 | .871 | 35 | .001 |

Table 6. 2. Test of normality – group 1 local and global scores.

*Tests of Normality*

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| local | .153 | 34 | .043 | .914 | 34 | .011 |
| global | .249 | 34 | .000 | .863 | 34 | .001 |

a. Lilliefors Significance Correction

Table 6. 3. Test of normality – group 2 local and global scores.

*Tests of Normality*

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| global | .236 | 35 | .000 | .893 | 35 | .003 |
| local | .199 | 35 | .001 | .904 | 35 | .005 |

a. Lilliefors Significance Correction

As the sigma value of three variables are lower than 0.05, there is a statistically significant difference between the normal distribution and variables. The Kolmogorov-Simirnov test showed that no variable has a normal distribution. Thus, non-parametric tests were conducted in the data analysis and each research question was examined separately.

For the analysis of first research question, it was aimed to compare the local and global scores of each group within itself. First comparison was conducted for the Group 1 which was presented with local and global texts respectively. For this comparison, non-parametric Wilcoxon signed-rank test was used as there is a repeated measure on a same group.

Table 6. 4. Local and global scores of group 1.

*Ranks*

| | | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| global1score - local1score | Negative Ranks | 13[a] | 12,27 | 159,50 |
| | Positive Ranks | 10[b] | 11,65 | 116,50 |
| | Ties | 11[c] | | |
| | Total | 34 | | |

a. global1score < local1score

b. global1score > local1score

c. global1score = local1score

*Test Statistics*[a]

| | global1score- local1score |
|---|---|
| Z | -.682[b] |
| Asymp. Sig. (2-tailed) | .495 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

As sigma value is equal to 0.495 (greater than 0.05) means that there is no statistically significant difference between the local and global scores of the students in group 1 in terms of the text context. Second comparison was conducted for the Group 2 which was presented with global and local texts respectively. For this comparison, non-parametric Wilcoxon signed-rank test was used as there is a repeated measure on a same group.

Table 6. 5. Local and global scores of group 2.

*Ranks*

| | | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| local2score - global2score | Negative Ranks | 11[a] | 9,95 | 109,50 |
| | Positive Ranks | 9[b] | 11,17 | 100,50 |
| | Ties | 15[c] | | |
| | Total | 35 | | |

Table 6. 5. Local and global scores of group 2 (cont.).

a. local2score < global2score

b. local2score > global2score

c. local2score = global2score

*Test Statistics*[a]

| | local2score- global2score |
|---|---|
| Z | -,174[b] |
| Asymp. Sig. (2-tailed) | .862 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

As sigma value is equal to 0.862 (greater than 0.05) means that there is no statistically significant difference between the local and global scores of the students in group 2 in terms of the text context.

For the analysis of second research question, we have to make sure about the students' prior argument quality. In order to check whether the groups are similar or not in terms of their initial argument quality, a Mann-Whitney U Test should be used.

Table 6. 6. Pretest scores of group 1 and group 2.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groups. | Independent-Samples Mann-Whitney U Test | .625 | Retain the null hypothesis. |

a. The significance level is ,050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 632,000 |
| Wilcoxon W | 1262,500 |
| Test Statistic | 632,500 |
| Standard Error | 76,654 |
| Standardized Test Statistic | .489 |
| Asymptotic Sig. (2-sided test) | .625 |

The result showed that the sigma value is 0.625 which means that it is greater than 0.05. It can be deduced that initial scores of both group 1 and group 2 are not significantly different from each other. Hence, the effects of different treatments can be observed as both groups are similar in terms of their argument production ability.

Another important point for the research is the comparison of two groups' gained ability after they presented with two different contexts. It is crucial as this study aims to examine the effect of context type and the presentation order of these contexts in the chosen socioscientific issue-plastic use. The Mann-Whitney U test was used to check the possible difference between two contexts accordingly. For this aim, local and global scores of group 1 and group 2 were compared with each other as they were presented with these contexts in different orders.

Table 6. 7. Group 1 global and group 2 global scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of VAR00002 is the same across categories of groups. | Independent-Samples Mann-Whitney U Test | .437 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 657,000 |
| Wilcoxon W | 1287,000 |
| Test Statistic | 657,000 |
| Standard Error | 79,751 |
| Standardized Test Statistic | .777 |
| Asymptotic Sig. (2-sided test) | .437 |

The results revealed that sigma=0.437>0.05 so the difference between global scores of Group 1 and Group 2 are not statistically significant. This result means that the order in which the context is given has no effect.

Table 6. 8. Group 1 local and group 2 local scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of VAR00003 is the same across categories of groups. | Independent-Samples Mann-Whitney U Test | .712 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 625,000 |
| Wilcoxon W | 1255,000 |
| Test Statistic | 625,000 |
| Standard Error | 81,401 |
| Standardized Test Statistic | .369 |
| Asymptotic Sig. (2-sided test) | .712 |

The results pointed out that sigma=0.712>0.05 so the difference between local scores of Group 1 and Group 2 are not statistically significant. This result means that the order in which the context is given has no effect.

Table 6. 9. Group 1 local and group 2 global scores.

*Hypothesis Test Summary*

| Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|
| 1 The distribution of scores is the same across categories of groupnumber. | Independent-Samples Mann-Whitney U Test | .777 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 618,000 |
| Wilcoxon W | 1248,000 |
| Test Statistic | 618,000 |
| Standard Error | 81,152 |
| Standardized Test Statistic | .283 |
| Asymptotic Sig. (2-sided test) | .777 |

Sigma value is equal to 0.777 implies that the difference between local scores of Group 1 and global scores of Group 2 are not statistically significant. This result means that the effect of the order in which the context is given and the context types are not significant.

Table 6. 10. Group 1 global and group 2 local scores.

*Hypothesis Test Summary*

| Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|

Table 6. 10. Group 1 global and group 2 local scores. (cont.)

| | | | | |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groupnumber. | Independent-Samples Mann-Whitney U Test | .455 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 655,000 |
| Wilcoxon W | 1285,000 |
| Test Statistic | 655,000 |
| Standard Error | 80,363 |
| Standardized Test Statistic | .747 |
| Asymptotic Sig. (2-sided test) | .455 |

Sigma value is equal to 0.455 implies that the difference between global scores of Group 1 and local scores of Group 2 are not statistically significant. This result means that the effect of the order in which the context is given and the context types are not significant.

For the analysis of third research question, it is important to explore the difference between the reasoning scores of each group instead of total score. Since this study examine the effect of context type on the argument quality of student, the components of argument will give clue. The Mann-Whitney U test was used to check the possible difference between two contexts accordingly.

Table 6. 11. Group 1 local and group 2 global reasoning scores.

*Hypothesis Test Summary*

| Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|

Table 6. 11. Group 1 local and group 2 global reasoning scores. (cont.)

| | | | | |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groupnumber. | Independent-Samples Mann-Whitney U Test | .737 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 569,000 |
| Wilcoxon W | 1199,000 |
| Test Statistic | 569,000 |
| Standard Error | 77,321 |
| Standardized Test Statistic | -.336 |
| Asymptotic Sig. (2-sided test) | .737 |

The result showed that the sigma value is 0.737 which means that it is greater than 0.05. It can be concluded that local reasoning scores of group 1 and global reasoning scores of group 2 are not significantly different from each other.

Table 6. 12. Group 1 global and group 2 local reasoning scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groupnumber. | Independent-Samples Mann-Whitney U Test | .515 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 642,000 |
| Wilcoxon W | 1272,500 |
| Test Statistic | 642,500 |
| Standard Error | 72,878 |
| Standardized Test Statistic | .652 |
| Asymptotic Sig. (2-sided test) | .515 |

Sigma value is 0.515 means that it is greater than 0.05. It can be concluded that global reasoning scores of group 1 and local reasoning scores of group 2 are not significantly different from each other.

Table 6. 13. Group 1 global and group 2 global reasoning scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groupnumber. | Independent Samples Mann-Whitney U Test | .902 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 603,500 |
| Wilcoxon W | 1233,500 |
| Test Statistic | 603,500 |
| Standard Error | 68,686 |
| Standardized Test Statistic | .124 |
| Asymptotic Sig. (2-sided test) | .902 |

Sigma value is 0.902 means that it is greater than 0.05. It can be concluded that global reasoning scores of group 1 and global reasoning scores of group 2 are not significantly different from each other.

Table 6. 14. Group 1 local and group 2 local reasoning scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groupnumber. | Independent-Samples Mann-Whitney U Test | .990 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 596,000 |
| Wilcoxon W | 1226,000 |
| Test Statistic | 596,500 |
| Standard Error | 78,699 |
| Standardized Test Statistic | .013 |
| Asymptotic Sig. (2-sided test) | .990 |

The result indicated that the sigma value is 0.99 which means that it is greater than 0.05. It can be concluded that local reasoning scores of group 1 and local reasoning scores of group 2 are not significantly different from each other.

For the analysis of fourth research question; it is essential to examine the difference between the rebuttal scores of each group instead of total score. The Mann-Whitney U test was used to check the possible difference between two contexts.

Table 6. 15. Group 1 global and group 2 global rebuttal scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a,b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groups. | Independent Samples Mann-Whitney U Test | .415 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 656,500 |
| Wilcoxon W | 1286,500 |
| Test Statistic | 656,500 |
| Standard Error | 75,509 |
| Standardized Test Statistic | ,814 |
| Asymptotic Sig. (2-sided test) | ,415 |

Sigma value is 0.415 means that it is greater than 0.05. It can be concluded that global rebuttal scores of group 1 and global rebuttal scores of group 2 are not significantly different from each other.

Table 6. 16. Group 1 global and group 2 local rebuttal scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groups. | Independent-Samples Mann-Whitney U Test | .402 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 658,500 |
| Wilcoxon W | 1288,500 |
| Test Statistic | 658,500 |
| Standard Error | 75,718 |
| Standardized Test Statistic | .839 |
| Asymptotic Sig. (2-sided test) | .402 |

Sigma value is 0.402 means that it is greater than 0.05. It can be concluded that global reasoning scores of group 1 and local reasoning scores of group 2 are not significantly different from each other.

Table 6. 17. Group 1 local and group 2 global rebuttal scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groups. | Independent-Samples Mann-Whitney U Test | .370 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 662,500 |
| Wilcoxon W | 1292,500 |
| Test Statistic | 662,500 |
| Standard Error | 75,251 |
| Standardized Test Statistic | .897 |
| Asymptotic Sig. (2-sided test) | .370 |

The result attested that the sigma value is 0.370 which means that it is greater than 0.05. It can be concluded that local reasoning scores of group 1 and global reasoning scores of group 2 are not significantly different from each other.

Table 6. 18. Group 1 local and group 2 local rebuttal scores.

*Hypothesis Test Summary*

| | Null Hypothesis | Test | Sig.[a, b] | Decision |
|---|---|---|---|---|
| 1 | The distribution of scores is the same across categories of groups. | Independent-Samples Mann-Whitney U Test | .365 | Retain the null hypothesis. |

a. The significance level is .050.

b. Asymptotic significance is displayed.

*Independent-Samples Mann-Whitney U Test Summary*

| | |
|---|---|
| Total N | 69 |
| Mann-Whitney U | 663,500 |
| Wilcoxon W | 1293,500 |
| Test Statistic | 663,500 |
| Standard Error | 75,607 |
| Standardized Test Statistic | .906 |
| Asymptotic Sig. (2-sided test) | .365 |

It was founded that the sigma value is 0.365 which means that we can retain the null hypothesis. It can be concluded that local reasoning scores of group 1 and local reasoning scores of group 2 are not significantly different from each other.

For the analysis of fifth research question, it was intended to analyze the difference between the upper and lower groups. To do this, all students are listed based on their pretest scores and upper 15 students and lower 15 students were selected for the Wilcoxon Signed Ranks test.

Table 6. 19. Local global score comparison of upper group.

*Ranks*

| | | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| globalscore - localscore | Negative Ranks | 4[a] | 4,00 | 16,00 |
| | Positive Ranks | 3[b] | 4,00 | 12,00 |
| | Ties | 8[c] | | |
| | Total | 15 | | |

a. globalscore < localscore

b. globalscore > localscore

c. globalscore = localscore

*Test Statistics*[a]

| | globalscore - localscore |
|---|---|
| Z | -.351[b] |
| Asymp. Sig. (2-tailed) | .726 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Based on the comparison of global and local scores of upper groups, sigma value is 0.726 means that it is greater than 0.05. It can be concluded that global and local score of upper groups are not significantly different from each other.

Table 6. 20. Local global score comparison of lower group.

*Ranks*

| | | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| globalscore - localscore | Negative Ranks | 2[a] | 3,00 | 6,00 |
| | Positive Ranks | 6[b] | 5,00 | 30,00 |
| | Ties | 7[c] | | |
| | Total | 15 | | |

a. globalscore < localscore

b. globalscore > localscore

c. globalscore = localscore

*Test Statistics*[a]

| | globalscore - localscore |
|---|---|
| Z | -1.732[b] |
| Asymp. Sig. (2-tailed) | .083 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Based on the comparison of global and local score of lower groups, sigma value is 0.083 means that it is greater than 0.05. It can be concluded that global and local score of upper groups are not significantly different from each other.

For the analysis of sixth research question; students' specific data citation frequencies were calculated for reasoning, rebuttal components and for total. In the first analysis, it was calculated whether the students made specific data citation in the reasoning question in local and global contexts.

Table 6. 21. Local/global specific data citation frequency in reasoning.

| | Specific Data Citation | Text Based |
|---|---|---|
| Local | 32 | 32 |
| Global | 15 | 10 |

In terms of specific data citation, comparisons show that 32 students in total presents specific data citation in reasoning component in the local context. All of these citations are local text based. For the global context, 15 students in total presents specific data citation in reasoning component. 10 out of 15 students made these citations based on the global text.

Table 6. 22. Local/global specific data citation frequency in rebuttal.

| | Specific Data Citation | Text Based |
|---|---|---|
| Local | 17 | 17 |
| Global | 14 | 13 |

Rebuttal comparison shows that, 17 students in total presents specific data citation in in the local context. All of these citations are local text based. For the global context, 14 students in total presents specific data citation in rebuttal component. 13 out of 14 students made these citations based on the global text.

Table 6. 23. Local/global specific data citation frequency in upper group.

| | Specific Data Citation | Text Based |
|---|---|---|
| Local | 13 | 13 |
| Global | 12 | 12 |

In addition to components, students' overall data citation points were calculated in this part. All the students were listed based on their local and global argument quality scores separately and data citation frequency of top fifteen students in this list were compared. Based on these comparisons, result showed that 13 students in 15 used at least one specific data and all of them were cited from the local context. However, this number is 12 out of 15 in global context.

Table 6. 24. Local/global specific data citation frequency in lower group.

| | Specific Data Citation | Text Based |
|---|---|---|
| Local | 2 | 2 |
| Global | 0 | 0 |

The same process was performed for the 15 students from the bottom of the list. Based on comparisons, result showed that two students in 15 used at least one specific data and all of them were cited from the local context. However, this number is zero out of 15 in global context.

# 7. CONCLUSION AND DISCUSSION

This chapter includes the summary and discussion of the results, limitations of the study and implications for future instructions respectively. In the first part, the importance and purpose of the study were explained based on the literature. Then, the results of the study were summarized clearly and discussed in terms of similarities and differences with other studies. In the following part, the limitations that may have affected the results of the study were examined. Lastly, recommendations are presented both in terms of research and instructions in order to eliminate the limitations of this study and to take the related study one step further.

## 7.1. Summary and discussion of the results

Since the emergence of the concept of society, different social structures have aroused. This activity, which started with the agricultural society, now continues as the information society. In this context, while information has a dominant role in society today, this situation has shaped the educational expectations of societies. Education curricula have also been updated as social needs such as acquiring and processing information, understanding and explaining the world and nature have arisen. This situation has spread in many countries with the first use of the concept of scientific literacy in the literature. Scientific literacy has been defined as a concept and included in the science education curriculum for economic, cultural, democratic or personal reasons. In the middle school science curriculum of Turkey, scientific literacy has been explained in the special aims part. In our curriculum, students are expected to have reasoning and decision-making skills on socioscientific issues as a part of scientific literacy expectation (MEB, 2018). As socioscientific issues are complex and debatable, it is important to present them in meaningful learning environments or with effective teaching materials so that students can easily analyze and make arguments by determining their claims and reasons. Although there are many different research studies about the socioscientific issues, most of them are about the relation of socioscientific issues with other constructs such as content knowledge (Mason and Scirica, 2006), moral perspectives of students (Sadler and Donnelly, 2006), ability level

of students (Lin and Mintzes, 2010), instruction types (Dawson and Venville, 2010; Chen et al., 2011). There is limited study about the socioscientific context and how to use them to support argument quality of students (Sadler et al., 2017). The context of the socioscientific issues has generally been examined from the perspectives of local, global or health-environment, and although a positive effect on students' argumentation skills or attitudes has been observed, there is no comparison of local and global contexts in Turkey (Durmaz and Karaca, 2019; Çapkınoğlu, 2020).

The study aimed to examine the difference between the argument quality of students based on the situated SSI text in local and global contexts. The basic expectation in this study is that producing argument in the local context is higher than in global context. To test these hypotheses, a quasi-experimental design was performed and the data was analyzed statistically.

In the first research question, the local and global scores of each group within itself were compared and test results pointed out that there was not a statistically significant difference between students' argument quality in terms of the local and global socioscientific contexts. In the second research question, the argument quality of students in different groups were compared after their initial argument producing ability was compared. The results showed that different contexts do not change argument quality of both groups. Apart from the total argument quality, all groups in two different contexts were compared in terms of their reasoning quality and result showed that students' reasoning quality are not significantly different from each other. The same result was observed for their rebuttal quality. This study shows that the presentation of the texts in different order does not make a difference in the quality of the students' arguments. Although there is no statistically significant difference as a result of comparing the local and global argument quality of different groups and the local and global argument skills of the same group, results showed that the students in both groups benefited from the learning material according to increase in their average argument quality points. The students in local context has extended their argument quality from base score 1.35 to 1.78 points out of six and the students in global context has increased their argument quality from base score 1.35 to 1.67 points out of six. These basic findings are consistent with research showing that socioscientific context have

a positive effect on the argument quality of students in their studies about local contexts (Çapkınoğlu et al., 2019). The analysis of Sadler and Zeidler (2005) shows that students' feedbacks change based on the SSI context. Contrary to these studies, although there are minor changes in the argument quality of students in local and global groups, this difference is not significant. In this point the study of Topçu et al. (2010) supports these results by stating that change in SSI contexts does not trigger the change in argumentation skills. As stated in the literature, socioscientific issues contribute to the argumentation ability of students. However, argument quality is affected by different factors. The prior content knowledge of students, their prior argument producing ability, the nature of experiences and context of materials. Although the effect of some factors is tried to be reduced, insignificant difference between the groups might be affected by the mentioned factors. The learning materials should be developed by considering these factors (Swarat et al., 2012; Mitchell, 1993).

One concern about the findings of this study was that the students' prior argument qualities. Although the detailed examination of students' pre-argument skills is not intended in this study, the students' weakness in terms of these skills caused deficiencies in writing and presenting their thoughts as argumentation. Based on the previous studies, students' prior argument quality is very low and the use of argumentation applications is limited in the classroom environment. The study of Anwar and Ali (2020) showed that before the SSI implementation, students' average argument quality is at maximum Level 2 which means that they can produce claim and support it either data or warrant. As the producing argument is complex process and the implementations in classroom is limited, student cannot produce a high-level argument. In order to cope with these cases, studies suggested that students should be supported with real life problems and they need to practice and guidance to create high level arguments (Anwar and Ali, 2020). Sadler et al. (2007) suggested that using the convenient SSI will support the understanding of students and their connections between science and society. In their study, students are presented with text and answer the questions based on the TAP framework of Toulmin. In the study of Atabey and Topçu (2017), although the average evidence and reasoning skills of students before implementation were low, high effect size was observed in reasoning and evidence components after the socioscientific issue-based instruction. The study of Khishfe et al. (2017) showed that most of the students

are not able to produce high quality arguments before the SSI based implementations in their study. This result ties well with the conclusion that the students were not able to form qualified arguments without prompting (Driver et al., 2000; Khishfe, 2012). Fowler and Zeidler (2010) suggested that argument generating process is affected by the nature of the socioscientific issue. A similar pattern of results obtained in Khishfe (2012) suggested that nature of socioscientific issues will trigger the argumentation process as it offers an opportunity for being familiar with it. The study conducted by Türköz and Öztürk (2019) showed that prior argument quality of preservice teachers reached maximum to the Level 3 before the SSI implementation in the levels of Erduran et al. (2004). The majority of students produce just claim or counterclaim and categorized as Level 1 in three different SSI contexts. These findings imply that the argument level of students from middle school to university level needs improvement with guidance and support. It is stated in the literature that especially in the argumentation processes, students do not produce rebuttal if they are not guided in their written arguments (Erduran et al., 2004). As in this study, the students are not familiar with the argumentation practices, they were guided with the text and the questions that enable them to choose claim and to produce reasoning and rebuttal, the average prior argument quality of students is 1.35 point out of 6 point and the initial argument scores of students were evaluated as poor.

Despite to the fact that result showed that local and global context does not make significant difference for total argument quality in the groups comparison, in terms of presenting specific data citation, this study shows that the specific data citation frequency of local and global groups for reasoning and rebuttal components are not same. The specific data citation number of students in local group are higher than the global group for reasoning and rebuttal components. The study of Çak (2020) supported these results by stating that argument driven socioscientific implementations increases the number of abilities to use scientific knowledge in their reasoning. Additionally, the local data citation number of students were also investigated based on the upper and lower group level since separating students into upper and lower groups can reveal the difference in scores between their argument quality more clearly. The local data citation frequency in upper group is higher than their global data citation frequency. The same result exists in the lower group, too. Moreover, almost all data citations made from the presented texts. Overall these findings are

in accordance with findings reported by Scannell and Gifford (2013) which examined the framing of climate change messaging based on local and global contexts to investigate the engagement level. As this study aims to highlight the effect of interest and as a trigger of participation in producing argument, the same framing was conducted for plastic use. According to the research of Palmer (2004) as the situational interest support the student's motivation and interest, the scientific texts were developed in two different contexts (local and global) to keep the attention of students contextually. As a result of this contextual difference, it was observed that the students in local group chosen the evidences and presented them in their answers more than the global group as these local datasets reflect their close environment. This idea is supported with the study of Mitchell (1993) which proposed that content of the activity will trigger the interest of students when the content is relevant to the student's daily life. The relation between the context and interest in this study was built on the text-based interest idea as this study has two different context-based argument producing task based on the text as a learning material. As Schiefele (1999) argued that the interest of person will be prompted by the content in texts and the design of the texts such as concreteness. From this point, the texts in this study presented concrete data both in local and global contexts.

Additionally, the study of Spence and Pidgeon (2010) showed that there is no correlation between the attitudes and the geographical context (local and distant) for the climate change. A similar pattern of results was obtained in argument quality for local and global contexts. The personal relevance of the context did not contribute to argument quality as expected to create a statistically significant difference between contexts. These insignificant differences can be caused by the number of participants or chosen content topic. Contrary to the findings about total argument quality, it was found that increase in the argument quality when compared to the initial score of students in favor of local context and the higher frequency of specific data citation of local context will give a cue about the effect of geographical context. The results of Scannell and Gifford (2013) showed that although the engagement level is higher in local group when compared to no message group, there is no difference between the global and no message group. In line with the study of Scannell and Gifford (2013), it can be deduced that using the data citations in answers are affected from context as locality contributed to the receptiveness of students towards given

information in this study. From the results of this study, it is clear that the frequency of students using specific data citation from local text in reasoning and rebuttal component doubled the frequency of students in global context. Furthermore, Çapkınoğlu (2015) supported these finding by suggesting that personally relevant socioscientific issues will help students to make decision on these topics. The difference of specific data citation frequencies in local and global contexts can be explained from the perspective of place attachment to one's own environment.

## 7.2. Limitations of the Study

The students' weakness in terms of their prior argument producing skill may have prevented to observe the significant difference between groups' argument quality in local and global contexts as they are not familiar with such a skill. Based on the prior scores of students in argument producing task it is seen that the average of the scores of students in sample is very low and they are not accustomed with doing inference, choosing evidences and evaluating them to support their opinion. It is seen that they did not often perform activities about making argument in the school environment. Even if the students were supported with appropriate learning texts containing data and justifications and guiding questions, low initial levels may have prevented the observation of significant difference. Additionally, the middle school science curriculum (MEB, 2018) also refers to the argumentation processes by stating that students should be provided with environments where they can discuss the benefit-harm relationship regarding scientific phenomena so that they can freely express their ideas, support their thoughts with different reasons, and develop counter arguments to refute the claims of their friends. Teachers are assumed to have a guiding role in discussions where their students present their claims based on valid data with justification. Although the participants in this study have completed the middle school science curriculum, their argument quality is very low. To overcome this situation, science policy should focus of the implementation of argumentation processes in the learning environment.

Additionally, asking the same questions to the students three times might have caused the students to get bored and indirectly their answers were weakened. In this study, there are

three argument tasks. In the first one, students' prior argument quality was evaluated with the questions in argument task to choose claim and to make reasoning and rebuttal. In order to create the different components of the argument, the questions asked before the study are presented to the students two more times in the local SSI context and in the global SSI context. It was observed that the competence of the answers given by the students decreased in a limited time because they encountered argument making processes that they were not familiar with before.

Furthermore, this study is limited to 69 eight grade students in one state school. This number may have potentially led to skewed distribution which ends with non-parametric analysis. To cope with this, increased number of students from different school groups (both from state and private) can change the distribution of data to be normal distribution.

In addition to this, students were presented with the learning materials (texts and questions) in one class hour as one-time argument producing task. The duration of the task will have a positive impact on the argument quality of students.

As a last limitation, researcher observed that students had serious problems in expressing their thoughts in their reasoning and rebuttal answers. Most of the students did not answer the questions properly after the first task or they copied the same answers to the other questions. Even within the same task, students repeated the same reasons in reasoning component, left the rebuttal question blank or stated the same answer as valid for rebuttal component. This problem can be connected with the OECD reports which stated that means scores of students in Turkey (466) are below the OECD average (487) in terms of reading ability (OECD, 2019). It is also important to state that this research has conducted during the pandemic period. This situation led to the idea that interviews can be conducted with certain groups of students as a qualitative component the study, and their answers could be discussed in detail with the students.

### 7.3. Implications for Future Instruction and Research

As the socioscientific issues are complex and open to discussion, these topics will be evaluated as difficult to understand, infer and reach a conclusion. Especially in the middle school level, these issues should be organized in meaningful way so that students can develop scientific explanation and can use their argumentation and decision-making skills. For this purpose, research conducted by Osborne and Patterson (2011) suggested that socioscientific issues from the environment of students will increase the quality of their scientific explanations. The study of Herman et al. (2019) also supported that accessible local contexts should be taken into consideration by teachers while developing learning experiences. There are many studies on the use of local socioscientific issues not only in argumentation skills but also in teaching scientific concepts and the nature of science (NOS). Wong et al. (2008) conducted a study to teach NOS through a SARS epidemic topic. Dolan et al. (2009) studied with middle school students to teach the concepts in science unit thorough SSI. These studies are consistent with research of Topçu et al. (2014) showing that local SSI enable students an opportunity to combine their socio-cultural basis with these issues. A similar conclusion was reached by Villarin (2020) in his study about emotional place involvement in terms of context of SSI and the socioscientific reasoning. This research also showed that students shows improvement in their argument qualities even if it was minor and they were positively affected from the presented texts in their specific data citation frequencies on behalf of local context. As a result, instructional implementations about SSI will be structured on the local context as it appeals to students' interests.

Despite to the fact that the results showed that the difference between the two context types (local and global) is not statistically significant in terms of the argument quality, the number of students who use the specific data citations from the text is higher in local context than the global context. Although the studies indicated that students are lack of ability to use evidence to support their claims (Erduran et al., 2004; Jiménez -Aleixandre, Rodriguez, & Duschl, 2000) despite the specific guidelines, our results demonstrated that students benefit from the evidences in learning materials while answering. Therefore, it is important to present data and evidence that enable students to use their cognitive skills to support the inquiry process. Students can access information and data about dilemmas in SSIs, thus their

argumentation and decision-making processes can be facilitated (Dawson & Carson, 2017). As in this study, it is important to support the learning texts prepared on socioscientific issues with data that appeal to the students' social/physical environment and interests.

The design of the learning material by the researchers and the directions for evaluation of these materials are also crucial for future instructions. For the design of text about plastic use in this study, some criteria have been determined based on the literature. There are six criteria for the design process about the socioscientific issue-based texts. As a summary of these criteria, before designing SSI-related learning material, an up-to-date SSI should be chosen that fits the curriculum. After choosing the topic, it is important to decide whether the chosen SSI is main focus of the whole unit (Zeidler and Kahn, 2014) or it will be focused only in a certain part of the unit to support learning process (Güven and Muğaloğlu, 2020). Then appropriate datasets, evidences should be selected and be presented in an impartial, balanced in terms of counter positions and age appropriate way so that students can support different positions (Tsai, 2018; Güven and Muğaloğlu, 2020).

In the research, increasing the sample size is one of the possible ways to meet with the normal distribution. If we collect more data, our data can be gathered around a normal distribution instead of scattering to one side and it will be able to describe chosen sample. Additionally, if the population had been selected from the group with high and low argument skills, the scores of the students could approach the normal distribution. Thus, the amount of spread of the argument quality scores around the mean will be distinctly noticeable. In this way, statistically significant differences could be observed between the scores showing the argument quality of the students in different contexts. Additionally, this study can be applied for different grades by adapting the level of instruments to observe the effect of learning materials in different groups. Hence, increase in the sample size will increase the generalizability of the study.

Finally, process of producing argument can be extended to the longer periods rather than one class hour. The detailed unit plan for the plastic use topic can be developed based on different contexts (local and global) as an instructional intervention. This situation may support students to better internalize the materials and contexts. Additionally, these

argument producing tasks will be applied for the different socioscientific issues too. In this study, the contextual differences were investigated in the topic about plastic use because of the rapidly increasing use of plastic all over the world and the fact that plastics are used in many areas from agriculture to health in daily life. The context can be extended to topics about health issues in specific regions, different environmental problems or technological dilemma.

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# APPENDIX A- LOCAL TEXT

## Plastik Kullanımı

Plastikler petrol ve doğalgaz kaynaklı ürünlerdir. Plastikler kolay şekil alan, elektrik ve ısı yalıtkanlığı olan, kolay kırılmayan ve paslanmayan yapıya sahiptir. Bu özelliklerinden dolayı günümüzde plastik hemen hemen her sektörde kullanılmakta ve hayatın her alanında yer almaktadır.

Plastik maddeler sağladıkları hijyen açısından gıda ve sağlık malzemelerinde kullanılmakta ve evlerimize girmektedir. Gıda ambalajlarında kullanılan plastik, ürünlerin temiz, sağlıklı ve güvenli koşullarda tüketiciye ulaşmasını sağlar. Örneğin Kocaeli'nde çıkarılan kaynak suları hijyenik bir şekilde plastik şişelerde paketlenerek Türkiye'nin çeşitli şehirlerine gönderilmektedir. Yine tek kullanımlık plastik tabak ve bardaklar, iğne enjektörleri, serum, ilaç paketleri vb ürünler de plastik malzemelerden üretilmektedir.

Öte yandan, plastikler belirli şartlarda kullanılmadığında sağlığı tehdit eden bir maddeye dönüşebilmektedir. 70-90°C sıcaklık, plastik ürünlerde dioksin adında bir madde açığa çıkmasına sebep olur. Dioksinin gıdalarla teması ve besin zinciri ile vücuda alınması kanser gibi hastalıklara sebep olmaktadır. Örneğin, Kocaeli ilinde, plastikleri de içeren atıkların yakıldığı tesis çevresinde beslenen hayvanların yumurta ve sütlerinde oldukça yüksek miktarlarda dioksin olduğu tespit edilmiştir. Dioksin gibi gözle görülemeyecek kadar küçük plastik parçalar da sağlığa zarar verebilmektedir. Bu plastik parçacıklar hava yoluyla akciğerlerde ve besin zinciri ile karaciğerde birikmeye sebep olmaktadır. Türkiye'nin çevresindeki denizlerde plastik parçacıklardan oluşan kirlilik en çok Ege Denizinde bulunup bunu Marmara Denizi ve Akdeniz takip etmektedir. Yapılan araştırmalar sonucunda bu denizlerde bulunan balıklarda plastik parçacıklar olduğu saptanmıştır.

İnşaat sektöründe de plastiklerin yalıtkanlık özellikleri sayesinde binaların ısıtılması ve soğutulması için gereken enerjide %70 tasarruf sağlanmaktadır. Ayrıca, plastik kullanımı su tasarrufu da sağlamaktadır. Örneğin, plastik torba üretimi sırasında harcanan su miktarı kâğıt torba üretimine göre 100 kat daha azdır. Tarımda kullanılan plastik sulama boruları, su

ve bitki besin maddelerini kontrollü bir şekilde damla damla bitkilere vererek, su kullanımını ortalama %75 oranında azaltır ve ürün verimliliğini arttırır. Bu sebeple Türkiye'de plastiklerin tarımda kullanım miktarının yıllık yaklaşık 600 bin ton olduğu belirtilmektedir.

Ancak plastiğin yoğun kullanımı, atık oranını da artırmaktadır. Kocaeli'nde bir kişinin günlük ortalama 125-gram plastik atık oluşturduğu ve yıllık 85 bin ton plastik kullanımı olduğunu göstermektedir. Plastiğin geri dönüşümü için yapılan harcamanın, yenisini üretmekten çok daha fazla olması sebebiyle, Türkiye'de ömrünü tamamlamış plastiklerin yalnızca % 15'i geri dönüştürülmektedir. Plastik atıkların saklanması ve geri dönüştürülmesi sorunu yüzünden Türkiye'de günde 144-ton plastik denize bırakılmaktadır.

# APPENDIX B- GLOBAL TEXT

## Plastik Kullanımı

Plastikler petrol ve doğalgaz kaynaklı ürünlerdir. Plastikler kolay şekil alan, elektrik ve ısı yalıtkanlığı olan, kolay kırılmayan ve paslanmayan yapıya sahiptir. Bu özelliklerinden dolayı günümüzde plastik hemen hemen her sektörde kullanılmakta ve hayatın her alanında yer almaktadır.

Plastik maddeler sağladıkları hijyen açısından gıda ve sağlık malzemelerinde kullanılmakta ve evlerimize girmektedir. Gıda ambalajlarında kullanılan plastik, ürünlerin temiz, sağlıklı ve güvenli koşullarda tüketiciye ulaşmasını sağlar. Örneğin Dünya 'da çeşitli bölgelerde çıkarılan kaynak suları hijyenik bir şekilde plastik şişelerde paketlenerek yerel ve bölgesel dağıtımı yapılmaktadır. Yine tek kullanımlık plastik tabak ve bardaklar, iğne enjektörleri, serum, ilaç paketleri vb ürünler de plastik malzemelerden üretilmektedir.

Öte yandan, plastikler belirli şartlarda kullanılmadığında sağlığı tehdit eden bir maddeye dönüşebilmektedir. 70-90°C sıcaklık, plastik ürünlerde dioksin adında bir madde açığa çıkmasına sebep olur. Dioksinin gıdalarla teması ve besin zinciri ile vücuda alınması kanser gibi hastalıklara sebep olmaktadır. İrlanda, Belçika ve İtalya gibi ülkelerde hayvansal gıdalar üzerinde yapılan incelemelerde, bu gıda maddelerinde insan sağlığına zarar vermeyecek dioksin orandan yaklaşık 200 kat fazla dioksin tespit edilmiştir. Dioksin gibi gözle görülemeyecek kadar küçük plastik parçalar da sağlığa zarar verebilmektedir. Bu plastik parçacıklar hava yoluyla akciğerlerde ve besin zinciri ile karaciğerde birikmeye sebep olmaktadır. Buna bağlı olarak dünya üzerinde insanlarda dâhil olmak üzere 400 kadar canlı türünün zarar gördüğü rapor edilmiştir. Buna ek olarak her yıl 100 bin deniz memelisi ve kaplumbağa, 1 milyon deniz kuşu plastik parçacık kirliliğinin yol açtığı problemlerden hayatını kaybetmektedir.

İnşaat sektöründe de plastiklerin yalıtkanlık özellikleri sayesinde binaların ısıtılması ve soğutulması için gereken enerjide %70 tasarruf sağlanmaktadır. Ayrıca, plastik kullanımı su tasarrufu da sağlamaktadır. Örneğin, plastik torba üretimi sırasında harcanan su miktarı

kâğıt torba üretimine göre 100 kat daha azdır. Tarımda kullanılan plastik sulama boruları, su ve bitki besin maddelerini kontrollü bir şekilde damla damla bitkilere vererek su kullanımını ortalama %75 oranında azaltır ve ürün verimliliğini arttırır. Bu sebeple dünyada plastiklerin tarımda kullanım miktarının yıllık yaklaşık 7 milyon ton olduğu belirtilmektedir.

Ancak plastiğin yoğun kullanımı, atık oranını da artırmaktadır. Yapılan araştırmalar Dünyada 1 yılda 60 milyon ton plastik üretiminin olduğunu ve 27 milyon ton plastiğin atık oluşturduğunu bildirmektedir. Plastiğin geri dönüşümü için yapılan harcama, yenisini üretmekten çok daha fazla olması sebebiyle, Dünya'da ömrünü tamamlamış plastiklerin yalnızca % 18'i geri dönüştürülmektedir. Plastik atıkların saklanması ve geri dönüştürülmesi sorunu yüzünden Dünya'daki deniz çöplerinin %77'sini plastikler oluşturmaktadır.

# APPENDIX C- TEXT FREE ARGUMENTATION QUESTIONS

İsim-Soyisim: Sınıf:

Plastik Kullanımı Hakkında Ne Düşünüyorsun?

Aşağıdaki soruları detaylı ve samimi bir şekilde cevaplayınız. Soruların doğru yada yanlış bir cevabı yoktur.

1. Aşağıdakilerden hangisi plastik kullanımı konusundaki görüşünü ifade eder? Sana en uygun gelen seçeneği işaretle.

| A | B | C | D |
|---|---|---|---|
| Plastik kullanımı kesinlikle yasaklanmalı. | Plastik kullanımı yasaklanmalı. | Plastik kullanımı yasaklanmamalı. | Plastik kullanımı kesinlikle yasaklanmamalı. |

2. Neden böyle düşündüğünü gerekçeleriyle açıklar mısın?

3. Seninle aynı görüşte olmayan bir kişinin gerekçeleri neler olabilir?

4. Senden farklı düşünen bu kişiye karşı cevabın neler olur?

# APPENDIX D- ARGUMENTATION QUESTIONS

İsim-Soyisim: Sınıf:

☐ Plastik kullanımı konusundaki metni detaylıca okudum.

Plastik Kullanımı Hakkında Ne Düşünüyorsun?

Aşağıdaki soruları detaylı ve samimi bir şekilde cevaplayınız. Soruların doğru yada yanlış bir cevabı yoktur.

1. Aşağıdakilerden hangisi plastik kullanımı konusundaki görüşünü ifade eder? Sana en uygun gelen seçeneği işaretle.

| A | B | C | D |
|---|---|---|---|
| Plastik kullanımı kesinlikle yasaklanmalı. | Plastik kullanımı yasaklanmalı. | Plastik kullanımı yasaklanmamalı. | Plastik kullanımı kesinlikle yasaklanmamalı. |

2. Neden böyle düşündüğünü gerekçeleriyle açıklar mısın?

3. Seninle aynı görüşte olmayan bir kişinin gerekçeleri neler olabilir?

4. Senden farklı düşünen bu kişiye karşı cevabın neler olur?

# APPENDIX E- INFORMED CONSENT F

# ORM (TURKISH)

## VELİ ONAM FORMU

Çocuğunuzun katılacağı bu çalışma, "Ortaokul Öğrencilerinin Sosyobilimsel Konulardaki Argüman Kalitelerinin İncelenmesi: Yerel Ve Küresel Bağlamların Etkisi" adıyla, Nisan ayında yapılacak bir araştırma uygulamasıdır.

Araştırmanın Hedefi: Çalışmanın temel amacı, sosyo-bilimsel bir konu olarak plastik kullanımının yerel ve küresel bağlamlarda sunumunun ortaokul öğrencilerinin argüman kalitesi üzerindeki etkisini araştırmaktır.

Araştırma Uygulaması: Anket şeklindedir.

Araştırma T.C. Milli Eğitim Bakanlığı'nın ve okul yönetiminin de izni ile gerçekleşmektedir. Araştırma uygulamasına katılım tamamıyla gönüllülük esasına dayalı olmaktadır. Çocuğunuz çalışmaya katılıp katılmamakta özgürdür. Araştırma çocuğunuz için herhangi bir istenmeyen etki ya da risk taşımamaktadır. Çocuğunuzun katılımı tamamen sizin isteğinize bağlıdır, reddedebilir ya da herhangi bir aşamasında ayrılabilirsiniz. Araştırmaya katılmamama veya araştırmadan ayrılma durumunda öğrencilerin akademik başarıları, okul ve öğretmenleriyle olan ilişkileri etkilenmeyecektir.

Çalışmada öğrencilerden istenen İsim-Soyisim bilgisi çalışmada kullanılmayacak olup öğrenciler rastgele atanan sayılar ile gösterilecektir. Cevaplar tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir.

Uygulamalar, genel olarak kişisel rahatsızlık verecek sorular ve durumlar içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden çocuğunuz kendisini rahatsız hissederse cevaplama işini yarıda bırakıp çıkmakta özgürdür. Bu durumda rahatsızlığın giderilmesi için gereken yardım sağlanacaktır. Çocuğunuz çalışmaya katıldıktan sonra istediği an vazgeçebilir. Böyle bir durumda veri toplama aracını uygulayan kişiye, çalışmayı tamamlamayacağını söylemesi yeterli olacaktır. Anket

çalışmasına katılmamak ya da katıldıktan sonra vazgeçmek çocuğunuza hiçbir sorumluluk getirmeyecektir.

Onay vermeden önce sormak istediğiniz herhangi bir konu varsa sormaktan çekinmeyiniz. Çalışma bittikten sonra bizlere telefon veya e-posta ile ulaşarak soru sorabilir, sonuçlar hakkında bilgi isteyebilirsiniz.

Saygılarımızla,

Araştırmacı:

İletişim Bilgileri:

***Velisi bulunduğum ..... sınıfı ..... numaralı öğrencisi ..... ……’in yukarıda açıklanan araştırmaya katılmasına izin veriyorum.*** (Lütfen formu imzaladıktan sonra çocuğunuzla okula geri gönderiniz*).

…./…../……

Veli Adı-Soyadı:

Telefon Numarası:

İmza:

# APPENDIX F- ETHICAL COMMITTEE PERMISSION OF BOGAZICI UNIVERSITY

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ REKTÖRLÜĞÜ
Fen Bilimleri ve Mühendislik Alanları İnsan Araştırmaları Etik Kurulu (FMİNAREK)

Sayı : 84391427-050.01.04-E.7314 27/04/2020
Konu : 2020-04 Kodlu Başvurunuz Hakkında

Sayın Dr. Öğr. Üyesi Devrim GÜVEN
Matematik ve Fen Bilimleri Eğitimi Bölüm Başkanlığı - Öğretim Üyesi

"Ortaokul Öğrencilerinin Sosyobilimsel Konular ile İlgili Argümantasyon Kalitelerinin İncelenmesi: Yerel ve Küresel Bağlamların Etkisi" başlıklı projeniz ile Boğaziçi Üniversitesi Fen Bilimleri ve Mühendislik Alanları İnsan Araştırmaları Etik Kurulu (FMİNAREK)'e yaptığınız 2020/04 kayıt numaralı başvuru 30.03.2020 tarihli ve 2020/03 sayılı kurul toplantısında incelenerek etik onay verilmesi uygun bulunmuştur.

Bu karar tüm üyelerin toplantıya on-line olarak katılımıyla ve oybirliği ile alınmıştır. COVID-19 önlemleri nedeniyle üyelerden ıslak imza alınamadığından bu onam mektubu tüm üyeler adına Komisyon Başkan Yardımcısı tarafından e-imzalanmıştır

Saygılarımızla bilginize sunarız.

e-imzalıdır
Dr. Öğr. Üyesi Şükrü Anıl DOĞAN
Başkan Yardımcısı

27/04/2020 Raportör Nilüfer SANTEMİZ

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