



Gifted students' decisions and justifications on a socio-scientific dilemma related to the COVID-19 pandemic

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Abstract

The study focuses on the socio-scientific dilemma which arises in the context of the COVID-19 pandemic and is frequently voiced in the society and media: "Should we get a COVID-19 vaccine or not?" The study group of the study were selected via holistic single case study design, one of the qualitative research methods, is comprised of gifted students (n:32). As a result of the study, it was determined that the students made positive and negative decisions regarding getting vaccinated, and some of them stated that they would decide to get vaccinated or postpone the decision depending on whether some criteria would be met. The justifications proposed by the students making a positive decision include protection against the virus, fear of being infected and increasing number of deaths while the students making a negative decision gave justifications including not trusting the WHO (World Health Organization) and the vaccines produced by other countries, wanting to develop immunity through natural ways and believing that free vaccine is dangerous. Some of the students stating that they would decide depending on whether the criteria would be met emphasized some criteria such as the vaccine's being tried and approved, development of the vaccine in their own country and its content's being harmless.

Keywords: COVID-19 vaccination; decision making; science education; socio-scientific issues

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1. Introduction

People who face challenges and issues in their daily lives that require the use of more scientific knowledge and thinking processes will have to make more effort to make informed decisions and take an active citizenship role (Khishfe, 2012). The COVID-19

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pandemic process we are in is one of the best examples to explain this situation. The pandemic is actually a period in which we learn the answers to the questions regarding the nature of science through experience such as *"How scientific data are obtained by scientists, how scientific claims are produced? How are scientific data and studies shared with other scientists and society?"*.

With the COVID-19 outbreak declared as a pandemic by the WHO, people all over the world have had to cope with many changes in their lives (Levrini, et al. 2020) and make decisions on a number of scientific issues. Uşak, Masalimova, Cherdymova and Shaidullina (2020, p.180) emphasized the shock created by the crisis environment we are in these days as follows: *"Nowadays, we all are sitting in our homes and watching what is going on in the world, as if we are watching a science fiction movie, in which we have the leading role"*.

Although the COVID-19 pandemic period, which turned into a global crisis (Muftahu, 2020), affected the health organizations and workers of countries most, education systems and educators were also severely affected by this situation. Leading researchers in the field of science education evaluated the COVID-19 pandemic period in terms of science education and emphasized the lessons that should be learned in both the pandemic period and the post-pandemic period, and made some suggestions (Reis, 2020; Erduran, 2020). Erduran (2020) emphasized that the pandemic period will have a critical reflection on STEM (Science & Technology & Engineering & Mathematic) education, which has been on the agenda in many countries' education systems in recent years, and that future generations should be equipped with knowledge and skills to deal with global concerns such as pandemics, climate change, and nuclear crisis. Dauer, Lute, and Straka (2017) pointed out that all students, as future voters, employees, policy makers and consumers, should be ready to evaluate complex socio-scientific problems within both STEM and non-STEM fields, and to make science-based decisions as socially responsible citizens.

The COVID-19 pandemic period in science education includes the characteristics of a science content that can be described as a socio-scientific issue due to the fact that it causes controversy, dilemmas in humans, requires risk management, has scientific and technological foundations, and has scientific data and claims that are not yet completed and can change with each day (Evren Yapıcıoğlu, 2020). In science education, theoretically, the COVID-19 pandemic period and the situations it includes are within the scope of socio-scientific issues (Reis, 2020). Individuals are expected to make conscious and sensitive decisions on socio-scientific issues they encounter (Khishfe, 2012), and to play an active role in solving social problems as a justice-oriented citizen (Pietrocola, et al., 2020).

Every action and behavior people are engaged in requires making a decision in advance. Therefore, the decision-making skill is one of the essential competences for

humans (Ersoy, Oğurlu and Aydın, 2019). Citizens' making informed decisions in the face of many socio-scientific dilemmas encountered during the COVID-19 pandemic is an extremely important issue in terms of what the effects of these decisions will be in the future. Therefore, given that students will be competent decision makers in different tasks and missions in the future (Zoller, 1982), decision-making skills on socio-scientific issues that are or are likely to be encountered (e.g., the COVID pandemic) should be developed through science education.

1.1. Socio-scientific Issues and Decision-Making Skills

The concept of decision-making is related to a series of concepts such as problems, solutions, values and actions (Kortland, 1996). In this respect, decision-making in the most general terms is to make a judgment by making justified choices among alternative actions, taking into account the values of the person (Cassidy and Kurfman, 1977). Svenson (1996), on the other hand, expresses decision making as the solution of a kind of conflict in generally contradictory situations and emphasizes that the solution of this conflict depends largely on the problem, the content of the problem and personal factors. The decision-making process involves a series of typical steps including identifying the problem and goals, generating options, considering the consequences of options, specifying the best option, implementing the decision and reviewing the implementation (Ersoy, Oğurlu and Aydın, 2019). In studies that try to explain decision-making skills and processes, two types of theories, Normative and Descriptive, are generally mentioned. The former of them deals with how a decision should be made rather than how a decision is made, while the latter is more about descriptive and predictive features of decision making, such as what people do when making decisions and how they make decisions (McCrimmon, 1968; Ersoy, Oğurlu and Aydın, 2019).

There are studies that examine the relationship of students' decision-making skills on socio-scientific issues with other variables, the development of decision-making skills, how they make decisions and their tendencies (Chang and Lee, 2010; Evagorou, Jimenez-Alexandre and Jonathan Osborne, 2012; Liu, Lin and Tsai, 2010; Öztürk, Eş and Turgut 2017; Sadler and Zeidler, 2005; Siribunnam, Nuangchalerm and Jansawang, 2014). The following processes are generally followed when making decisions on socio-scientific issues (Lee and Grace, 2012):

- Negotiating disagreements based on conflicting claims,
- Assessing the reliability of claims and perceived risks based on evidence,
- Evaluating the pros/cons of options for the decision by taking ethical, environmental and social considerations into account.

Sadler and Zeidler (2005) emphasize that decision-making on socio-scientific issues involves more complex informal reasoning models that include personal experiences,

moral values, emotional factors, and social evaluations. The authors pointed out that participants used rational, emotional, and intuitive types of informal reasoning in dilemmas such as gene therapy and cloning. Liu, Lin, and Tsai (2010) determined that epistemological views, which include uncertainty and care about the creative side of science, are important components that emerge in the socio-scientific decision making process. The authors stated that students who believe that scientific knowledge is changing and uncertain, can develop more approaches towards being aware of the complexity and multiple perspectives of socio-scientific issues and questioning the omniscient authority in the decision-making process. In addition, they examined the fact that the majority of students make a decision on a socio-scientific issue usually using a single reasoning mode from an educational perspective. Öztürk, Eş, and Turgut (2017) examined socio-scientific issues such as “*GMO Foods*”, “*Farm Chicken Consumption*” and “*Bread Consumption*” and determined that students adopted different approaches according to the issue being addressed. Chang and Lee (2010) stated that when students talk about socio-scientific issues, they often emphasize their values, feelings, emotions and world views explicitly or implicitly. The authors stated that the individuals' family environment, past experiences and prior knowledge, personal characteristics and interests, and religious views affect their decision-making tendencies towards socio-scientific issues. Jimenez-Aleixandre and Pereiro-Munhoz (2002) stated that students' decisions on socio-scientific issues are not only based on conceptual understanding and scientific evidence, but also on their value judgments. In particular, students talk more about their ecological values rather than their economic values in value hierarchies and take positions accordingly. Evagorou, Jimenez-Aleixandre, and Jonathan Osborne (2012) argued that students with different cultural backgrounds, different achievement levels and educated by different teachers adopt different approaches when deciding on a socio-scientific issue. In summary, it can be said that individuals adopt different approaches to different socio-scientific issues, that they use informal reasoning methods and justifications, that individuals' views on the nature of science are effective in their decisions on socio-scientific issues, and that the individual's cultural environment, family, achievement level, experiences, beliefs and prior knowledge are among the factors that affect his/her decisions.

In the current pandemic period, the research in the literature regarding the COVID-19 outbreak is mostly published in the field of health sciences, includes healthcare professionals or adults in study groups and focuses on issues related to moral and ethical dilemmas (Topçu and Nasuhbeyoğlu, 2020), vaccine acceptance, indecision, rejection (Erkekoğlu, Erdemli Köse, Balcı and Yirün, 2020; Reiter, Pennel and Katz, 2020; Üzüm, Eliaçık, Hortu Örsdemir and Karadağ Öncel, 2020; Wang et al., 2020; Yavuz, 2018). In this regard, the study by Reiter et al. (2020) is of critical importance. The authors classified adults aged 18 and over (n:2006) as willing [48% definitely willing + 21% likely (maybe) willing] to get a COVID-19 vaccine. Thirty one percent of the participants were

classified as unwilling (17% not sure + 5% probably not willing + 9% absolutely unwilling). The main factors affecting vaccine acceptance were found to include the cost of the vaccine to the individual, how well the vaccine works, the recommendation of a doctor, the health history of the individual, the changes in the number of infected people, the duration of protection by the vaccine, the possible side effects of the vaccine and the individual's having a planned trip abroad. Fewer participants stated that the opinions of family members and friends and their race / ethnicity would be important in their vaccination decision. Nas et al. (2020) investigated the factors affecting the decision of the parents refusing at least one of the vaccines that should be taken by their children within the scope of the Expanded Immunity Program of the Turkish Ministry of Health. The authors determined that the majority of the individuals who refused the vaccine are individuals with a high socioeconomic and educational level and that the most important factors in refusing vaccination are the lack of trust in the ingredients of the vaccine and insufficient information.

The counterpart of the concepts such as vaccine acceptance, vaccine rejection and being indecisive about getting a vaccine in the field of health sciences is making-decision in the field of science education. In fact, accepting or rejection an action includes a decision in any way. In addition, many situations encountered during the COVID-19 pandemic are socio-scientific in nature in terms of including moral and ethical dilemmas and drawing attention to the social dimensions of science. In socio-scientific issues, students often encounter conflicting and uncertain situations (Emery, Harlow, Whitmer and Gaines, 2017) due to the diversity of data, evidence and opinions. In this connection, the purpose of the current study is to investigate gifted students' decisions on a socio-scientific dilemma "Should we get a COVID-19 vaccine or not?" which they have frequently encountered in their daily lives and discussions in the media during the COVID-19 pandemic and their justifications for their decisions. The current study is a descriptive study of the existing situation rather than a normative theory according to the classification made by Mc Crimmon (1968). The study group of the current research is comprised of gifted students who will work in different professions and statuses in the future and will fulfil their citizenship duties as active decision makers when necessary.

2. Method

The purpose of the current study is to investigate gifted students' decisions on a socio-scientific dilemma (Should we get a COVID-19 vaccine or not?) experienced during the COVID-19 pandemic and their justifications for their decisions. The study is designed according to the holistic single case study design, one of the qualitative research methods, as proposed by the classification of Yin (2017). In the holistic single case study design, a single case and analysis unit are used. Moreover, according to Yin (2017), case study is a research method that is used to answer "Why" and "How" questions in cases

which are up-to-date and where the researcher does not have any control on variables. Single case studies, on the other hand, allow the examination of complex social structures of events and cases with high discriminative power, rare and non-repetitive (Merriam, 2009; Yin, 2017). In this respect, the socio-scientific dilemma discussed within the context of the current study is also the analysis unit of the study. The following research questions guide this study.

- What are gifted students' decisions on the socio-scientific dilemma of "Should we get a COVID-19 vaccine or not?"
- What are gifted students' justifications for their decisions on the socio-scientific dilemma of "Should we get a COVID-19 vaccine or not?"
- What are the factors affecting gifted students' decisions on the socio-scientific dilemma of "Should we get a COVID 10 vaccine or not?"

2.1. Data collection tools

Case study does not require the use of a specific data collection tool or a specific analysis method. For this reason, any data collection tool and any data analysis method thought to be effective in answering the research question(s) can be used (Merriam, 2009). In the current study, in order to determine gifted students' opinions on the socio-scientific dilemma "Should we get a COVID-19 vaccine or not?" and their justifications for their decisions, a document including a written text followed by open-ended questions was used to collect data. Although it was first intended to be used as a semi-structured interview form, it was then converted into a document (adapted) as the current study was conducted during a pandemic when there were many restrictions such as social distancing and then administered to gifted students.

The data collection tool developed to investigate gifted students' decisions and justifications. It consists of three parts. In the first part, there is a text (65 words) giving information about vaccines and vaccination; in the second part, there is a text explaining the socio-scientific dilemma addressed in the current study and in the third part, there are open-ended questions. The text in the second part of the data collection tool explains both positive aspects of getting a vaccine (64 words) and claims of those who are against vaccination (63 words) on the basis of the information given in the vaccine portal in the web site of the Turkish Ministry of Health and the study by Kutlu and Altundiş (2018). In order not to affect the students' decisions, an equal number of words and judgment expressions were used in the texts. In order to examine the format and impartiality of the data collection tool, it was sent to a field expert who has conducted research in the field of socio-scientific issues, and in light of the received feedback, corrections were made and the tool was finalized. Another data collection tool used in the study is the drawings produced by the gifted students regarding their decisions on the socio-scientific dilemma three months after the completion of the first application. Of the 32 students answering

the open-ended questions in the first data collection tool on a volunteer basis, 11 students determined by means of the convenience sampling method produced drawings regarding their decisions on the socio-scientific dilemma and then their drawings were analysed. The students' drawings were used to support, deepen and enrich the qualitative data obtained through the primary data collection tool of the study. Moreover, when the primary data collection tool (the document) of the study was administered, there was no vaccine officially approved by the WHO. However, in the analysis and reporting phase of the research data, vaccines developed by the USA, China and Germany were approved by WHO and included in the vaccination schedules of different countries. Turkey preferred to obtain the vaccine developed by China first. Such changes having occurred during the analysis and reporting of the data are the reasons why a second data collection tool was administered in the study.

2.2. Data analysis

The qualitative raw data obtained through the text explaining the socio-scientific dilemma and open-ended questions in the first data collection tool (the document) were analyzed using the inductive content analysis method. In inductive content analysis, categories and themes are created from the existing data (Elo and Kyngas, 2008). The students' drawings, which are the secondary data source of the study, were subjected to both content analysis and descriptive analysis. The stages followed in the analysis phase of the study are summarized below.

- The responses given by the participants to the open-ended questions were read and transferred to computer for transcription. The expressions related to the research problem were coded by reading the transcript over and over again.
- Themes were reached by categorising similar codes and a coding scheme was created.
- Visual figures in the students' drawings were examined one by one.
- The visual figures were categorized depending on whether they reflected a positive or a negative decision.
- The categorized visual figures were placed in themes.
- Both the coding scheme for the primary data source and the 20% of the transcript including the raw data, and the students' drawings obtained from the secondary data source were sent to an expert specialized on qualitative research analysis.
- The codes were examined in terms of consistency and the inter-coder consistency for the data collected with the first data collection tool was found to be 92% by using the formula proposed by Miles and Huberman (1998). The inter-coder consistency for the data obtained from the students' drawings was found to be 94%.
- In the presentation of the data, tabulation was used and frequency and percentage calculations were made for the repeated codes. From among the gifted students'

drawings, the ones showing interesting and striking features are also presented as supportive evidence and interpreted.

2.3. Participants and Setting

Gifted individuals who constitute the study group of the current research, according to MONE (2013), refer to individuals who perform at a higher level than their peers in intelligence, creativity, art, leadership capacity, motivation and special academic fields. Gifted students are seen as critical human resources for the future of countries, especially in developed countries (Summak and Çelik Şahin, 2014). The talent areas in which these students are considered to be ahead of their peers are categorized as the area of intellectual ability, the area of visual arts talent and the area of musical talent [Science and Art Center (SAC) Directive, 2016]. The institution responsible for the education and training of gifted students in Turkey is SAC. In the SAC directive, the education and training activities to be carried out for gifted students are planned to be conducted on weekdays and at weekends outside the formal class hours. The study group of the current study is comprised of gifted students receiving education and training at SACs located in the city of Mersin and in its surrounding districts in Turkey. The study group on the other hand is comprised of the gifted students participating in the project “*Trip to Nature with the Scientists of Future*” supported by TUBITAK (The Scientific and Technological Research Council of Turkey) within the framework of Science and Society projects. This project was carried out face-to-face between 07.09.2020 and 12.09.2020 by taking the necessary measures due to the pandemic. The main goal of the project was giving a nature education to gifted students. The current study was later included in the schedule of the project to investigate the students’ decisions on COVID-19 vaccine and their justifications for their decisions and just occupied 45 minutes of the project because when the project application was made to TUBITAK, there was no pandemic. The information about the gender and grade level of the participating students is given in Table 1.

Table 1. Demographic features of the participants

Grade Level	f	%
6th Grade	16	44,4
7th Grade	12	33,3
8th Grade	2	5,5
9th Grade	6	16,6
Gender		
Female	25	69,4
Male	11	30,5
Total	36	100

As can be seen in Table 1, 69.4% of the participating students are females and 30.5% are males. Of the participating students, 44.4% are 6th graders, 33.3% are 7th graders, 5.5% are 8th graders and 16.6% are 9th graders. The participation was on a volunteer basis and as four of the participants stated that they did not want to participate, they were excluded from the study. Thus, the sample of the current study is comprised of 32 gifted students.

The setting where the study was conducted was the Conference Hall of the Taşucu Teachers' House located in the district of Silifke in the city of Mersin in Turkey. In the administration of the first data collection tool (the document), students were seated on desks located with at least 1.5 m distance between each other considering the rules of social distancing. In addition, mask and face shield rules were observed. The daily health conditions of the students were checked under the supervision of the responsible health personnel in the project.

3. Results

In the current study a total of four themes were reached on the basis of the gifted students' decisions on whether getting a COVID-19 vaccine or not. These themes are those making positive decision on getting a vaccine [Theme 1 (T1)], those making negative decisions on getting a vaccine (T2), those stating that they will decide depending on some certain criteria (T3) and those postponing their decisions (T4). The number of repeated codes (C) and justifications are given in Table 2.

Table 2. The students' decisions of getting or not getting a COVID-19 vaccine and their justifications for their decisions

Decisions	Justifications	f	%
T1: Positive	C1: Protection from the virus	20	62.5
	C2: Not getting infected		
	C3: Developing immunity		
	C4: Preventing deathly effects		
	C5: Increasing number of deaths		

	C6: Fear of the disease		
T2: Negative	C7: Not trusting the WHO		
	C8: Not trusting vaccines produced by other countries	5	16
	C9: Developing immunity through natural ways		
	C10: Believing that free vaccine is dangerous		
T3: Making a decision depending on a criterion	C11: The vaccine's being tried/approved/proved		
	C12: Vaccine's being developed by my own country		
	C13: The ingredients of the vaccine being harmless	5	16
	C14: Wanting to observe and examine the side effects of the vaccine on people who are getting it		
T4: Postponing decision	C15: Not having information	2	6.2
	C16: Needing time		
TOTAL: 4 Themes	16 Codes	32	100

As can be seen in Table 2, 62.5% of the gifted students participating in the study made a positive decision on getting a COVID-19 vaccine. On the other hand, a considerable portion of the students (16%) made a negative decision on getting a COVID-19 vaccine or stated that they would make their decision depending on some certain criteria (16%). Of the participating students, 6.2% stated that they would postpone their decision. The justifications used by the students while making their decisions are given below within quotations taken from the students' own statements.

3.1. The justifications of the students making a positive decision

The gifted students who stated that they would make a positive decision proposed the following justifications for their decisions: protection from the virus, not getting infected, wanting to develop immunity, preventing deathly effects of the virus, increasing number of deaths and fear of the disease. Some excerpts reflecting the justifications of the students making a positive decision are given below.

S1 (Student 1): I would get the vaccine because I want to be protected from this dangerous virus. We need to be vaccinated or we cannot be protected from the virus. (T1, C1)

S19: Since COVID-19 has a fatal effect I would be vaccinated and protected from COVID-19. (T1, C1, C4)

S22: Getting vaccinated does not hurt people. On the contrary, we need to be vaccinated in order to develop immunity against viruses and to become stronger. I have been vaccinated before and I am more resistant and immune against many diseases. (T1, C3)

S17: The number of deaths in our country is increasing. Therefore, I must take a precaution (T1, C5).

S2: I'm afraid because I know I will have difficulties when I'm sick. I don't want to get infected with corona virus and to be sick (T1, C2, C6).

3.2. The justifications of the students making a negative decision

The gifted students who stated that they would make a negative decision proposed the following justifications for their decisions: not trusting the WHO, wanting to develop immunity through natural ways, believing that free vaccine is dangerous. Some excerpts reflecting the justifications of the students making a negative decision are given below.

S11: I do not trust WHO (World Health Organization) and other countries. WHO suggested at the beginning of the COVID-19 pandemic not to wear a mask. So, I cannot trust a vaccine approved by it (T2, C7, C8).

S4: Sooner or later we'll get this disease. I think we will strengthen immunity after getting infected and recovered. Look, it takes a long time to increase the body resistance of a person through natural ways, but it would be effective. (T2, C9).

S13: Because if I were infected, my body would develop resistance and immunity. If my condition is not too bad, I will not get it (T2, C9).

S 8: Because they give this vaccine free of charge, it may be dangerous. They can put dangerous substances in it for our body. Or the vaccine could fight us instead of protecting our bodies (T2, C10).

3.3. The justifications of the students deciding depending on some certain criteria

A significant portion of the gifted students stated that they would decide depending on some certain criteria. The criteria proposed for the students to make their decision include the following: The vaccine's being tried/approved/proved, the vaccine's being developed by my own country, the ingredients of the vaccine being harmless and wanting to observe and examine the side effects of the vaccine on people who are getting it. Some excerpts taken from the statements of the students stating that they would decide depending on some criteria are given below.

S3: If the vaccine found is a tried and approved vaccine, then I can get it (T3, C11).

S12: ...I do not trust other countries ... Russia can send us harmful substances while giving good vaccines to its own citizens. Those who produced the avian flu vaccine themselves did not get it. If it is not produced in Turkey, I won't get it. If it is produced in our country, then I can get it (T3, C12).

S28: As long as it is not a must, I won't get the vaccine. If I observe that there is no side effect on people vaccinated, then I can get it (T3, C14).

S5: I learn about the substances in it. Are they harmful or not? Then I decide (T3, C13).

S30: I will wait for a while to see whether something bad has happened to people vaccinated. If there is nothing bad, then I can get vaccinated (T3, C14)

3.4. The justifications of the students postponing their decision

Of the participating gifted students, 6.22% stated that they would postpone their decision and the justifications proposed by these students include the following: not

having information about the vaccine and needing time. Some excerpts from the statements of the students stating that they would postpone their decision are given below:

S32: Frankly I have no idea about whether it is useful or useless. I would research for a while, then decide (T4, C15).

S6: I think I need time to decide on this. I cannot decide right away (T4, C16).

3.5. Factors affecting the students' decisions

The factors affecting the gifted students' decisions on getting the COVID-19 vaccine were found to include: the individual himself/herself, their families (father, mother, siblings) and friends, news and discussions in media, the minister of health as the authority figure, the president, the World Health Organization, doctors and family physicians, professors, scientists and experts in academic circles. The related data are presented in Table 3.

Table 3. Environments affecting the students' decisions

Theme	Codes	f	%
T1: Social environment	C1: Family (mother, father, siblings)	12	36.3
	C2: Friends		
T2: The individual himself/herself	C3: Myself	7	21.2
T2: Authority	C4: Minister of health	4	12.1
	C5: President		
	C6: World Health Organization		
T3: Health personnel	C7: Family physicians	3	9.0
	C8: Doctors		
	C9: Health workers		
T4: Academic environment	C10: Professors	4	12.1
	C11: Experts		
	C12: Scientists		
T5: Media	C13: News	3	9.0
TOTAL: 5 Themes	13 Codes	33	100

When Table 3 is examined, it is seen that the most effective factors on the students' decisions are the students themselves (21.2%) and families and friends from their social environment (36.6%). The other factors include the authority figure (12.1%), people from academic environment (12.1%), opinions of health personnel (9.0%) and news in media (9.0%). Some excerpts taken from the statements of the students about the factors affecting their decisions are given below.

S15: ... My family's decision and my own opinion can be influential. Also, both my family and me are not against vaccination (T1, C1; T2, C3)

S30: My desire to save both myself and all healthcare professionals from a virus that harms people like this is effective. Healthcare professionals who help under all circumstances... (T2, C3)

S28: ... Information given by the health minister and president (T2, C4, C5)

S32: ... Although it is not thought to be reliable, the World Health Organization is an effective factor ... (T2, C6)

S19: ... The opinions of the professors and the experts and doctors working on the subject affect my decision (T3, C8; T4, C10, C11).

3.6. The drawings produced by the students regarding their opinions on getting or not getting a vaccine

When the drawings produced by the students (n:11) regarding their decisions on getting or not getting a COVID-19 vaccine are examined, it is seen that the great majority of them (81.8%) produced colourful drawings by using visual figures about their positive decisions on getting a vaccine. On the other hand, 18.1% of the students produced drawings largely in black and white and grey reflecting their negative decisions on getting a vaccine. The codes describing the decision in the drawings and the related themes are given in Table 4.

Table 4. Findings from the students' drawings on the COVID-19 pandemic

Theme	Codes	f	%
Positive	C1: Virus (pictures of a virus escaping from the vaccine, sad, perplexed, angry)		%81,8
	C2: People (Laughing or smiling people, happy people vaccinated and unhappy people not vaccinated)	9	
	C3: World (happy world vaccinated and unhappy world not vaccinated)		
Negative	C4: People (screaming people, a surprised nurse)	2	%18,1
	C5: Pessimism (obscurity, question marks)		

In the drawings of the students making a positive decision, the figures of a virus escaping from the vaccine, the faces of a sad virus, an angry virus, happy people and

happy world come to the fore. Some striking examples from these drawings are given in Figure 1.

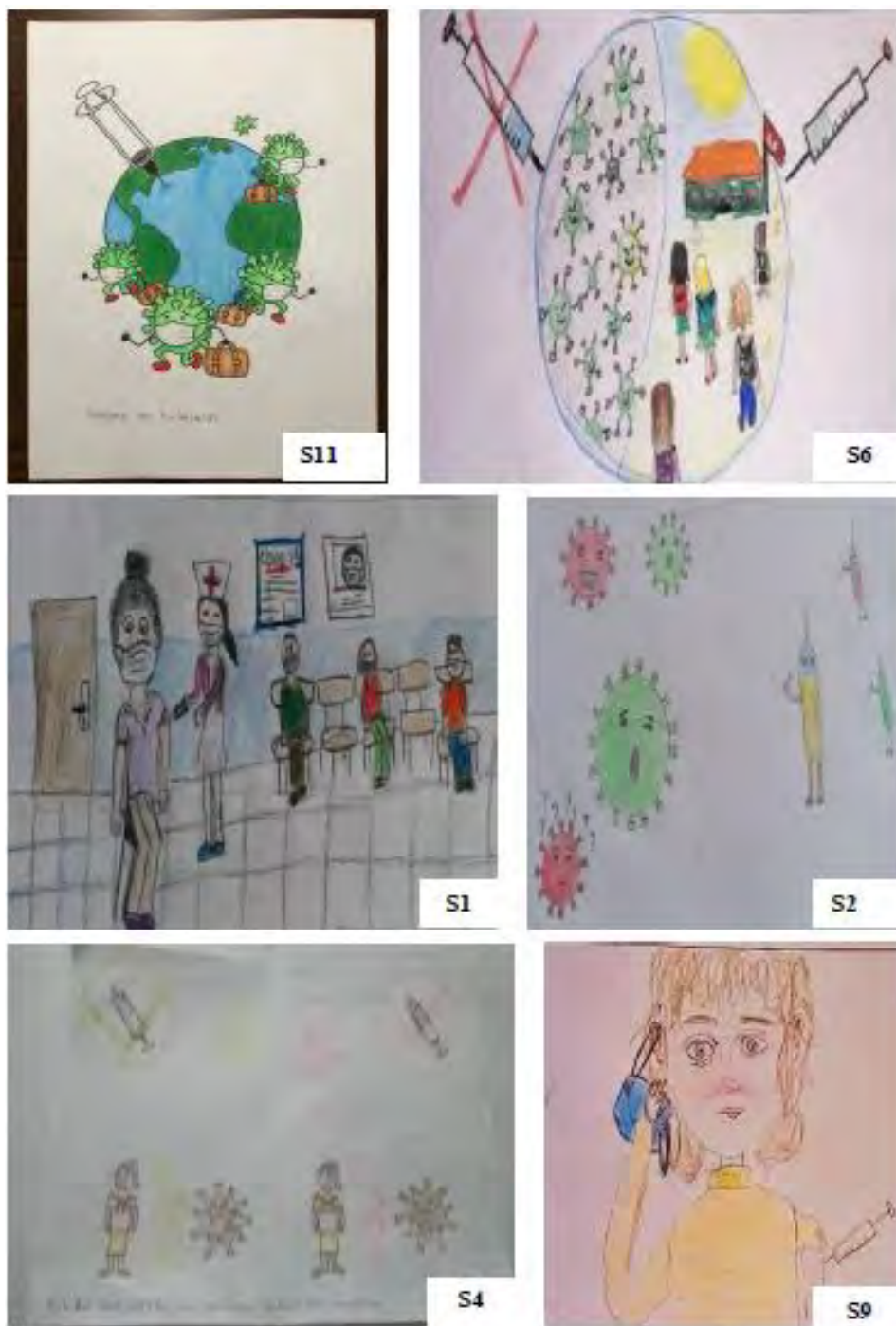


Figure 1. The drawings produced by S11 (Student 11), S6, S1, S2, S4 and S9 making a positive decision

When the drawing produced by S11 in Figure 1 is examined, it is seen that figures indicating that the virus will be destroyed in the vaccinated world. The drawing shows the vaccinated blue-green planet and the COVID-19 viruses wearing a mask and carrying their suitcases with a sad face. The student producing this drawing shared the slogan "Vaccine will save the world" under the drawing. In the drawing made by the student S6, the world is divided into two, occupied by those vaccinated and those not vaccinated. The student depicted students going to their schools in the vaccinated part while a large number of COVID viruses with happy faces are depicted in the part not vaccinated. Under the drawing, the student explained both his/her decision and drawing by using the phrase "Let's get the COVID-19 vaccine so that the disease ends as soon as possible; let's return to our schools that we miss." The student S1 depicted a moment in a hospital room when the vaccine shot is given, using figures of nurses, people who are vaccinated, and people waiting for getting vaccinated. The nurse is depicted smiling while the person getting vaccinated is depicted with a surprised face. People waiting to be vaccinated are positioned according to the social distance rule and are observing the vaccinated person. The student wrote the following statement under the drawing to describe his/her decision; "In my opinion, if we get vaccinated, we can get rid of COVID-19. I think people should be vaccinated.". The student S2 depicted injections in three different colours and vaccines and also the COVID-19 viruses seeing these vaccines are depicted angry, surprised and unhappy in this drawing. The student S4 used happy human figures vaccinated and unhappy human figures not vaccinated and indicated his/her decision by putting a green thick on an injection. In the drawing of the student S9, there is a smiling female figure while being vaccinated and he/she explained his/her decision with the slogan written under the drawing "If we want to get rid of Corona and the mask, we should get vaccinated".

In the drawings of the two students (18.1%) making a negative decision regarding the COVID-19 vaccine, the figures of screaming people and perplexed people come to the fore and there are question marks and speech bubbles indicating pessimism and uncertainty. The relevant drawings are given below.

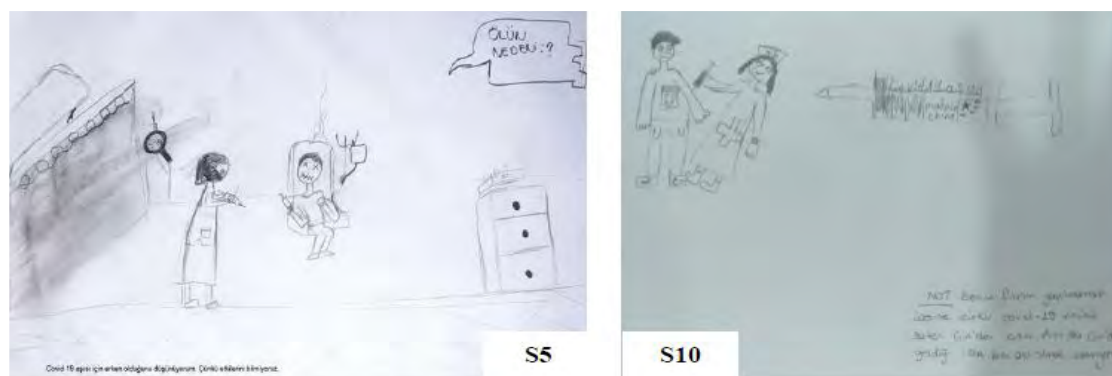


Figure 2. The drawings of the students S5 and S10 making a negative decision

In the drawings of the students Ö and Ö10, figures are depicted in black and white. The student Ö5 depicted a nurse with a black mask, the person being vaccinated with a sewed mouth and unhappy. In the same drawing, there is a speech bubble indicating that the reason for his death is unknown. The student made the following explanation under the drawing “I think it is too early for the COVID-19 vaccine because we do not know its side effects.” to indicate his/her negative decision. In the drawing of the student Ö10, there is a screaming face next to an injection on which there is the phrase “Chinese vaccine”. Under the drawing, the student expressed his/her negative decision by writing “I am against the vaccine because the COVID-19 virus first emerged in China and as the vaccine comes from China, I do not want to get vaccinated.”.

4. Discussion and Conclusion

In the current study, it was found that more than half of the gifted students (62.5%) expressed their positive decision on getting a COVID-19 vaccine addressed as a socio-scientific dilemma in the current study and the justifications proposed by them for their decisions include the following: protecting from the virus, not being infected, developing immunity, deadly effects of the virus, increasing number of deaths and fear of the disease. In the great majority of the student drawings (81.8%) supporting the data collected through the primary data collection tool of the study, the students reflected their positive decisions through the figures of a virus surprised, angry and escaping from the vaccine, smiling human faces, happy people vaccinated and unhappy people not vaccinated, and a happy world vaccinated and an unhappy world not vaccinated. Similar to the current study, there are some studies investigating the influenza vaccine as a socio-scientific issue in the science education literature (Öztürk, Eş and Turgut, 2017; Öztürk, Altan and Yenilmez Türkoğlu, 2021). Similar to the findings of the current study, the majority of the gifted students in these studies were found to express a positive decision on getting an influenza vaccine (Öztürk, Eş and Turgut, 2017). Wang et al. (2020) investigated the attitudes of individuals towards accepting the COVID-19 vaccine and found that 1879 (91.3%) of the participants would get a COVID-19 vaccine after it was ready, that 980 (52.2%) wanted to be vaccinated immediately and that 47.8% of them would postpone vaccination until the safety of the vaccine was proved. In their study using the drawings of pre-service teachers as the data source, Yenilmez Türkoğlu and Öztürk (2019) concluded that the pre-service teachers generally demonstrated negative attitudes towards socio-scientific issues such as nuclear energy, GMO (genetically modified organisms) and glucose loading yet that they demonstrated positive attitudes towards organ donation and almost equal levels of positive and negative attitudes towards hydroelectric plants. There are many studies in the literature addressing issues such as vaccine rejection, attitudes of health professionals, parents towards vaccination but not within a socio-scientific context (Akçay Ciblak, Nohutcu, Gürbüz, Badur and Güldal, 2012; Yavuz, 2018; Memiş Doğan and Düznel, 2020). For instance, Sarı, Temoçin

and Köse (2017) determined that a very small portion of the health professionals in the sample (4.3%) got the influenza vaccine. However, while they investigated the participants' reasons for not getting the vaccine, they did not investigate their reasons for getting the vaccine. According to the results of an online survey conducted on 1500 participants, Doğan and Düzel (2020) concluded that the individuals largely have positive attitudes towards getting vaccinated against pandemics. As the socio-scientific dilemma "*Should we get a COVID-19 vaccine or not?*" is currently experienced in the daily lives of people and it has lasted much longer than many other diseases (e.g. bird flu, swine flu and ebola), the students participating in the current study might have felt more inclined to express positive decisions on getting a COVID-19 vaccine. In fact, the use of socio-scientific issues with dominant health content in science education literature is quite limited (Lee, 2012). Health is our priority in our future plans or in any matter related to ourselves. For this reason, psychological reasons such as fear of illness rather than rationality may have played a more important role in such socio-scientific decisions. Similarly, Memiş Doğan and Düzel (2020) stated that in epidemics such as COVID-19 with high contagiousness and life-threatening risk, individuals are very concerned and afraid that they and their relatives will catch the virus.

In the current study, while 16% of the participating students expressed a negative decision on getting a COVID-19 vaccine, 16% stated that they would decide depending on some certain criteria. The justifications proposed by the students for their decisions of not getting a COVID-19 vaccine were found to include the following: not trusting WHO and the vaccines produced by other countries, wanting to develop immunity through natural ways and believing that a free vaccine is dangerous. In the student drawings supporting these findings obtained from the primary data collection tool of the study (18.1%), the negative decisions of the students are reflected with the figures of screaming and perplexed people and question marks indicating obscurity.

WHO is the organization that works for everyone to reach the highest level of health as possible and is responsible for tasks such as guidance and cooperation in international health studies (Samancı, 2016). Topçu and Nasuhbeyoğlu (2020) emphasized that, as in the 2009 influenza pandemic, during the COVID-19 pandemic, the discussion of different views among scientists voiced in visual and social media weakened the trust in science, scientists and institutions. At the beginning of the pandemic, WHO's ambiguous statements that COVID-19 virus was not yet identified, and that cases of pneumonia of unknown etiology (unknown cause) were detected in Wuhan City may have had an impact on the society. Indeed, situations of uncertainty that seem normal in the nature of the socio-scientific process can be used by people for non-scientific purposes in different ways (Erduran, 2020). For this reason, in this panic atmosphere, the political claims of the heads of state in different countries and the news of scientists who were popular figures in media have frequently occupied the agenda and have been criticized by others. For such reasons, students' confidence in WHO may have been damaged, and this may

have caused them to put forward justifications that they could only trust vaccines produced by their own countries. This is also reflected in the drawings of the students as gifted students show an advanced level of sensitivity and questioning attitude towards social events compared to their peers. For example, in the drawing of the student S10, there is a screaming face next to an injection on which there is the phrase “*Chinese vaccine*”. Under the drawing, the student expressed his negative decision by writing “*I am against the vaccine because the COVID-19 virus first emerged in China and as the vaccine comes from Chine, I do not want to get vaccinated.*”. One of the justifications for the negative decision of students is their wanting to develop immunity through natural ways. According to CDC (2017), immunization is developed in two ways, active and passive. Developing immunity through both natural ways and vaccination occurs when the individual is exposed to the disease agent. In immunity acquired naturally, the individual comes into contact with the disease pathogen and develops immunity as a result of past infections experienced symptomatically or asymptotically. In immunization with vaccination, the individual is exposed to the killed or weakened form of the pathogen, which is the cause of the disease, and thus immunity is acquired. Both types of immunity can last long even for a whole life. In the current study, students’ preferring natural immunity and refusing to be vaccinated is actually a matter of preference. However, it should not be forgotten that many diseases in the past (smallpox, cholera, etc.) have been eliminated through vaccination. In terms of its importance, it should be noted that even the presence of an infected person can lead to the onset of an epidemic that will lead to a pandemic or epidemic. In addition, the presence of a chronic condition that the person is not yet aware of can put his/her in danger. Another justification used by some students to support their negative decision is that a free vaccine could be dangerous. These students placed their price and value perception on the basis of their decision on the COVID-19 vaccine as a socio-scientific issue. These students consider the COVID-19 vaccine as a consumer product, which draws attention to the existence of a positive correlation between their perception of service value or quality and its price. For this reason, it can be said that there is a group that think that a free healthcare service cannot be of high quality and that vaccination studies carried out by different countries are focused on earnings rather than human health. However, one of the important factors in the high vaccination rates in a society and accordingly in developing social immunity is that the vaccines developed against epidemic diseases are free of charge. Only in this way, inequalities of opportunity that may arise in the society depending on the socioeconomic level can be prevented. This striking finding of the current study is frequently reflected in studies where consumers are used as samples. For example, there are positive correlations found between price and the perception of quality or value for a product in the studies of Doods and Monroe (1985) and İsmail and Khatibi (2004). Reiter et al. (2020) also determined that the cost of the vaccine developed

affects the individuals' decisions to be vaccinated. However, they found that if the vaccine has a high cost, it affects people's decisions to be vaccinated negatively.

When the justifications proposed by a few students stating that they would postpone their decisions on getting a COVID-19 vaccine are examined, it is seen that they tend to postpone as they do not have information or need more time. The tendency to postpone, in the most general sense, is to delay the decisions and responsibilities of the person and leave them to a later time (Kachgal, Hansen and Nutter, 2001; Sriois, 2007). Personal fears and inadequacies, poor decision-making skills, and reluctance to take responsibility are among the important reasons for postponing (Milgram and Toubiana, 1999). Thus, the lack of information stated by students about the COVID-19 vaccine might have led to their exhibiting the act of postponing. At the same time, some of the vaccines developed are a new technology and information pollution due to a lot of information published in this process may have caused them to postpone their decision.

When the circles that are influential on the students' decisions were examined, the social environment, the individual himself/herself, the current authority, healthcare professionals, academic circle and media were determined to be influential. The codes obtained in the current study are similar to ones obtained in the study of Öztürk, Eş, Turgut, (2017). However, they concluded that while the media and the authority circles were the most effective source of information used in the decisions of gifted students, in the present study, the social circle and the individual himself/herself were found to be more effective factors in making decisions. This might be because each socio-scientific content brings different sources of information to the fore. Kolstø (2001), on the other hand, stated that students mostly use different strategies while evaluating their sources of information on socio-scientific issues, criticize the researchers, disagreements between scientists disappoint them, but they generally trust the authority. Similar to the current study, Reiter et al. (2020) stated that a doctor's recommendation of the vaccine is important for individuals to accept the vaccine, while unlike the current study, they stated that the opinions of the individual's family members and friends are less important. In the current study, the individual himself/herself and his/her social circle (family, friends, etc.) were found to be more important factors than healthcare professionals (family physicians, doctors, etc.) and academic circles (academics, scientists, etc.). Although qualitative findings similar to the literature were obtained regarding the factors affecting the decision of being vaccinated, the reason why the gifted students primarily consider different factors in their decision-making can be attributed to the fact that the sample groups in other studies are generally 18 years of age and older. In the pandemic process experienced in Turkey and other countries since March 2020, students' needs and emotional states include more complex processes for the sake of adapting to an unfamiliar situation. Anxious, bored students, who have changed their lives due to the epidemic, are also witnessing a historical process. The reason for this difference in their decisions and the justifications they stated can be explained by the fact that the study

group consisted of gifted students experience several different contradictory situations together during the pandemic process, and that they are members of a highly sensitive community. In light of the findings of the current study, recommendations can be made for both researchers and practitioners.

4.1. Recommendations

In the current study, it was determined that while the majority of the gifted students made a positive decision on getting a COVID-19 vaccine (62.5%), 16% of them made a negative decision and 16% stated that their decision would be dependent on some certain criteria. A very small portion of the students postponed their decisions on the grounds that they do not have adequate information and they need more time. According to the qualitative data of the study, the students making a negative decisions stated justifications for their decisions such as not trusting WHO and vaccines produced by other countries. Based on these findings, it may be suggested that the scientific findings of the vaccine development studies should be compiled by WHO for the sake of accountability to the societies and announced on the official sites of the Ministry of Health. Another striking finding of the study is that students believe that a free vaccine will be dangerous and accordingly make a negative decision about vaccination. In the field of public health, whether the vaccine is paid or free is an important factor in increasing vaccination rates and ensuring equal opportunities. Socio-scientific problem scenarios dealing with the values related to the issue of free vaccine can be prepared and students' decisions and judgments on this issue can be examined in more detail. In addition, another remarkable finding of the study is the false causality that students established between the origin of the COVID-19 virus and the Chinese vaccine. In this respect, case studies based on the relationship between the origins of viruses in past pandemics in the history of science and the social perspective (e.g. Spanish flu, French syphilis) can be presented in socio-scientific issues-based teaching environments. Although the primary environment that are influential in students' decisions are themselves and their families, senior leaders in the society, expressed as authority (minister of health, president) are also considered to be influential. In this respect, it is important that leaders include evidence-based findings in their speech texts in order to create a perception of trust in the society. Another important factor affecting decisions on socio-scientific issues is people from academic environment. It is important for these people to use a social and simple language while talking about science so that they can affect the perception of people from different sections of the society about vaccination. The justification proposed by some of those who made a negative decision is that they want to develop immunity through natural ways. This is actually a matter of preference. However, topics such as "How our body becomes immune to infectious diseases", "What the effects of different types of immunization pathways are on public health" can be

determined as agenda topics that should be included in the science education activities of gifted students.

Based on the current study, it may be suggested to include subjects that point to interactions between Science, Technology, Society and Environment (STSE), as well as socio-scientific issues with a health content in curriculums, and to develop sample teaching practices, since they have been addressed to a very limited extent in the literature. In addition, case studies in the history of science can be integrated into textbooks for science education. In the education of gifted students, different socio-scientific issues such as climate and nuclear crisis, which can be encountered in the future, can be addressed through dystopian scenarios, and their decisions and judgments can be determined by examining both quantitatively and qualitatively.

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