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ORIGINAL ARTICLE

Investigation of Secondary School Students' Perceptions of Scientist in terms of Emotions: How is the Scientist in My Mind?

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ABSTRACT

In this study, it is aimed to determine the emotions that middle school students attribute to the images of scientists and to examine how students perceive scientists and how they explain the emotional aspects of these perceptions from a qualitative perspective. The research is based on qualitative methodology. The study group of the research was determined by convenience sampling in accordance with the purpose and model of the study. 44 girls and 48 boys aged between 11 and 13 participated in the research process. Emo-DAST was used as a data source in the data collection process. The students were asked to draw the scientist in their minds, make explanations about the scientist they drew, and show clues to express their emotions. The data obtained from the research were analyzed with a descriptive analysis technique. At the end of the study, it was determined that students mostly attributed positive emotions to scientists. In conclusion, this study reveals how students perceive scientists emotionally and contributes to the literature on the image of scientists.

KEY WORDS: Drawings, emotion, perception of scientist, secondary school students

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INTRODUCTION

The importance of science, scientific knowledge, and scientists is increasing day by day and continues to increase. Especially with the need to increase the number of scientists who use and produce scientific knowledge, it is important to guide the young scientists of the future in the field of science and to encourage them in this direction in their career choices (Karacam et al., 2021). In this direction, individuals should understand the nature, necessity, and importance of science and have scientific thinking skills (Akman et al., 2003). Such skills, which are seen as important in the development of all societies, are especially included under the concept of scientific literacy (Turgut, 2007). The first studies on science literacy were conducted by Hurd (1958), who defined this concept as a goal of science education and treated it as a term in the literature. In the 1960s, various studies aimed at defining science literacy took place in the science education literature of the USA (Roberts, 2007). Miller (1983) summarized science literacy in three basic components. These are: understanding the norms of science and the structure of science, understanding scientific terms and concepts, being aware of the impact of developments in science and technology on the individual and society. In the 1990s, the National Science Education Standards defined the concept of science literacy as individuals' awareness of scientific issues in decision-making processes and their ability to give reasons in scientific and technological terms (National Research Council [NRC], 1996). The outcomes expected to be achieved in the education system in the 2000s require that the value of scientific knowledge is recognized and that scientific thinking skills are used in all areas of daily life (Turgut et al., 2010). In this context, one of the most important components of scientific literacy in science education is the nature of science and it is extremely important to understand this concept correctly (Bell and Lederman, 2003; Lederman, 2007). The primary condition for understanding the nature of science is to have a correct image of science and the scientist as the subject of science (Kaya et al., 2008). Emphasizing the importance of the nature of science, many researchers have conducted research on determining the image of science and scientists (Akcay, 2011; Ateş et al., 2021; Buldu, 2006; Chambers 1983; Finson, 2002; Karacam et al., 2021; Türkmen, 2008; Yontar Toğrol, 2000; Camcı Erdoğan, 2018; Christidou et al., 2023; Korkmaz and Kavak, 2010; Song and Kim,1999; Turgut et al., 2017). The findings of the studies will be discussed in detail in the discussion and conclusion sections.

It was determined that individuals' perspectives and mental images of scientists have a significant impact on their attitudes toward science and their future career choices (Ateş et al., 2021; Finson, 2002; Mason et al., 1991; Turgut et al., 2017). In this direction, it is very important to determine the images of scientists in students' minds and to develop them in accordance with the nature of science (Doğan, 2015). As a matter of fact, a healthy

perception of a scientist is seen as important in students' career choices, perhaps in their orientation toward becoming a scientist or preferring fields where scientific knowledge is intensively processed (Turgut et al., 2017). On the other hand, students' images of science and scientists are linked to the development of their understanding of the nature of science and thus to their becoming science literate individuals (Lederman and Lederman, 2004). Studies have shown that people have a stereotypical perception of scientists (with glasses, laboratory coats, unkempt hair, etc.) (e.g., Christidou et al., 2012; Finson, 2002; Fung, 2002; Turgut et al., 2017; Türkmen, 2008). Beyond these judgments, it was considered important in the study to reach the emotions in students' drawings of scientists and to determine which emotions they attribute to scientists. There are limited studies on scientist emotions in the literature (Christidou et al., 2023), and it is thought that the findings of the current study will be a guide for future studies on emotions in scientist images.

Scientists and Emotions

Mead and Metraux conducted the first systematic study on images of scientists in the United States in 1957. In their research, they pointed out that perceptions of scientists are traditional. It was conducted in 1961 by Beardslee and O'Dowd at the level of high school students. In 1983, Chambers developed the "Draw A Scientist Test" (DAST) to better understand students' images of scientists. DAST has been used in many studies to determine the perception of scientists. However, DAST was limited in identifying and revealing students' in-depth thoughts about the scientist in their drawings (Avraamidou 2013; Farland-Smith 2017; Reinisch et al., 2017). As a matter of fact, the elements related to students' images of scientists with DAST were able to reflect a part of the image in their thoughts (Christidou et al., 2023). There are also researchers who want to obtain in-depth data on scientist images and use different data sources along with DAST. For example, Brown et al. (2004) used semi-structured interviews in addition to DAST to determine primary school students' perceptions of scientists. At the end of the study, it was determined that student drawings provided more comprehensive information than the image of the scientist given by DAST. Guy et al. (2023) translated the DAST test into a digital form and showed that the digital DAST allows for more comprehensive scientist analysis. Ateş et al. (2021) used the Word Association Test in addition to the DAST to determine the perception of scientists in their study. With this method, the perception of scientists was determined in more depth. Farland-Smith (2012) developed an additional rubric to analyze the perceptions of scientists in DAST in more detail. Thus, detailed information was obtained beyond the drawings. Hillman et al. (2014) used a six-question questionnaire along with DAST in their study and evaluated students' perceptions of science more comprehensively. Lamminpää and Vesterinen (2020) integrated drawings with comic strips to determine scientists' perceptions and pointed out that this approach could elicit rich emotional responses from students related to science. The researchers emphasized that the use of DAST as the only data source was a limitation in determining students' perceptions of scientists (Hillman et al., 2014; Farland-Smith and McComas, 2009). In their study, Farland-Smith and McComas (2009) preferred more than one drawing method in determining perceptions of scientists with DAST. Thus, in-depth perceptions of scientists were analyzed. When the literature is examined, it is understood that along with the use of DAST in determining the perceptions of scientists, there is a need for in-depth data collection techniques in creating perceptions of scientists. In this context, determining the emotions that students attribute to scientists is important in terms of deepening their perceptions of scientists. As a matter of fact, scientists have strong emotions while conducting their work and epistemic emotions shape how they participate in scientific processes; it is emphasized that emotions are important in students' learning processes of scientific knowledge. In science education, it is meaningful not only to learn scientific knowledge but also to encourage students to think and feel like scientists. The emotions that scientists feel while testing their hypotheses or searching for a solution to a problem increase their motivation to work (Jaber and Hammer, 2016). The emotions attributed from the students' perspective are important in terms of determining the perceptions of science and scientists from the students' perspective. Finson's (2002) emphasis that "individuals with negative perceptions of science or scientists are unlikely to pursue a science education and then enter a career in science" indicates that the perception of scientists has an impact on students' career development and decision-making processes in science. In the current study, the Emo-DAST data source proposed by Christidou et al. (2023), which focuses on determining the emotions portrayed by children toward scientists, which brings a new perspective to the image of scientists, was used. In this study, it is aimed to determine the emotions that middle school students attribute to the images of scientists and to address how students perceive scientists and how they explain the emotional aspects of these perceptions from a qualitative perspective. In this direction, the following sub-questions were sought to be answered in the research:

1. What emotions do middle school students process about scientists in their drawings?
2. What are the graphical clues showing emotions in the images of scientists in students' drawings?
3. How do students explain the emotions they attribute to the images of scientists in their drawings?

METHODS

This study, in which the images of scientists of secondary school students were examined, was based on qualitative methodology (Merriam and Tisdell, 2015).

Participants

A total of 134 students aged between 11 and 13 years old studying in a provincial center located in the Central Black Sea Region in Türkiye were invited to participate in the study. However, 42 students' drawings were excluded from the analysis because they did not depict a scientist. The criterion for exclusion was that drawings that did not directly depict a scientist, but

instead focused on visuals that were unrelated to the scientist or their work, such as different figures, shapes, or relationships, were not included in the study. In the end, 92 student drawings were included in the study. Information on the demographic characteristics of the students is presented in Table 1:

Table 1: Demographic characteristics of the students

Distribution of students by grade level and gender					
Grade level	**5th grade**	**6th grade**	**7th grade**	**8th grade**	**Total**
Gender					
Female	5	10	20	9	44
Male	7	9	21	11	48
Total	12	19	41	20	92

As seen in Table 1, 12 of the students are in the 5th grade, 19 in the 6th grade, 41 in the 7th grade, and 20 in the 8th grade. The age range of the students varies between 11 and 13 years. The study group of the research was determined according to the convenience sampling method. The participants were middle school students from a small province in the Central Black Sea Region of Türkiye. The application was carried out by obtaining a consent form from the students. Students who did not want to participate in the study were given the option of not participating in the study process.

Data Collection Process

The data obtained from the study were collected in September-October 2024. Emo-DAST proposed by Christidou et al. (2023), which focuses on determining the emotions portrayed by children toward scientists, which brings a new perspective to students' image of scientists, was used as a data source. First, a pilot study was conducted to determine the comprehensibility and applicability of the data collection tool. The pilot study was conducted with 20 students; some students did not write justifications in their drawings or did not draw scientists. In this case, the form directed to the students was revised and instructions were added with sufficient explanations. Participant and parental consent forms were obtained from the students to determine their participation in the study process. It was explained to the students that the data would be kept confidential and would only be used for study purposes. The steps followed during the implementation process are presented in Figure 1.

Obtaining the data in the research was basically carried out in two stages: The drawing phase and the presentation phase in which the drawings were explained. First, the students were instructed to *"Draw the picture that comes to your mind when you think of a scientist (male or female). In your drawings, draw the scientist in his/her environment and describe the emotion he/she makes you feel."* No time limit was set for students to complete their drawings. No explanation or guidance was given to the students during drawing. In the second stage, to elaborate the themes obtained from the drawings in depth, individual interviews were conducted with 25 randomly selected students and the students were asked to explain what they were describing in their drawings and their perceptions of scientists were elaborated. The findings obtained from the 2-3-minute mini-interviews with the students were used as supporting data when interpreting their drawings about their perceptions of scientists.

Data Analysis

In the analysis of the drawings obtained from the research, the three-dimensional analysis framework put forward by Christidou et al. (2023) was used and the descriptive analysis technique was adopted. These criteria are (i) change in facial expression, (ii) posture, and (iii) context. Two researchers analyzed the children's drawings at different times. The agreement between the raters was acceptable (facial dimension: 92%; posture dimension: 94%; context dimension: 92%). The explanations provided by students in their drawings and the short presentations they gave were similarly subjected to descriptive analysis. The analysis was conducted according to five codes that describe the reasons for the scientist's feelings, as defined by Christidou et al. (2023) (liking/interest/earning, self-efficacy, inventions/discoveries, dangers/difficulties/barriers, and irrelevant). Two researchers analyzed the student explanations corresponding to the specified codes. The third researcher provided support in cases where the two researchers were in conflict, matching the relevant explanations with the relevant codes. The analysis process was finalized, and sample statements from student drawings and opinions appropriate to each code were included.

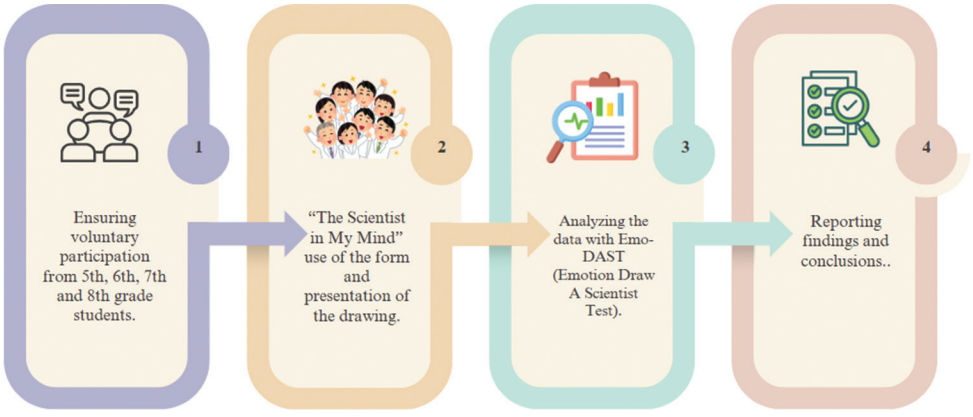

Figure 1: Data collection process

The codes obtained in the data analysis of the study are as follows: Happiness, Tension, Confusion, Sadness, Fatigue, Fear/panic. Within the framework of the analysis, the scientist's emotions and graphical clues showing emotions, written and verbal justifications were used (Figure 3).

An example analysis using the drawing clues in Figure 2 is as follows:

- The scientist's emotion: Happiness
- Facial expression: Positive emotion, slight smile, eyes open
- Posture: Relaxed and natural look. Arms outstretched to the sides
- Context: He may be giving a presentation with the telescope next to him. Or he may be preparing to make an observation. Environmental context established.

Figure 2: Sample drawing of a scientist

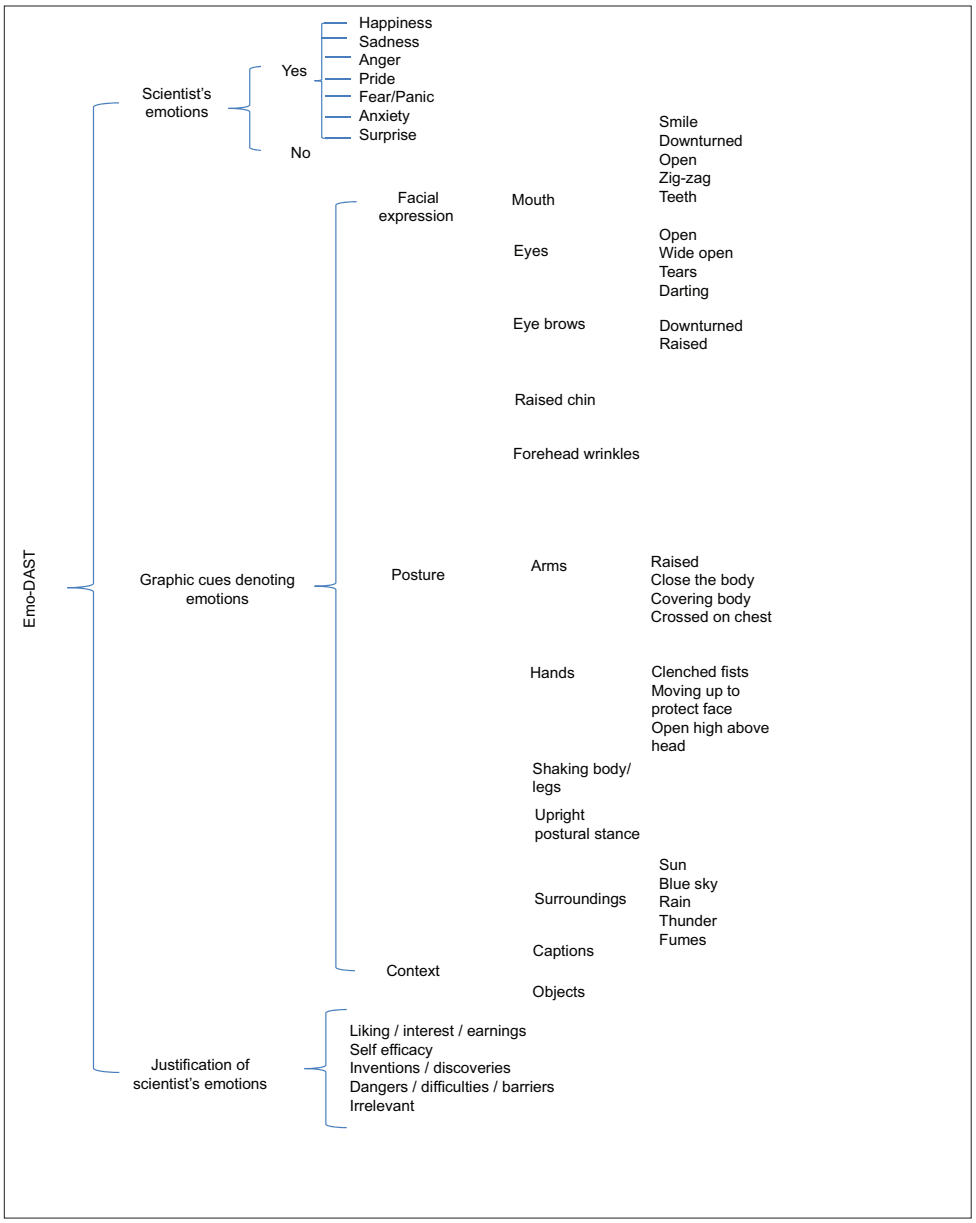

Figure 3: Data analysis framework (Christidou et al., 2023)

During the data analysis process, the students' drawing papers were named representatively (e.g., S1 for student 1 and S2 for student 2) and explanations were made with these names on the sample drawings.

FINDINGS

Findings on the Emotions of Middle School Students about Scientists in their Drawings

When the research findings were analyzed, the students' attribution of emotions to scientists was determined. It was determined that the majority of the students expressed the scientist with a description of an emotion (n = 80), while 12 students did not describe any emotion. The detailed finding related to this is presented in Table 2:

Table 2: Frequencies and percentages of the types of emotions that students attribute to scientists

Emotion	Types of emotion	f	%
There is emotion	Happiness	49	51.58
	Anger/Tension	10	10.53
	Surprise	9	9.47
	Anxiety	7	7.37
	Fear/Panic	5	5.26
	Sadness	3	3.16
No emotion		12	12.63

Table 2 shows that more than half of the students depicted feelings of happiness (f = 49) in their drawings of scientists. Subsequently, some students referred to feelings of anger/tension (f = 10) and surprise (f = 9). In addition, some students depicted scientists as having emotions such as anxiety, fear/panic, and worry in their drawings. Some of the students did not reflect any emotion of the scientist in their drawings. Looking at the general table, it was determined that students mostly attributed positive emotions to scientists.

Findings Related to Graphical Clues Showing Emotions in the Images of Scientists in Students' Drawings

Considering the depictions of the emotions that students attributed to the scientist, the evaluations in the categories of facial expression, posture, and context were mostly based on the facial expressions drawn by 72 students; 24 students' posture and 12 students' context categories were taken into consideration.

Examples of students' drawings of scientists are as follows:

Figure 4 drawing analysis: 5th grade-emotion

Facial expression: slight smile and surprise in the eyes, one open eye, eyebrows arched downwards.

Posture: arms out to the sides, natural posture, one arm raised.

Context: As written in the description, he is happy with his invention, but there was a fire in the work area because chemicals were spilled, emphasizing that mistakes can be made during work.

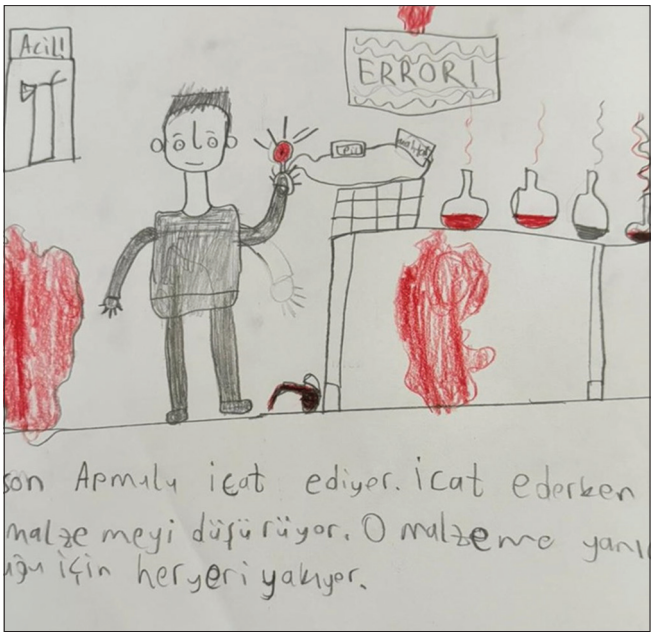

Figure 4: A drawing of a tense, sad, and confused scientist in S6's study

Figure 5 drawing analysis: 7th grade-emotion

Facial expression: happy expression, smile.

Posture: relaxed and natural posture, one arm raised.

Context: there is an explanation and experimental materials drawn. The scientist who is happy as he/she works is intended to be described.

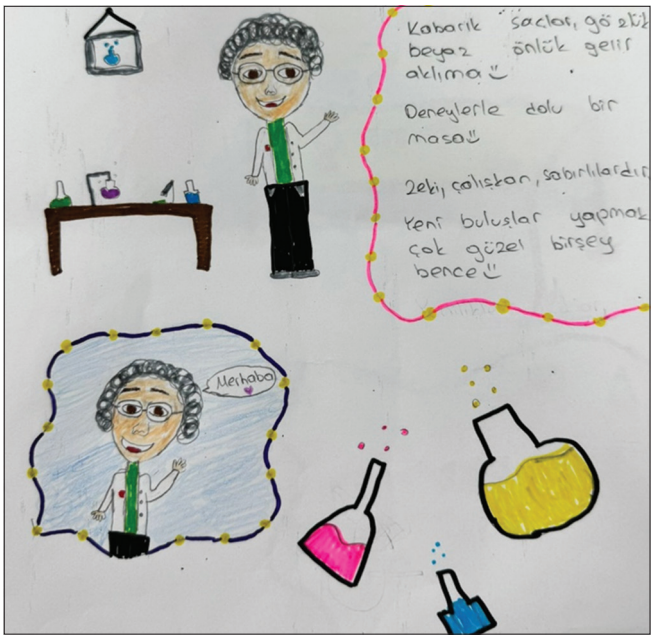

Figure 5: Drawing of a happy and confused scientist in S32's study

Figure 6 drawing analysis: 8th grade-emotion

Facial expression: anxious tired eyes and sad expression drawn, mouth curled down.

Posture: arms very close to the body, covering the body.

Context: according to the description, the scientist is tired of working hard.

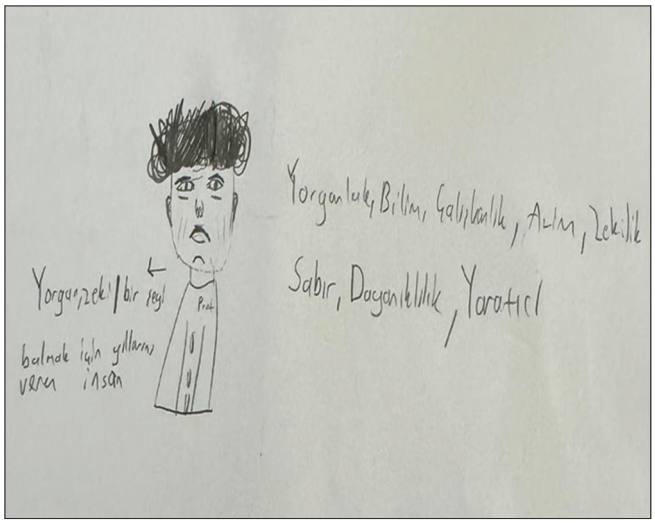

Figure 6: An anxious and tired scientist drawing in the study of S13

Figure 7 drawing analysis: 8th grade-emotion

The drawing emphasizes an experimental process rather than emotion. The scientist is sitting at a laboratory table holding an experimental instrument. The facial expression is ambiguous; there is no emotional emphasis other than the glasses. Children often express their interest in scientific phenomena through such drawings. The simplicity of the posture suggests a focus on the experiment itself.

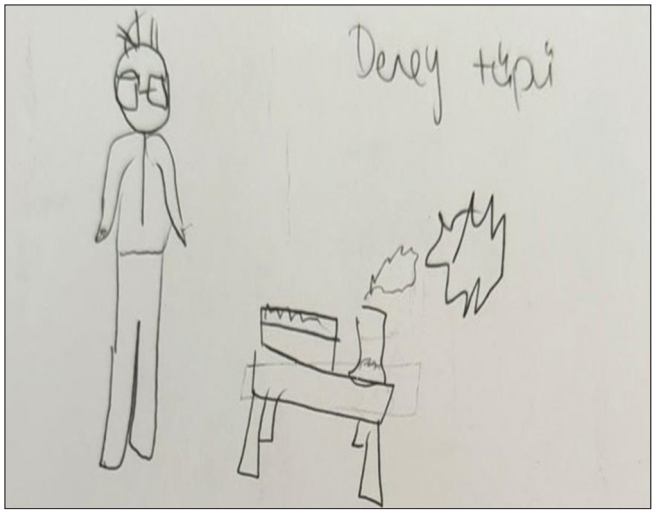

Figure 7: S2's drawing of an emotionless scientist

Figure 8 drawing analysis: 8th grade-emotion

Facial expression: Eyes wide open, mouth open, fear/panic facial expression.

Posture: Arms close to the body, clenched fists, and panic.

Context: The table and materials are ready for the experiment. The happiness and panic of starting the experiment are depicted.

Figure 8: Drawing of a scientist in fear/panic in S23's work

Figure 9 drawing analysis: 7th grade-emotion

Facial expression: Eyes covered with glasses, raised eyebrows, slight smile, tense and panicked posture.

Posture Upright posture showing work in progress, one arm raised

Context: the working environment, the painting hanging on the wall, the test tubes held in the hand, and the description are intended to emphasize the hard work of the scientist who is constantly researching and experimenting.

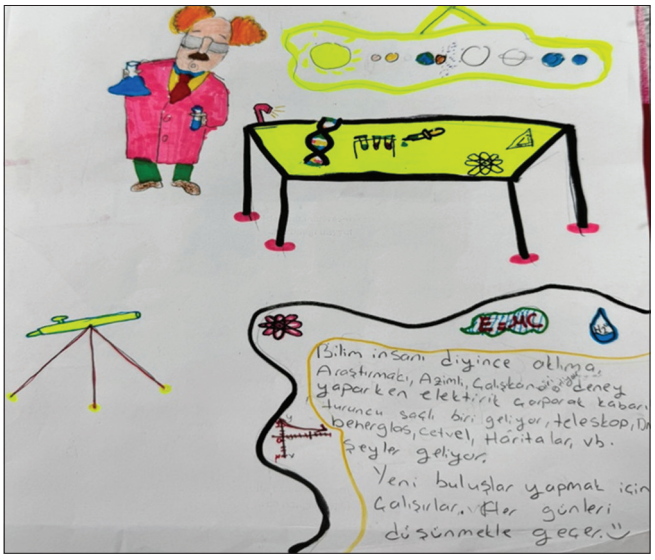

Figure 9: A drawing of a tense and panicked scientist in S30's work

Figure 10 drawing analysis: 8th grade-emotion

Facial expression: Eyes wide open, mouth open, tongue visible, eyebrows raised, fear/panic facial expression.

Posture: Arms close to the body, raised, clenched fists, vertical posture.

Context: The table and materials are ready for the experiment. The happiness and panic of accomplishing the experiment are depicted.

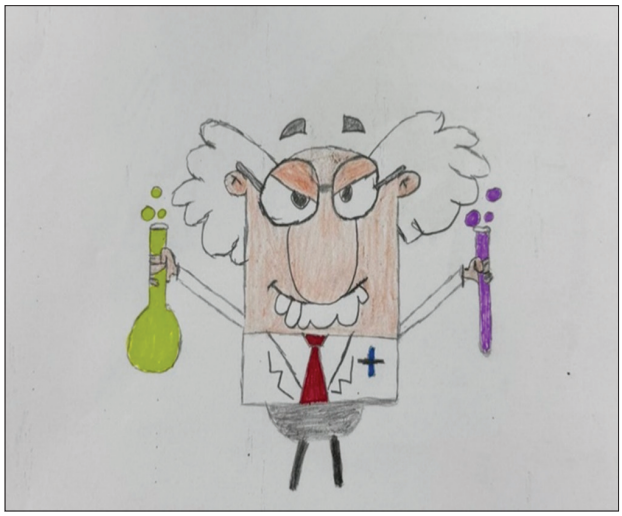

Figure 10: Drawing of a scientist with fear/panic but self-confidence in the study of S24

Figure 11 drawing analysis: 8th grade-emotion

Facial expression: slight smile and surprise in the eyes, one open eye, raised eyebrows, anxious and happy expression.

Posture: Arms close to the body, shoulders raised, upright posture.

Context: The materials on the table are being used to start the experiment. According to the description, he is depicted as anxiously anticipating the success of the experiment and his hope for humanity.

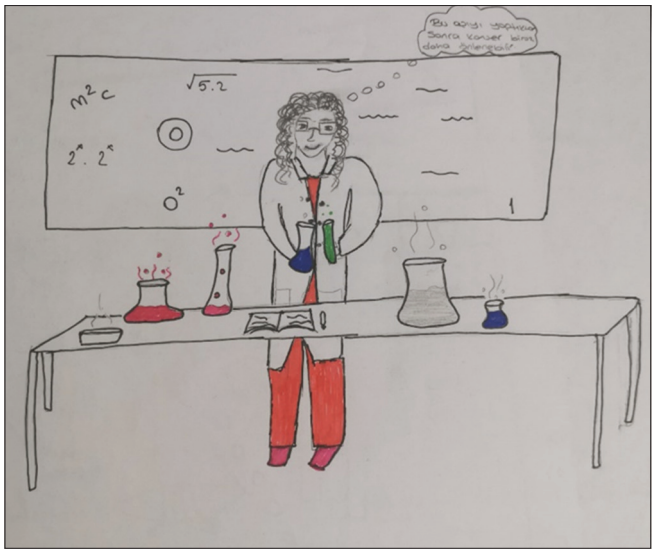

Figure 11: S82's drawing of a happy and anxious scientist

Figure 12 drawing analysis: 6th grade-emotion

Facial expression: Eyes open and focused, mouth closed, eyebrows raised, serious and anxious facial expression as indicated in the description.

Posture: Arms close to the body and positioned forward, vertical posture.

Context: He is working in a focused way to find a definitive solution to a disease, as the description says.

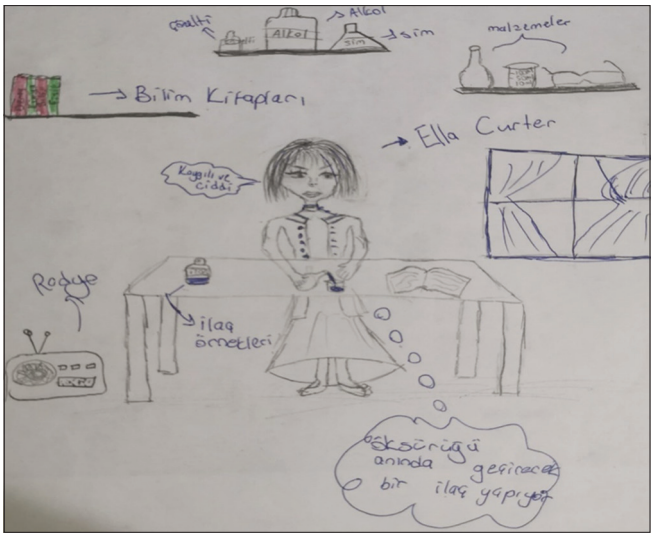

Figure 12: S71's drawing of an anxious and serious scientist

Figure 13 drawing analysis: 6th grade-emotion

Facial expression: Eyes open and focused, mouth open, teeth visible, happy expression.

Posture: Arms close to the body, vertical posture.

Context: The table and materials are ready for the experiment. The happiness of doing an experiment is depicted.

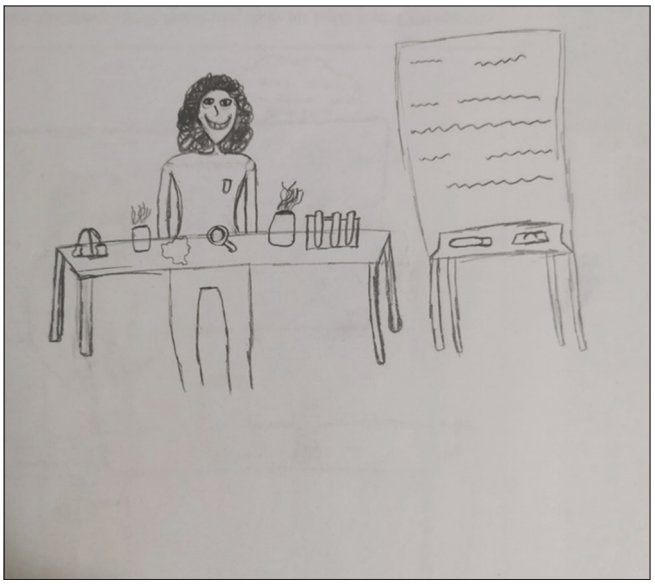

Figure 13: S88's drawing of a happy scientist

Figure 14 drawing analysis: 8th grade-emotion

Facial expression: Eyes and general posture are tired but there is a smile and concern, eyebrows curled down, forehead wrinkles and pride is expressed with a raised chin.

Posture: Hands clasped together, a thoughtful posture.

Context: The description emphasizes that the scientist is someone to be respected.

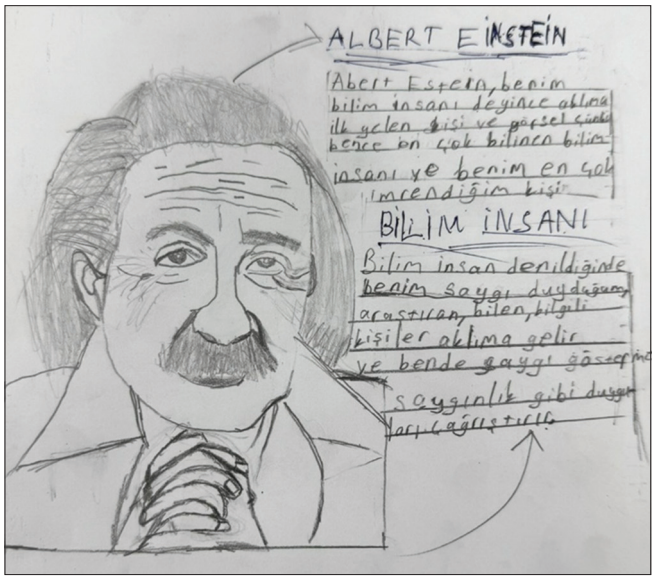

Figure 14: S22's drawing of a happy and anxious scientist

Figure 15 drawing analysis: 8th grade-emotion

Facial expression flat closed mouth and anxious eyes

Posture natural posture with arms open

Context: It is stated that the scientist experiments with animals and conducts research with formulas. According to the explanation, it is emphasized that they are very intelligent people.

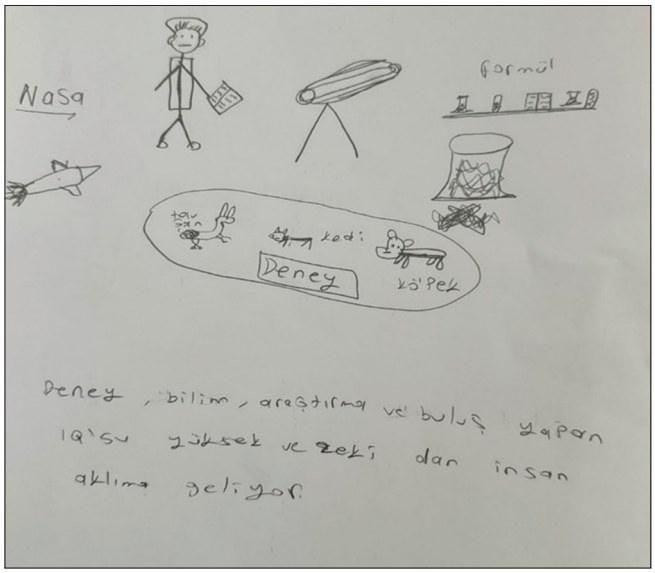

Figure 15: Drawing of an anxious scientist in the study of S17

When the student drawings are analyzed, it is seen that students referred to scientists with emotions of happiness, anger/nervousness, surprise, anxiety, fear/panic, and sadness. In the drawings, the mouth and eyes gave more clues, mostly in the face area. Contextual student explanations provided important clues in determining emotions. For example, PST71's drawing depicted an anxious facial expression and made an explanation in the speech bubble as "he is making a medicine to cure cough" and emphasized that the scientist was doing an important scientific study.

Findings Related to Students' Explanations of the Emotions they Attributed to the Images of Scientists in their Drawings

Students provided some explanations and justifications in the form of short notes on their drawings. The justifications put forward by the students while expressing their feelings toward the scientist were explained under five themes.

These themes are admiration/interest/gain, self-efficacy, inventions/discoveries, dangers/difficulties/obstacles, and indifference.

When Table 3 is examined, the emotions depicted were justified. It was determined that the majority of the students (f = 59) reflected the details of experimentation, invention, and discovery in their drawings of scientists, for example, S17, S24 (Figures 11 and 16). It was determined that students who had a positive perspective and depicted happy scientists mostly emphasized invention/discovery and self-efficacy in their justifications. Among the students who did not express emotion (f = 10), almost all of them had hints of an experimental setup, a laboratory environment. For example, in the drawing of an emotionless scientist by S2 (Figure 8), it is seen that an experimental process is at the forefront. The scientist is in the laboratory and holding an experimental device. In the like/interest/profit dimension, a significant portion of the students (f = 33) stated that they liked the work of scientists. In this way, they also overlapped with their own feelings. For example, S44 expressed his feelings about Aziz Sancar and made positive explanations about the scientist. These reasons are present in Aziz Sancar's drawing that he loves his job. Similarly, in terms of self-efficacy, the drawings of some students (f = 23) reveal clues about the scientist's work, the functionality of their discovery, and their sense of achievement. For example, in S77's drawing, it is stated in the explanations that the scientist made an invention and that this invention was functional. And in the justification, it is stated that the scientist is happy because of the success. When Table 3 is analyzed, there is a clue that only two of the students encountered some difficulties in their drawings. There were no students who provided an irrelevant justification in their scientist drawings.

In the mini-interviews conducted with 25 randomly selected students, it was determined that the students verbally elaborated on the drawings and explanations. It was determined that almost all of the students expressed the explanations in the drawings, and some of them explained the expressions in more detail. For example, S70 drew Aziz Sancar as a scientist and depicted him in an environment where he gave a lecture to people. In his explanation, *"Aziz Sancar received the Nobel Prize in Chemistry as a result of his inventions in chemistry branches such as biological clock etc."* In the explanation of his drawing, he said, "*I wanted to draw Aziz Sancar here because I take his success as an example. He showed that something can be done when you want it, and in this drawing he explains the importance of success. It tells about his work*

and inventions. If you look at him, he speaks very confidently on the lectern and he loves his job" (Figure 16).

With these statements, it was determined that the student referred to the dimensions of Liking/interest/earning, self-efficacy, and invention/discoveries. In S92, the scientist did not make an explanation in his drawing but briefly explained his drawing during his presentation as follows (Figure 17);

Figure 16: Drawing a scientist in S70's work

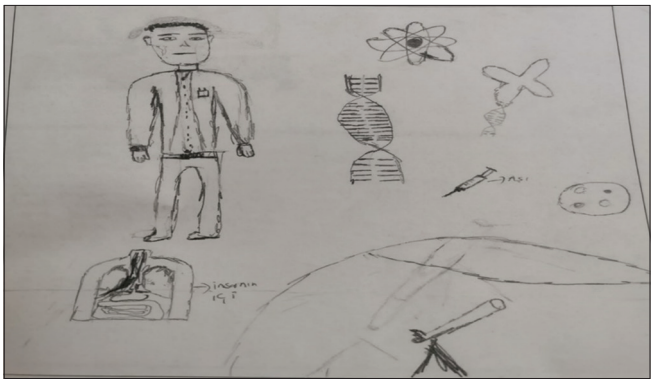

Figure 17: Drawing of a scientist in the study of S92

Table 3: Students' justifications for their feelings about scientist

The justification of scientist's emotions	f	Example expressions
Liking/Interest/ Earning	33	*"Albert Einstein is the first person I think of when I think of a scientist. Because he is the best-known scientist and the person I admire the most. It evokes feelings like respectability."* S22 8th grade [Figure 14]
		"Scientists are the people who help us to gain knowledge and they investigate and help us. I like this profession very much, I wonder what scientists do when they are doing research. I am honestly happy." S41 7th grade
		"The scientist is knowledgeable and open-minded. They consider every theory and work for the best of everything. They work for the good of people and for the future. They make new discoveries and inventions, they are hardworking." S43 7th grade
		"I take Aziz Sancar, who won the Nobel Prize as a scientist, as an example. I am very happy because he is a hardworking person who does not give up, so I try to follow his example." S44 7th grade
		"Scientists are patient and do not give up (200th trial) I take their behavior as an example." S54 6th grade
		"I look up to Albert Einstein for his behavior, his work and his determination. Even though he had health problems, he believed in himself and succeeded." S59 6th grade
Self-efficacy	23	*"When I think of a scientist, I think of a scientist wearing a lab coat and doing experiments in a lab. I think it is very cool to be a scientist in this way."* S37 8th grade
		"Scientists produce many things we use today. They contribute to many things we use in daily life. I am especially proud of the electronic ones, like cables and telescopes." S39 7th grade
		"I am very interested in Isaac Newton's invention of falling apples. He found gravity by doing research with his curiosity and loving his work. I think this invention is very valuable invention." S47 7th grade
		"The scientist I drew made an invention called seeing glasses and it was made for blind people. When a person puts them on, a simulation opens in front of him and he gave the glasses the ability to speak. This feature tells us what will happen on the path that man walks. "I am very happy to present it to people," says the scientist." S77 5th grade
Inventions/ Discoveries	59	*"I think of people with high IQ and intelligence who conduct experiments, science, research, and inventions."* S17 8th grade
		"Scientists make me happy with their work. They have come up with many inventions that have made our lives easier so far." S24 8th grade
		"When I think of scientists, I think of people who do experiments. Or people engaged in observation and discovery." S40 7th grade
		"When I think of scientists, I think of experiments, inventions, discovering cures for diseases." S42 7th grade
		"I think if it wasn't for scientists, it could have been the end of the world. For example, we defeated Covid-19 virus thanks to scientists who invented vaccines." S53 6th grade
		"Aziz Sancar won the Nobel Prize in Chemistry for his inventions in chemistry such as biological clock etc." S70 6th grade
Dangers/Difficulties/ Barriers	2	*"Edison invents the light bulb. While inventing it, he accidentally drops a material from his hand. Since that material is flammable, it burns everywhere."* MS6 5th grade
		"Why is this not the endoplasmic reticulum I found, the scientist can say." S76 7th grade
Irrelevant		No answer

"My scientist is a serious and anxious scientist. Because he does a lot of research and makes a lot of discoveries and therefore he has a constant desire to work and be successful. I wanted to draw him serious because he loves his job very much. He does not want there to be any problems with his inventions, he is a scientist who wants to succeed." With this explanation, the student's drawing referred to the dimensions of appreciation/interest in the scientist, invention/discoveries, self-efficacy, and dangers.

DISCUSSION, CONCLUSION, AND SUGGESTIONS

When the research findings were analyzed, the emotions students attributed to scientists and the clues and justifications they used to describe these emotions were investigated in detail. In this section, three sub-problems were taken together and the discussion and conclusion section was tried to be reflected holistically. It was determined that more than half of the students attributed happiness to scientists. This shows that students have a positive perception. The other emotions are anger/nervousness, surprise, anxiety, fear/panic, and sadness, respectively. The important situation understood in the students' drawings and justifications is the following: From the students' point of view, scientists are perceived as people who are constantly researching, experimenting, and making inventions, even if they are in different emotional states. In the research findings, it is understood that the feeling of happiness is attributed to scientists regardless of age. The current data have not revealed any significant differences between grade levels. Consistency was also ensured by graphical clues and justifications. In Christidou et al. (2023), in children's drawings, children of all age groups generally attributed positive emotions to scientists and these emotions were associated with the work and achievements of scientists. In this respect, it is compatible with the findings of the current study. As a matter of fact, when student drawings and explanations were taken into consideration in the current study, it was determined that most of those who expressed positive opinions along with the emotions attributed to the scientist emphasized the achievements and self-efficacy of the scientist in the explanations they made in their drawings and mini-interviews. In the drawings, the most clues were captured from facial expressions; similarly, Christidou et al. (2023) used facial expressions to indicate emotions in their study. It can be said that the situation of less use of other clues is similar. In Ateş et al. (2020) study, it was determined that scientists were drawn with smiling faces in teacher and student drawings. The scientists drawn were generally depicted with the characteristics of invention/discovery. These findings overlap with the findings of the current research which attributes the emotion of happiness as the emotion of a scientist and the finding of facial expression clues among emotion clues. Similarly, Ferguson and Lezotte (2020) stated in their study that students' perceptions of scientists described characteristics such as doing their job with passion, happy, curious, and hardworking. The findings of Finson's (2002) study that the perception of scientists has evolved toward a more positive one coincide with the findings of the current study. It was revealed that the students had a broader image of scientists and did not necessarily perceive people who conduct scientific research as men with crazy hair working alone and that they drew elements related to new technology in their drawings and a scientist doing research on the job. At the end of the studies, it was determined that positive characteristics were generally attributed to the personalities of scientists. Bernard and Dudek (2017) emphasized in their study that positive perceptions of scientists are important in their career choices.

The steps followed in this study differ significantly from the Emo-DAST approach used by Christidou et al. (2023). While Christidou et al. (2023) asked students to draw scientists experiencing specific emotions, this study asked students to draw the scientist in their minds and describe what that scientist felt while working. This shifts the interpretation from merely the emotions attributed to the scientist to also include the emotional thoughts reflected in the students' image of the scientist and evoked in their minds. This difference may have influenced the students' responses. For example, the frequent attribution of happiness to scientists in student responses may be related to the positive emotions students feel when thinking about scientists, or it may stem from the facial expressions depicted in the drawings. Therefore, when interpreting the findings, it is important to consider and holistically evaluate both the emotions students attribute to scientists and the emotions evoked in themselves through scientists, as this offers a new perspective. In this context, the study reveals not only how students depict scientists but also the emotions they attribute to them. When the results obtained from the research were evaluated in general, it was determined that students' perceptions of scientists were positive in terms of emotions. It was concluded that the perceptions of scientists were more detailed and inclusive when viewed from a broader perspective compared to previous studies. For example, Christidou et al. (2023) found in their study that students mostly attributed positive emotions to scientists. In this respect, the results obtained are parallel to those obtained in the study conducted in Türkiye using a three-dimensional coding framework. Similar results indicate that students in different cultural environments share common emotions in their perceptions of scientists. In this context, it is thought that the dissemination and comparison of the Emo-DAST approach across different cultures will contribute to achieving the global goals of science education. Thus, it will be possible to contribute to supporting students' perceptions and emotions toward scientists in a more comprehensive and holistic manner. Indeed, with the updated 2024 science curriculum in Türkiye, an important goal was set for students to recognize the contributions of scientists to science and society and to develop the understanding that science is a common effort of cultures by presenting examples from scientists (Ministry of National Education [MoNE], 2024). In this context, practices based on the emphasis on exemplary

scientists and long-term studies can be carried out to contribute to the development of the perception of scientists. In addition, projects supported by different methods and techniques such as animation and role-playing, in which the lives of scientists are the subject and emotions are employed, can be carried out.

Jaber and Hammer (2016) emphasize that supporting students in "feeling like scientists" will influence their perceptions of scientists and can increase motivation and learning. It is thought that students who experience emotions such as curiosity, excitement, and surprise through classroom activities may view scientists from a different perspective and begin to perceive them as figures connected to their own lives. Similarly, emotion-themed assignments can be given to students. Scientists may be asked to express the emotions they experience during the research process, such as excitement, happiness, and anxiety, through short stories, drawings, or diaries. In addition, in experiment-based activities, tools such as emotion cards (questions like: How did you feel when the experiment started? How did you feel when the process did not go as expected?) and emotion journals (the student's explanations of what emotions they experienced like a scientist after the activity) can be used to support students in describing how they felt throughout the process.

On the other hand, studies can be conducted on the widespread use of science interviews conducted by scientists and the effect of these interviews on the perception of scientists. In this way, students can establish a strong bond with scientists. To move beyond the perception of scientists as people working only in laboratories, students can be supported to come together with scientists who are active in fields such as medicine and industry. In this way, students will have the opportunity to have a multidimensional view of scientists by interacting with them. Developing students' perceptions of scientists in a positive way and making an effort to do so gives hope to the idea of touching the scientists of the future already.

Limitations

There are two limitations in the study. One of them is that the study was conducted with students identified in a school district. Generalizing the data obtained from students is seen as a limitation. As a matter of fact, similar results may or may not be obtained in different regional schools. The second limitation is that although there are necessary explanations and justifications on the Emo-DAST form for student drawings, in-depth interviews were not conducted with all students, and mini-interviews were conducted with 25 students. Students' Emo-DAST drawings and explanations were generally found sufficient.

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