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TUBITAK 4006 Science Fairs in The Eyes of Students: A Phenomenological Study

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Abstract

This study aimed to determine middle school students' views of TUBITAK (Scientific and Technological Research Council of Turkey) 4006 Science Fairs. The study adopted phenomenology, which is a qualitative research design. The sample consisted of 31 (20 female and 11 male) students recruited using purposive criterion sampling. Participants attended a TUBITAK 4006 science fair. Data were collected using an interview questionnaire developed by the researcher. The data were analyzed using content analysis. Participants regarded the science fair as a fun and instructive fair that helped them learn new things. They also believed that the science fair helped teachers deliver science, science applications, and information technologies and software classes. Participants experienced different problems during the science fair and found different solutions. They saw scientists in a more positive light after the science fair. The results indicate that educators should encourage students to attend science fairs to help improve their perceptions of scientists. The study made suggestions based on the results.

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Introduction

Advances in science and technology have a tremendous impact on every sphere of life, from economy to healthcare and education (Yıldırım, 2021). Facing the paradigmatic change in science and technology, states are undergoing a whole series of transformations and establishing new cultural and intellectual codes for their citizens to follow (Arslan, 2021). This process has also changed the way states view education. Today, they reform their education systems because they need citizens with new skills and qualifications (Okal et al., 2020). For example, they have undertaken various reformative steps in their education systems to turn students into science-literate individuals. Scientific literacy, or science literacy, is the critical reading and interpretation of a scientific text (Koch & Eckstein, 1995). Scientific literacy is accessing scientific knowledge and understanding the world by solving problems (Bybee, 1997). Miller (1983) defines scientific literacy as a process in which one addresses science from the perspectives of scientific knowledge, technology, and society. In this context, countries have focused on educational initiatives and projects to promote scientific developments and make science more appealing to students (Sontay et al., 2019). For example, science fairs are educational initiatives undertaken by the Scientific and Technological Research Council of Turkey (TUBITAK) (Yıldırım, 2018). TUBITAK 4006 Science Fairs aim to help students develop problem-solving, data analysis and interpretation, design, and math and computational thinking skills (TUBITAK, 2019).

In recent years, TUBITAK Science Fairs have become popular (Yıldırım & Şensoy, 2016) for various reasons. First, they encourage students to put their science process skills into practice. Second, they help them develop research and inquiry skills. Third, they make science more appealing. Fourth, they promote communication and self-confidence (Avcı & Su Özenir, 2018; Çavuş et. al., 2018; Erdal & Sarı, 2020; Soyuçok, 2018; Şahin & Çelikkanlı, 2014; Yavuz et al., 2014). This growth in popularity has also grabbed the attention of researchers across the academic spectrum. For example, they have investigated how students are affected by science fairs and what they think about them (Benzer & Evrensel, 2019; Erdal & Sarı, 2020; Günbey & Değirmençay, 2021; Kahraman, 2019; Sontay et al., 2019; Yıldırım, 2018). They have also looked into what administrators, teachers, or parents think about science fairs (Okuyucu, 2019; Yener & Balcı, 2020; Yıldırım, 2020).

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Aim of research and questions

This study aimed to determine middle school students' views of TUBITAK 4006 Science Fairs. The main research question was, "What do middle school students think about TUBITAK 4006 Science Fairs?" The subquestions were(1) "In what way do TUBITAK 4006 Science Fairs contribute to classes?," (2) "What kind of problems do middle school students face during TUBITAK 4006 Science Fairs and how do they solve those problems?," and (3) "How do TUBITAK 4006 Science Fairs affect middle school students' interest and attitudes?"

Method

Research model

This study adopted a phenomenological research design to solicit middle school students' views of TUBITAK 4006 Science Fairs. Phenomenology was the research design of choice because the study aimed to determine middle school students' views of TUBITAK 4006 Science Fairs objectively, validly, and reliably. Phenomenology is used to identify phenomena and focus on subjective experiences (Yıldırım & Şimşek, 2016). Therefore, this study elicited information on middle school students' views of TUBITAK 4006 Science Fairs and interpreted their opinions from a holistic perspective.

Research sample

Participants were recruited using purposive criterion sampling, which is a non-probability sampling method. The primary objective of criterion sampling is to recruit a sample that satisfies a set of predetermined criteria (Yıldırım & Şimşek, 2016). The inclusion criteria of the present study were (1) having attended a TUBITAK 4006 Science Fair and presented a project, (2) being a middle school student, (3) volunteering to participate in the study. The sample consisted of 31 (20 female and 11 male) middle school students who met the inclusion criteria. Each participant was assigned a code (P1, P2, P3, etc.) for confidentiality and anonymity.

Data collection tools

Interview questionnaire

Semi-structured interviews were conducted to determine participants' views of TUBITAK 4006 Science Fairs. The researcher developed an interview questionnaire in four steps. First, he developed a pool of open-ended questions. Second, he consulted experts for intelligibility and relevance. Third, he conducted a pilot study with two students and revised the questions based on their feedback. Fourth, he finalized the questions and conducted the interviews with participants. The interview questionnaire consisted of six intelligible and open-ended questions.

Data analysis

The data were analyzed using content analysis in four steps. First, the interviews were transcribed. Second, themes, categories, and codes were developed. Third, findings were extracted. Fourth, the findings were interpreted. Two experts analyzed the qualitative data separately. They came together and developed themes, categories, and codes. They identified the parts on which they disagreed and discussed them until they reached a consensus. They also calculated the intercoder reliability, which was 84% (Miles et al., 2014).

Results

This section addressed the results regarding each research question and presented them in Tables.

Participants' views of TUBITAK 4006 science fairs

The first research question addressed participants' views of TUBITAK 4006 Science Fairs (Table 1)..).

Table 1.
Participants' views of TUBITAK 4006 science fairs

Theme	Code
Participants' views of TUBITAK 4006 science fairs	Learning new things *(n=5)*
	Fun *(n=5)*
	Instructive *(n=5)*
	Helping students deliver lectures *(n=3)*
	Algorithmic thinking skills *(n=3)*
	Making students more interested in science *(n=2)*
	Helping students discover their skills *(n=1)*
	Positive attitudes towards science *(n=1)*
	Critical thinking *(n=1)*

Participants had different opinions of TUBITAK 4006 Science Fairs. They stated that the science fair was a fun and instructive fair that helped them learn new things. They noted that the science fair also helped teachers deliver lectures. Below are quotes from participants:

P1: The science fair helped me deliver lectures and made me more interested in science. (Helping teachers deliver lectures and Making students more interested in science)

P3: The science fair had instructive and fun projects. (Instructive and Fun)

P4: The science fair helped me discover my skills. (Helping students discover their skills)

The contribution of TUBITAK 4006 science fairs to classes

The second research question investigated how participants thought TUBITAK 4006 Science Fairs contributed to classes. Table 2 presents participants' views.

Table 2.
Participants' views of the contribution of TUBITAK 4006 science fairs to classes

Theme	Code
The contribution of TUBITAK 4006 science fairs to classes	Science *(n=7)*
	Science applications *(n=4)*
	All classes *(n=4)*
	Math *(n=3)*
	Information Technologies and software *(n=3)*
	Social studies *(n=3)*
	Technology and design *(n=2)*
	Turkish *(n=1)*

Participants had different views of the contribution of TUBITAK 4006 science fairs to classes. They remarked that the science fair contributed to different classes, such as science, science applications, and information technologies and software. Some participants expressed that the science fair contributed to all classes. Below are quotes from participants:

P11: I think that the science fair contributed to all classes because I got to use everything I learned from all classes to complete the projects. (All classes)

P17: I think that the science fair contributed to the "science" and "social studies" courses (Science and Social Studies)

P18: I think that the science fair helped with the "robotic coding" course. I had a chance to prepare before the "robotic

coding" course. (Information Technologies and Software)

The effect of TUBITAK 4006 science fairs on participants' interests and skills

The third research question looked into the effect of TUBITAK 4006 Science Fairs on participants' interests and skills. Table 3 presents participants' views.

Table 3.
The effect of TUBITAK 4006 science fairs on participants' interest and skills

Theme	Category	Code
The Effect of TUBITAK 4006 science fairs on participants' interest and skills	Interests	Making students more interested in coding *(n=3)*
		Making students more interested in science *(n=3)*
		Making students more interested in technology *(n=1)*
		Making students more interested in doing research *(n=1)*
		Making students more interested in designing models *(n=1)*
	Skills	Communication *(n=6)*
		Presentation *(n=6)*
		Algorithmic thinking *(n=4)*
		Cooperation *(n=4)*
		Self-confidence *(n=3)*
		Creativity *(n=3)*
		Critical thinking *(n=1)*
		Problem-solving *(n=1)*
		Analytical thinking *(n=1)*

Participants had different views of the effect of TUBITAK 4006 Science Fairs on their interests and skills. They stated that they became more interested in coding, science, and technology after the science fair. They added that the science fair helped them develop presentation, algorithmic thinking, cooperation, critical thinking, and problem-solving skills. Below are quotes from participants:

P1: I learned about teamwork. I mean, the science fair helped me develop cooperation skills (Cooperation)

P5: The science fair made me realize the things I was interested in. It made me realize that I was interested in coding. (Making students more interested in coding)

P10: I got to talk about and interpret projects, which made me more interested in technology. (Making students more interested in technology)

The effect of TUBITAK 4006 science fairs on participants' perceptions of science

The fourth research question focused on how participants thought TUBITAK 4006 Science Fairs affected the way they looked at science. All participants noted that they viewed science in a more positive light after attending the science fair. Below are quotes from participants:

P8: I was already interested in science before the science fair, but it's made me more interested in it.

P11: We should improve ourselves scientifically and do research. So, I think that the projects have led to a positive change in my perception.

P12: Even the thought of attending a TUBITAK 4006 science affair was enough to bore me, but I changed my mind after I attended one. Now, I would love to attend such fairs.

P14: I used to think that it was only the scientists that did science. But the science fair has made me realize that anyone can do science.

The challenges of TUBITAK 4006 science fairs and participants' solutions

The fifth research question investigated the challenges of TUBITAK 4006 Science Fairs and participants' solutions. Tables 4 and 5 present the challenges and solutions, respectively.

Table 4.
The challenges of TUBITAK 4006 science fairs

Theme	Code
Challenges	Broken tools and materials *(n=4)*
	Too many attendees *(n=2)*
	Getting nervous during presentations *(n=2)*
	Too little space *(n=2)*
	Communication problems *(n=2)*
	Selecting the wrong students *(n=1)*
	Conflicting with classes *(n=1)*
	Unoriginal projects *(n=1)*
	Lack of auxiliary materials *(n=1)*

Participants reported different problems they experienced during the science fair. For example, they had difficulty doing the projects because the tools and materials were not working properly. Moreover, they noted that there were too many attendees and too little space. They added that they got nervous during their presentations and had a hard time communicating with students from other grade levels. Some participants complained that the projects were unoriginal. Below are quotes from participants:

P9: I don't think the projects were original. (Unoriginal projects)

P10: I got a little nervous talking to people about my project. (Getting nervous during presentations)

P14: We had communication problems; I mean, we had difficulty talking to students from other grades. (Communication problems)

Table 5.
Participants' solutions to problems

Theme	Code
Participants' Solutions to Problems	The fairground should be more spacious *(n=2)*
	Project teams should consist of small groups of students *(n=1)*
	Working more on presentations *(n=1)*
	Projects should be original *(n=1)*
	Student selection should be more meticulous *(n=1)*
	Material selection should be more meticulous*(n=1)*
	There should be spare material *(n=1)*
	Teachers should help students *(n=1)*
	Projects should not conflict with classes *(n=1)*
	There should be auxiliary materials *(n=1)*

Participants proposed different solutions to the problems they encountered during the science fair. For example, they stated that the fairground should be more spacious, that there should be spare materials, and that the projects should be original and not conflict with classes. Below are quotes from participants:

P9: The projects should be based on original ideas, and students should

present original projects. (Projects should be original)
P25: The fairground should be more spacious because it gets too busy after a while. (The fairground should be more spacious)

P30: We should be able to ask our teachers to fix the mistakes that we make during the fair. (Teachers should help students)

Participants' observations regarding TUBITAK 4006 science fairs

The sixth research question focused on participants' observations regarding TUBITAK 4006 Science Fairs. Table 6 presents participants' observations.

Table 6.
Participants' observations regarding TUBITAK 4006 science fairs

Theme	Code
Participants' observations regarding TUBITAK 4006 science fairs	Presentations on new projects *(n=3)*
	Social interaction *(n=2)*
	Helping each other *(n=2)*
	Science concepts *(n=1)*
	Different designs *(n=1)*
	Effective communication *(n=1)*
	Watching robots operate *(n=1)*
	Excited students *(n=1)*
	A fun setting *(n=1)*
	Coming together for a common cause *(n=1)*
	Students doing presentations *(n=1)*
	Different materials and tools *(n=1)*
	Students working together *(n=1)*

Participants stated that they saw excited students doing presentations, coming up with different designs, communicating with one another effectively, watching robots operate, coming together for a common cause, and working together in a fun setting. Below are quotes from participants:

P19: I got to see a lot of projects. (Presentations on new projects)

P21: I saw interesting designs; I think it's a very nice fair. (Different designs)

P27: I've learned how robots work and how to use them. (Watching robots operate)

Discussion and Conclusion

The first research question focused on middle school students' views of TUBITAK 4006 Science Fairs. Participants expressed different opinions about the science fair they attended. They stated that the science fair was a fun and instructive fair that helped them learn new things, develop algorithmic thinking skills, and teach their courses. They also noted that it made them more interested in science and helped them discover their skills and develop positive attitudes towards science and critical thinking skills. Günbey and Değirmençay (2021) also found that students had positive views of science fairs. Our results are consistent with the literature (Benzer & Evrensel, 2019; Grote, 1995; Okuyucu, 2019; Yener & Balcı, 2020).

The second research question concentrated on middle school students' views of the contribution of TUBITAK 4006 Science Fairs to classes. Participants remarked that the science fair helped them teach science, science applications, mathematics, social studies, Turkish, technology-design, and information technologies and software. Şahin (2012) determined that science fairs helped students develop positive attitudes towards chemistry. Our results are consistent with the literature (Erdal & Sarı, 2020; Ural Keleş & Soyuçok, 2021; Yıldırım & Şensoy, 2016).

The third research question investigated middle school students' views of the effect of TUBITAK 4006 Science Fairs on their interests and skills. Participants' views were grouped under two categories. Under the category of "interests," participants stated that the science fair made them more interested in coding, doing science and research, developing technology, and designing models. Under the category of "skills," participants noted that the science fair helped them develop communication, presentation, algorithmic thinking, problem-solving, cooperation, critical thinking, and analytic thinking skills. They also added that it made them more creative and confident. Ural Keleş and Soyuçok (2021) found that parents believed that science fairs could help students develop critical thinking and problem-solving skills and make them more creative. Our results are consistent with the literature (Avcı & Su Özenir, 2018; Çavuş et. al., 2018; Erdal & Sarı, 2020; Soyuçok, 2018; Yavuz et al., 2014; Yıldırım, 2018).

The fourth research question looked into middle school students' views of the effect of TUBITAK 4006 Science Fairs on their perceptions of science. All participants stated that the science fair allowed them to see science in a more positive light. Çelik (2019) also reported that students who attended science affairs saw science in a more positive light. Our results are consistent with the literature (Avcı & Su Özenir, 2018; Benzer & Evrensel, 2019; Kahraman, 2019; Keçeci et al., 2018; Sontay et al., 2019).

The fifth research question examined what problems middle school students experienced during TUBITAK 4006 Science Fairs and what kind of solutions they found to those problems. Participants remarked that they had difficulty performing science projects due to broken tools and materials. They noted that the science fair was too busy. They added that they got nervous during presentations and experienced communication problems. Moreover, they complained that the science fair conflicted with classes, included unoriginal projects, and failed to provide auxiliary materials. Participants proposed different solutions to those problems. According to them, science fairgrounds should be large, project teams should be composed of few people, projects should be original, and student selection should be more meticulous. Okuyucu (2019) also reported that teachers and students faced different problems (lack of material, conflicts, etc.) during science fairs and came up with different solutions. Bunderson and Anderson (1996) emphasized that students should be selected for science fairs according to certain criteria. Our results are consistent with the literature (Günbey & Değirmençay, 2021; Şahin & Çelikkanlı, 2014; Özel 2016; & Akyol, Ural Keleş & Soyuçok, 2021; Yener & Balcı, 2020).

The sixth research question focused on middle school students' observations of TUBITAK 4006 Science Fairs. Participants remarked that the science fair was a fun event where they had the chance to watch presentations on new projects and see other attendees interacting, helping each other, and coming up with different designs. They also added that they had the opportunity to watch robots operate. Students have the chance to present their projects in science fairs (Yavuz et al., 2014) and communicate effectively with their peers and share their experiences with them (Perry, 1995). Students talk to one another and help one another with their science projects and have fun during the process (Şahin & Çelikkanlı, 2014). Our results are consistent with the literature.

Future Research and Limitations

Future Research

This study investigated middle school students' views of TUBITAK 4006 Science Fairs. Researchers should recruit students from other grade levels and look into their views of TUBITAK 4006 Science Fairs. Future studies should also focus on what teachers, parents, and administrators think about TUBITAK 4006 Science Fairs. Our participants stated that they encountered different problems during science fairs. Authorities should take those problems into account and revise science fairs accordingly. Our participants noted that they saw science in a more positive light after attending the science fair. Therefore, educators should encourage students to attend science fairs. Our participants also added that the science fair positively affected courses.

Therefore, teachers should make use of science fairs to teach their courses more effectively.

Limitations

This study had three limitations. First, the sample consisted only of middle school students. Therefore, the results cannot be generalized to all students. Second, the study adopted a phenomenological research design. Therefore, the results are based on self-reports. Third, the results may be biased because students who attend science fairs are already interested in science. Therefore, our participants might have expressed more positive opinions regarding TUBITAK 4006 Science Fairs.

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