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The Contribution of Informal Learning Environments to Gifted Students and Advisors: The Case of 4006 Science Fair

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ABSTRACT

The aim of this study is to comprehensively examine the effects of the 4006 TÜBİTAK Science Fair on teachers and students. The study was designed with a phenomenological design, which is a design of qualitative research method. The participants consisted of 17 gifted students and 6 advisor teachers who participated in the fair held at the Science and Art Center (SAC). The data collection process was carried out through semi-structured interviews and in-depth information was obtained from the experiences of the participants. The findings of the study show that the science fair contributed significantly to the professional development of teachers. The advisor teachers stated that the science fair provided them with important opportunities to improve their teaching skills, enrich their pedagogical approaches and interact with students. They also emphasized that science fairs enable teachers to develop more innovative and creative methods in learning processes. In terms of students, it was observed that the project development and presentation processes increased self-confidence, strengthened communication skills and provided a deeper involvement in scientific research processes. Participants stated that the science fair provided an experience that encouraged them to research and reinforced their scientific thinking skills. This has a positive impact on students' academic achievement by increasing their interest in science and technology. As a result, it was determined that the 4006 TÜBİTAK Science Fair provides important gains for both teachers and students in the educational context.

Keywords: Informal Learning, Science Fair, Gifted

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INTRODUCTION

Informal Learning

Educational environments do not only consist of formal learning-teaching processes in the classroom. Students can also acquire knowledge and skills outside formal learning environments, in their free time or through independent activities. Informal learning is a form of learning that is unplanned and unstructured and that individuals acquire through social interactions, various daily life experiences, environmental observations and on-the-job practices. This type of learning is based on individuals' interests, needs, abilities, motivation, attitudes and curiosity and is an important component of lifelong learning processes. Out-of-class learning environments allow students to develop their creative thinking skills, increase their problem-solving abilities and gain more in-depth knowledge in their areas of interest. Formal learning takes place in formally established educational institutions such as schools, colleges, universities, training centers, etc. (Hager & Halliday, 2007). Informal learning manifests itself in life practices outside these formal institutions. Individuals learn in many different ways through social interaction and networks (Marsick, 2009). The concept of informal learning has a wide range of uses. Although the concept of informal learning is used everywhere, the term is difficult to define and somewhat controversial (Callanan et al., 2011). The reason why it is difficult and complex to define may be that it is diverse and broad in nature, has an unplanned and uncontrolled structure, and involves individual differences and subjective experiences.

Informal learning is not a structure designed as a planned and programmed learning process. Therefore, it is not easy to standardize, systematize and assess informal learning (Marsick, 2009). Informal learning has a broad and deep nature. It is all learning that takes place outside the curriculum of formal and informal educational institutions and programs (Schugurensky, 2000). Formal training programs usually have a generic structure and are not adapted to the needs of individual employees (Decius et al., 2019). In fact, the fact that the structure of formal training programs is usually standardized may be insufficient to meet the specific learning needs of individuals. This can reduce the effectiveness of teaching-learning processes and negatively affect students' motivation to learn. On the other hand, informal learning environments offer a more flexible learning experience according to individuals' own needs and interests. Thus, individuals can experience a meaningful learning process and continue their personal development. Informal learning covers the learning processes that individuals experience throughout their lives. Therefore, informal learning and lifelong learning are closely related to each other. Individuals learn by experiencing and interacting in all areas of their lives, not only at school, in educational institutions outside school or in job training. Lifelong learning involves the process of continuously acquiring knowledge, skills and competencies throughout one's life. The concept of lifelong learning gained great importance in cultural and intellectual integration in the late 1960s (Hager & Halliday, 2007). In fact, there is much debate about lifelong learning in popular, political and scientific structures (Billett, 2018). These debates are inherent to lifelong learning. Lifelong learning is influenced by the ever-changing needs of societies, individual, social and economic changes. Individuals develop personally, professionally and socially through informal learning environments throughout life. Informal learning occurs in many settings. Due to the flexible nature of informal learning, there is a wide range of informal

environments. From the workplace to digital platforms, there are many learning environments such as social networks, internet, communities, home environment, group of friends, street, etc. Some of the informal learning environments where individuals freely acquire knowledge and skills and gain experiences are zoos, botanical gardens, aquariums, nature parks, art galleries, historical sites and monuments, museums and libraries. One of the informal learning environments where individuals learn knowledge and skills through rich experiences, make discoveries with interest and curiosity, and develop their skills is science fairs.

Science Fairs

There are different types of organizations where students exhibit scientific projects, workshops are organized and various scientific experiments/activities are carried out. Science fairs, science festivals and science festivals are some of them. These organizations can be seen as informal learning environments (Öztürk et al., 2023). Science fairs are events where students develop and exhibit projects on various scientific topics. Science fairs are of great importance in terms of introducing science in a fun way and strengthening individuals' relationship with science. At such events, participants exhibit their scientific projects, conduct experiments and activities, and exchange information. These fairs are usually organized by educational institutions, various societies and science centers. In Türkiye, the Scientific and Technological Research Council of Türkiye (TÜBİTAK) organizes science fairs to improve students' scientific thinking skills and to increase their interest in science and technology. Some of the goals of this program are to direct students to scientific studies, to develop students' teamwork skills in the form of interdisciplinary cooperation, and to develop career awareness in different fields of science (TÜBİTAK, 2024). Science fair processes motivate students to produce scientific projects. Students prepare original scientific projects to be exhibited at the fair. During the project preparation process, students develop scientific thinking and research, problem solving and creativity, teamwork, communication and presentation skills. In the science fair organization, students, under the supervision of a teacher, investigate a problem situation they are curious about using scientific methods and present their findings to other students, teachers and the community (Çetinkaya & Ayartepe, 2020). TÜBİTAK 4006 Science Fairs program has a special importance in the field of education as it directly addresses schools and students (Torun & Akpınar, 2021). Science fair activities allow students to experience scientific processes by bringing together practice and theory. This process improves students' ability to think analytically and apply scientific methods. Science fairs have an important place in science teaching because they enable students to learn science, contribute to the development of positive attitudes towards science, enable students to take part in research-based activities and motivate students to scientific research (Çetinkaya, 2020).

In recent years, students' and teachers' interest in science fairs has been increasing in Türkiye. The fact that science fairs provide students with the opportunity to develop 21st century skills, that project exhibition and presentation processes increase students' motivation, and that these processes provide students with the opportunity to gain hands-on experiences may be among the important reasons for this increased interest. In recent years, studies examining the views of teachers and students on the TÜBİTAK 4006 Science Fairs Support Program have been conducted (Çetinkaya & Ayartepe, 2020; Günbey, & Değirmençay, 2021; Kural & Nakiboğlu, 2020; Keleş & Soyuçok, 2020; Şen, 2023; Topcu & Kumru, 2022). In addition, there are studies

examining the contributions of science fairs to students (Öztürk et al., 2023), the effect of science fairs on science process skills (Keskin & Özel, 2022; Özel & Keskin, 2022), and attitudes towards science fairs (Çağan et al., 2020; Çetinkaya, 2020). The importance of this study lies in the fact that it provides concrete data on the educational process by examining the contributions of 4006 Science Fairs to students and teachers in depth. Science fairs provide an important opportunity for students to develop their understanding of science, develop skills such as scientific thinking, conducting research, producing projects and expressing themselves, while also providing teachers with the opportunity to reinforce their counseling skills and gain experience. (Ward, at, al, 2018). Science fairs increase students' understanding of science research. The strengths of science fair programs include focusing on science research and allowing students flexibility in choosing and conducting projects (Schmidt & Kelter, 2017). This study aims to determine the benefits of science fairs from the perspectives of teachers and students by revealing the value they add to educational environments.

Purpose of the Study

The aim of this study is to examine the contribution of 4006 Science Fair to students and teachers. In line with this purpose, in the research;

-What are the opinions of advisor teachers about the contributions of the science fair?

-What are the opinions of the gifted students who took part in the science fair about the contributions of the science fair?

METHOD

Research Model

The research was designed according to the phenomenological design, which is one of the qualitative research methods. In this design, it focuses on the concepts and phenomena that people form as a result of their experiences and the education they receive (Creswell & Poth, 2016).

Participants

The participants of the study consisted of 17 gifted students and 6 advisor teachers who took part in the 4006 TÜBİTAK Science Fair at a Science and Art Center in Van province.

Data Collection Tool

One of the most powerful aspects of interviews used in a qualitative study is that they help us learn about what we cannot see and reveal detailed information about what we can see (Glesne, 2011). Collecting data through interviews is frequently used especially in studies conducted in the field of education. After a detailed review of the relevant literature, the researcher drafted semi-structured interview forms. These interview forms were presented to two experts in the field of science education, one in the field of science education in gifted education and one in the field of Turkish language education in order to check how well they serve the objectives of

the research, their comprehensibility, applicability and academic accuracy. In line with the suggestions of the experts, the interview forms were edited and finalized. The data were collected through these semi-structured interviews with students and teachers at the end of the fair.

Application

The students in the study group prepared projects for five months in the presence of mentors. Students and mentors exchanged ideas on the progress of the project on a weekly basis. The projects, the type of projects and the thematic subject of the projects are given in Table 1:

Table 1: Projects exhibited at the science fair, type of projects and thematic subject of the projects

No	Project name	Project type	Project thematic topic
1	I Learn Science Concepts with Fun	Design	STEAM (Science, Technology, Engineering, Arts and Mathematics)
2	Our Idols Revive with Art	Design	Values Education
3	"Coding in English" Board Game	Design	Robotics and Coding
4	English Rebus Game	Design	Foreign Language Education
5	Carbon Footprint	Design	Environment and Environmental Protection
6	Remote Controllable Robotic Arm	Design	Robotics and Coding
7	Periodic Ruler Game	Design	Robotics and Coding
8	Can My Robot Play Soccer?	Design	Robotics and Coding
9	Learning the Origins of Words with Wheel of Fortune	Research	Language and Literature
10	Investigating the Use of Hexagon in Cold Storage and Columns Inspired by Beehives	Review	Biotactics
11	Produce Bioplastics from Waste	Review	Waste Management and Recycling
12	Learning My Rights through Play	Research	Human Rights and Democracy
13	"Our Loyal Friend is the Black Earth"; Let's get to know Aşık Veysel	Research	Values Education
14	"Hacivat-Karagöz" and Elements of a Sentence	Research	Game and Gamification
15	Waste Batteries Become Tickets!	Design	Robotics and Coding
16	Cryptology with Password Wheel	Design	Original Algorithm Design
17	We Recognize Our Authors with Raffles!	Research	Values Education
18	We Learn Our Values with My Watch	Research	Values Education

As seen in Table 1, students developed 18 projects in total. Ten of the projects were of "design", six were of "research" and two were of "investigation" type. When the thematic areas of the projects were examined, it was determined that 1 project was prepared in STEAM (Science, Technology, Engineering, Art and Mathematics), 5 projects in Robotics and Coding, 4 projects in Values Education and one project each in Foreign Language Education, Environment and

Environmental Protection, Language and Literature, Biotactics, Waste Management and Recycling, Human Rights and Democracy, Games and Gamification and Original Algorithm Design. The developed projects were exhibited as a "Science Fair" for two days. The fair was held between May 16-17, 2024. The exhibited projects were visited by both students and teachers studying at the Science and Art Center and students and teachers studying at different grade levels in different schools in the city center. The students involved in the projects gave information to the visitors about the projects they developed.

Data Analysis

While analyzing the answers given by the students, content analysis method, one of the qualitative data analysis methods, was used. The aim of content analysis is to reach concepts and relationships that can explain the collected data (Kleinhekselet et al., 2020). During the analysis, firstly, the answers given by the students were examined in detail and words were written on the margin of the paper as a result of the examinations. Open coding (Merriam, 2009) was performed at the beginning of the analysis. Then, similar and related codes were combined under certain categories. To ensure the reliability of the study, the collected data were analyzed by two independent researchers. The codes and categories were presented in a way that the reader could understand. Some of the answers given by the students were given directly. All participants were told that participation in the study was voluntary and instead of their real names, they were given codes as S1, S2 ... S17. The teachers were coded as T1, T2, ... In order to ensure the reliability of the research, the collected mind maps were analyzed by two independent researchers. The agreement between the codes created by the two independent researchers was examined (Miles & Huberman, 1994) and the agreement between the experts was calculated as 90%.

Validity and Reliability

In qualitative research, unlike quantitative research, concepts such as credibility, transferability or consistency are used instead of validity and reliability (Patton, 2014). In this study, strategies were used to ensure credibility, transferability, verifiability and consistency. In order to increase the credibility of the research, depth-oriented data were collected and participant approval was obtained for the data obtained. In order to increase the transferability of the research, rich and intense definitions were made and explained in detail, the data obtained were described in detail and direct quotations were used. In order to increase the confirmability of the research, all data were transferred to the computer and kept in digital environment. The results obtained were verified with continuously collected data and a logical explanation was presented to the reader in this context. In order to ensure consistency in the research, different researchers were assigned to analyze the data and the analyses created by the researchers were compared. As a result of the comparison, it was seen that there was consistency between the analyzes.

FINDINGS

The data obtained from the research were analyzed and the following findings were obtained from the responses of teachers and students, respectively.

Findings related to the contributions of the science fair to the students

The findings related to the question *"What contributions did the Science Fair we conducted make to you?"* in the semi-structured interview questions asked to the students are given in Table 2 below:

Table 2: Themes and codes related to the question *"What contributions did the Science Fair we conducted make to you?"*

Theme	Code	f
Development of communication skills	Presentation Skills	4
	Speaking Skills	2
	Self-expression	2
	Project Presentation	2
	Narrative Skills	2
Increased motivation to make and carry out projects	Motivation	6
	Being Happy	1
	Rejoice	1
Increase in student self-confidence	Self-confidence	6
	Confidence in yourself	2
Acquiring academic knowledge	Acquiring information	4
	Learning	1
	Acquiring New Knowledge	2
	Information	1
Getting experience in the academic field	Getting Experience	2
	Experience	1
Being responsible	Taking responsibility	5
Development of imagination	Imagination	3

As a result of the content analysis of the data obtained from the interview question, the students' answers were grouped under the themes of "development of communication skills (12)", "increased motivation for making and carrying out projects (8)", "increase in student self-confidence (8)", "Acquiring academic knowledge (8)", "Being responsible (5)", "development of imagination (3)" and "getting experience in the academic field (3)". Some student responses to these themes are given below:

S1: It gave me the desire to do a project. It helped me to be more open and clear to people. It helped me to improve my speaking and explaining skills.

S2: The desire to do a project... It contributed to motivation to create a project, gaining self-confidence, and increasing our knowledge.

S8: I got experience and knowledge while doing the project.

S12: I met younger students and understood my teachers. I took a responsibility for myself.

The findings related to the question "Can you describe the situation that excites you the most at the Science Fair?" in the semi-structured interview questions asked to the students are given in Table 3 below:

Table 3: Themes and codes related to the question *"Can you describe the situation that excites you the most at the Science Fair?"*

Theme	Code	f
Presentation of the developed project	Ability to make a presentation	7
	Explaining/speaking about the project	3
	Presenting the project	2
	Introducing the project	2
Conducting project visits	When their own friends come to visit	2
	Having visitors	1
Lack of an exciting situation	I'm not excited	2

As a result of the content analysis of the data obtained from the interview question, the answers of the students were grouped under the themes of "making the presentation of the project developed" (14), "making project visits" (3) and "not having an exciting situation" (2). Some student responses belonging to these themes are given below:

S12: Presenting it to adult people.

S2: When the science fair officials asked us to explain our project.

S16: Our class coming to visit us.

S14: Explaining and introducing the project to people.

Findings on the contributions of the science fair to teachers

The findings related to the question *"What contributions did the Science Fair we conducted make to you*?" in the semi-structured interview questions asked to the teachers are presented in Table 4 below.

Table 4: Themes and codes related to the question *"What contributions did the Science Fair we conducted make to you?"*

Theme	Code	f
The idea of producing new projects	Motivation for the new project	1
	Increased motivation	2
	Don't like it	1
	Willingness to do new projects	1

Working collaboratively on projects	Working as a team	1
	Working collaboratively	2
	Doing it as a team	1
Innovative thinking about future projects	Increased imagination	2
	Innovative thinking	2

As a result of the content analysis of the data obtained from the interview question, the students' answers were grouped under the themes of "working collaboratively in projects" (4), "the idea of producing new projects" (5) and "innovative thinking about future projects" (2). Some of the teachers' responses to these themes are given below:

T1: I talked a lot with the audience during the project exhibition. I realized my communication skills. I felt that I now think more innovatively to create a new product.

T3: It enabled me to work in cooperation with my colleagues at school...

T5: When I saw the excitement in my students, my desire to do a project, to be a consultant for a project revived and showed that I was on the right track.

The findings related to the question *"What do you think the Science Fair we conducted contributed to the students who took part in the projects?"* in the semi-structured interview questions asked to the teachers are given in Table 5 below:

Table 5: Themes and codes related to the question *"What do you think the Science Fair we conducted contributed to the students who took part in the projects?"*

Theme	**Code**	**f**
Increase in students' self-confidence	Gaining self-confidence	4
	Increased self-confidence	1
Request to create a new project	Making an original project	1
	Motivation to create a project	1
	Creating/producing new projects	1
Improved self-expression and communication skills	Self-expression	1
	Making a presentation	1
	Public speaking	1
	Interactivity	1
Acquiring new knowledge	Learning something	1
	Acquiring knowledge	1
	Learning a lot	1
	Learning new ideas	1

As a result of the content analysis of the data obtained from the interview question, the teachers' answers were grouped under the themes of "increase in students' self-confidence" (5), "desire to create new projects" (3), "self-expression and improvement in communication skills" (4) and

"acquiring new knowledge" (4). Some of the teachers' responses to these themes are given below:

T5: In addition to social developments, I think that it contributed to the students' ability to explain the project they did and bring it to a level that the other person can understand and to the students' ability to defend an idea.

T4: Students gain values such as teamwork and self-confidence.

T2: It helps students to express themselves, make presentations and gain self-confidence.

T1: Students acquired new knowledge thanks to this fair. I think they learned a lot from other projects. students are in communication and interaction because they work in groups.

The findings related to the question "*What are the science process skills that you think Science Fair develops in students?"* in the semi-structured interview questions asked to the teachers are given in Table 6 below:

Table 6: Themes and codes for the question *"What are the science process skills that you think Science Fair develops in students?"*

Scientific process skills	**f**
Observation skills	6
Recording and interpreting data	6
Experimenting	6
Hypothesis making and testing	5
Determining and controlling variables	5
Conclusion skills	5

As seen in Table 6, the scientific process skills that teachers think students have acquired based on their answers are grouped under the headings of "observation skills" (6), "recording and interpreting data" (6), "experimenting" (6), "hypothesis making anda testing" (5), "determining and controlling variables" (5) and "conclusion skills" (5).

DISCUSSION AND CONCLUSION

The findings of this study show that the science fair had significant positive effects on students and teachers. The science fair increased students' communication skills, motivation and self-confidence towards doing projects, and especially contributed to their social and academic development. While presenting their projects at the science fair, students developed not only

their ability to convey information, but also their ability to explain complex issues to others and ensure their comprehensibility. This situation reveals that science fair is an effective method in providing students with both social and academic skills. Yıldırım (2020) conducted a study to examine the opinions of students and advisor teachers who participated in the science fair with a project, and it was found that science fairs provide students with skills, gain love, motivation, interest in science lessons and contribute to the learning of science course subjects according to the opinions of students and advisor teachers. Sontay et al. (2019) stated in their study that 4006-TÜBİTAK Science Fairs helped students gain positive attitudes and skills during the project preparation and project presentation processes. In his study, Okuyucu (2019) stated that the participants stated that the science fair contributed to them in the fields of 'positive attitudes and behaviours' and 'higher order thinking skills'. Similarly, Çetinkaya & Ayartepe (2020) stated that the majority of teachers had positive thoughts about science fairs, that the source of project ideas were generally teachers and students, and that teachers thought that the projects prepared by teachers contributed to students. Kural & Nakbioğlu (2020) aimed to reveal the perspectives of experienced chemistry teachers who participated in these fairs as coordinators or advisors, and concluded that science fairs were found to be positive in terms of students learning the ways of accessing information. Haataja, et. al. (2019) Examines five educators' understanding of the characteristics of mathematically gifted students and the social learning environment that supports their development at a school for mathematically gifted adolescents in Finland. This research shows that gifted students and their educators form a tight community, the social learning environment of which supports shared motivation, and practicing social skills. Zahidi, et al. (2021) investigates the effectiveness of science camp (Youth Science Camp) on young children's understanding and knowledge about science. This study showed that the Camp is effective in increasing young children's knowledge about science concepts. Calabrese and Capraro (2022), in their study aimed to determine whether the attitudes of gifted students in a STEM summer camp were parallel to the educational needs of adults, that is, self-directed learning; they showed that students expressed more positive self-efficacy and intrinsic motivation, decreased extrinsic motivation and anxiety, and were less focused on task completion. The results obtained in this study are in parallel with the results in the literature.

In our study, it was revealed that the 4006 Science Fair played an important role in developing students' speaking, communication and presentation skills. It can be said that such activities contribute to students' academic and social development by strengthening their ability to express themselves. In their study, Benzer & Evrensel (2019) stated that science fairs have many contributions such as making presentations, speaking in front of the public, defending their opinions, participating in democratic discussion environments, and developing arguments. In this study, it was observed that the scientific research and enquiry skills of the students who participated in the science fair improved. It was determined that students became more competent in processes such as forming hypotheses and testing this hypothesis, designing experiments, making observations, recording and interpreting data. In the literature, it was concluded that science fairs are necessary for the realisation of effective science education (Özdemir & Babaoğlan, 2019). In addition, there are studies indicating that science fairs have positive contributions to the development of students' scientific process skills (Erdal & Sarı, 2020; Keskin, 2019; Keskin & Özel, 2022).

The advisor teachers in the study stated that their participation in the science fair increased their desire to produce new projects and improved their collaborative working skills. The fact that teachers create and present a project step by step with students prepares a ground for them to think more creatively and innovatively in future projects. At the same time, they are inspired to improve their own teaching practices through the effects they observe on students. Teachers' views that the science fair increases students' self-expression and presentation skills emphasise that it makes students better equipped for future scientific activities. The fact that students acquire new knowledge and share information is evidence that the fair contributes to the learning process. Çetinkaya & Ayartepe (2020) found that teachers found that taking part in a science fair made various contributions to them and that they mostly wanted to take part in a science fair again. Kural & Nakipoğlu (2020) concluded in their study that chemistry teachers found science fairs positive in terms of students learning the ways of accessing information. In addition, Öztürk et al. (2023) stated in their study that all of the teachers who participated in the science fair pointed out that the project process developed positive attitudes and positive understanding towards science and scientists. These findings coincide with the results of our study and support the general trend in the literature on the educational effects of science fairs.

Suggestions

Based on the findings of this study, it is suggested that the integration of scientific activities such as 4006 TÜBİTAK Science Fair into science teaching should be systematically encouraged. Firstly, considering the positive effects of science fairs on student and teacher development, such activities should be made more widespread at all levels of education. Considering that science fairs improve students' research, project development, critical thinking and communication skills, it is suggested that science fairs should be considered not only as end-of-term activities in curricula, but also as continuous learning and application areas spread over the whole education process. In this direction, systematic support of science fairs together with project-based learning strategies, especially in science education, will strengthen the participation of students not only in exam-oriented but also in process-oriented and experiential learning processes. For teachers, in order to increase the collaboration opportunities and pedagogical contributions offered by science fairs, it is recommended that in-service training programmes should be organised to improve teachers' scientific research, project management and consultancy skills. In addition, incentive mechanisms should be created to increase teachers' motivation towards scientific projects. Finally, in order to evaluate the long-term effects of science fairs, it is recommended to conduct longer-term longitudinal studies examining the effects of science fair experiences of teachers and students on their professional lives and scientific perspectives. Such studies will contribute to a more comprehensive evaluation of the contribution of science fairs to education and to the development of sustainable policies to increase the impact of these events.

Author Statements

Ethical Rules: The ethics committee report of this research was obtained with the decision of İstanbul 29 Mayıs University dated 07.10.2024 and numbered 2024/10.

Authors Contributions: %50 first author, %50 second author

Conflict of Interest: The authors declare that they have no conflict of interest related to this study.

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