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STEM EXPERIENCES OF SCIENCE TEACHERS AND FIFTH GRADE STUDENTS

Alaattin ERDEM, Burcu ANILAN, Zeynep KILIÇ

Abstract: The aim of this study is to reveal the opinions of science teachers and fifth grade students on STEM education and applications, which form the basis of the field of Science and Engineering applications. Qualitative data collection tools were used in the study. Data were collected using an open-ended questionnaire prepared with open-ended questions used in phenomenology research. The obtained data were analyzed by descriptive analysis method. The results of the analysis of the data showed that teachers experienced some problems during the application, but they saw it as an especially useful application for both themselves and students. They said that students have similar problems with teachers, but they have contributed to them in many ways. As a result, it can be said that although there are many deficiencies in the implementation of STEM education, it provides positive contributions for science teachers and students. For these applications to be more effective and efficient in the future, studies can be conducted to search and eliminate the shortcomings of the application.

Key words: STEM education, STEM applications, science teaching, teacher opinions, student opinions.

1. Introduction

Developments in science and technology that make our lives easier and enable us to live better and help us solve the problems we meet, have an impact on education as well as every field. Therefore, the aims of education have also changed from the past to the present. In the 21st century we live in, the aim of education is to provide individuals with basic skills (reading, writing, arithmetic) as well as high-level skills (critical, creative thinking, critical thinking, problem solving, working in collaboration etc.), for individuals to make their lives healthier and more functional. 21st century skills are the basic skills necessary for individuals to be successful in their school, social, professional, personal, and daily lives (Partnership for 21st century Skills, 2009 [P21]). Through these skills, individuals gain access to information by knowing how to access information, use the information they reach to solve the problems they meet in their daily lives, perform complex tasks, employ high-level thinking skills, work in harmony with other individuals, use technology effectively and positively. They become aware of their own competencies, the economic and social events in the world and the society they live in (Anagün, Atalay, Kılıç, & Yaşar, 2016). The curricula renewed in Turkey include 21st century skills such as entrepreneurship, problem solving, creative thinking, critical thinking, collaboration, self-management. Besides, with the science course, it is aimed that students acquire scientific process skills and raise students as science literate individuals (Kaptan, 1998). Science literate individuals possess characteristics of people who can understand the nature of science and use the concepts, laws and principles related to science in daily life, understand the relations between science-technology-society, take into account the scientific processes and 21st century skills in solving the problems and making decisions, work in the field of natural sciences and be willing to explore the world and accept that knowledge can change in line with changes in science, and distinguish the benefits and harms of science for human life (Anagün, 2018).

It is important that the science course curriculum has approaches designed in a way that can highlight various aspects of students during the activities in the science course and relate what they learn to daily life to raise students who are science literate (Demirel, Tuncel, Demirhan, & Demir, 2008).

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Therefore, there are innovative approaches in the renewed and updated science curriculum. One of these approaches is STEM education.

STEM can be found under different names across various countries. It is referred to as FeTeMM in Turkey. STEM education is formed by the combination of all knowledge and skills in science-technology-engineering and mathematics (Yamak, Bulut & 2014). In 2016, the Ministry of National Education, defined STEM as an education system formed by establishing a relationship between the fields of science, technology, engineering, and mathematics in its STEM education report (MEB, 2016). Although STEM is known as a new education system that has been tried to be implemented all over the world, its origins date back to old times (Yıldırım & Selvi, 2015). The purpose of STEM education is to increase the number of individuals who specialize and make a career in STEM fields, to expand the STEM workforce and to ensure that all students are STEM literate (National Research Council [NCR], 2011).

STEM literate individuals use 21st century skills to solve the problems they encounter, they benefit from the disciplines that make up STEM, they are open to changes, economically productive and interested in professions related to science-technology-engineering-mathematics (Bybee, 2011). Since STEM education plays a significant role in raising qualified individuals required by our age, it is included in the programs of different countries. One of the curricula covering STEM education in our country is the Science course. The dimension of "Engineering and design skills" was added to the skills in the Science curriculum updated in 2018 (MEB, 2018). Therefore, science teachers conducting the science course should include applications related to STEM in their lessons.

There are many studies in the literature on STEM. Some of these studies examined the effect of STEM education on students' academic achievements, motivations and thinking skills (Keçeci, Alan and Zengin, 2017; Knezek, Christensen, Tyler-Wood and Periathiruvadi, 2013; Koyuncu and Kırgız, 2016; Meng, 2013; Yamak, Bulut, & Dündar, 2014). Some studies on STEM have examined students' attitudes towards STEM (Aydın, Saka & Guzey, 2017; Wendell and Rogers, 2013). In addition, there are studies in which the views of teachers and students about STEM and STEM education and the problems met in STEM education are addressed (Hacıoğlu, Yamak, & Kavak, 2016; Pinnell, et al., 2013; Weber et al. 2013). The STEM education and implementation process to be conducted functionally, it is thought that the experiences and opinions of teachers and students in this process are determined, and the results of this study are important to determine the needs and the problems experienced in this process and to achieve the goals of the curriculum. In this context, this study aimed to reveal the opinions of science teachers and fifth grade students on STEM applications.

2. Method

2. 1. Research design

The research is designed using basic qualitative research. The focus of basic qualitative research is on how participants offer meaning of a situation or phenomeon. Researchers who are interested in how people interpret their experiences, how they construct their world (Merriam, 2009). This research is aimed to reveal perceptions and experiences of science teachers and fifth grade students about STEM and STEM applications. In this context, the basic qualitative research approach was used in the research.

2. 2. Participants

Criterion sampling types are used in qualitative research (Patton, 2002). In this research, criterion sampling, which is one of the purposeful sampling types, was used. Criterion sampling uses criteria which participants meet (Yıldırım & Şimşek, 2013). The criteria in this research are that teachers are science teachers and teaching fifth grade students. The students are fifth grade students. The reason why teachers are science teachers is that there are STEM activities in the science curriculum. In this context this research was carried out in the state secondary schools in the central districts of Eskişehir province (Odunpazarı and Tepebaşı), affiliated to the Ministry of National Education in the spring

term of the 2017-2018 academic year. A total of 29 science teachers, 20 female and 9 male, and a total of 151 fifth grade students, 82 of whom were female and 69 were male, participated in the study.

2. 3. Data collection instrument

A questionnaire form consisting of open-ended questions was used to collect data in the study. The questionnaire form, which consists of open-ended questions, is one of the techniques used for data collection in the qualitative field and is referred to as "open-ended questions" or "open-ended survey" in the literature (Creswell, 2005).

The questionnaire– nine open-ended questions for science teachers and seven open-ended questions for fifth grade students. The research data were collected in a total of one month. Within the scope of the research, data were collected from both fifth grade students and science teachers. Since science teachers were willing to participate in the research but did not prefer to face to face interviews, the questionnaire consisiting open-ended questions was used in the study. Considering the developmental period questionnaire consisting open-ended questions was also used for the students. The questionnaire consisting open-ended questions was developed by reviewing the literature. Then questionnaire consisting open-ended questions was prepared for both teachers and students separately.

2. 4. Data analysis

Descriptive analysis technique was used to analyze the data in the study. The data obtained in the descriptive analysis are summarized and interpreted according to previously determined themes. Direct quotations are used to reflect the views of individuals interviewed or observed (Yıldırım & Şimşek, 2013). In this research, based on research questions a framework was formed for data analysis. Thus, it was determined according to which theme the obtained data would be organized. After the themes were determined, the data were brought together in a meaningful way according to the context. Then the data were defined and interpreted.

2. 5. Validity and Reliability

In this study, some precautions were taken by the researchers to ensure validity and reliability. The first of these measures is to seek expert opinion. Two faculty members of the subject area expert (studying science and STEM education and conducting qualitative research) examined the questions prepared by the researchers. According to the feedback from experts, researchers made corretions in the questions to bring research into a more appropriate from. After the themes were determined, each researcher analyzed the answers of science teachers and fifth grade students and formed a checklist. The reason for forming the checklist is to ensure the consistency of the data. Researchers came together and compared the checklists. When there was a conflict between the checklists, the answers of the science teachers and fifth grade students were re-examined and a consensus was reached.

The Turkish text of the study was translated into English. For this was taken a help from expert who translated from Turkish to English. The translation specialist translated the Turkish working text into English. Later, researchers and translation experts came together. The translation specialist and researchers re-read the work translated into English. The Turkish text of the study and the English text were compared. Thus, the consistency of the research was ensured.

3. Findings

The findings of this study, which aims to reveal the opinions of science teachers and fifth grade students on STEM applications, are given in accordance with the themes in Figure 1.

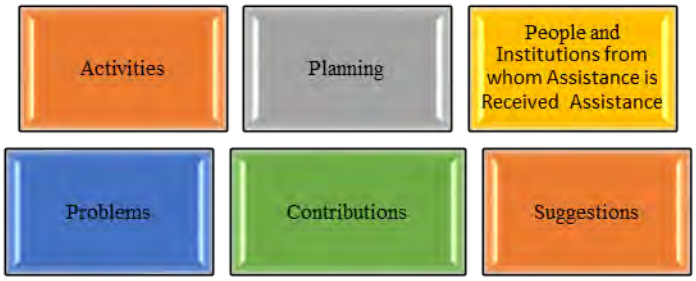

Figure 1. *Themes obtained from science teachers and fifth grade students*

The themes determined from the opinions of science teachers and fifth grade students, such as "Activities", "People and institutions from whom assistance are received", "Problems", "Contributions" are the common themes obtained from the opinions of science teachers and fifth grade students. The "planning" theme is the one that emerges only from the opinions of fifth grade students. The findings of the study are discussed in the form of the opinions of science teachers and fifth grade students, respectively.

Science Teachers' Views on STEM Applications

The opinions of science teachers participating in the study about STEM applications are given in Figure 2

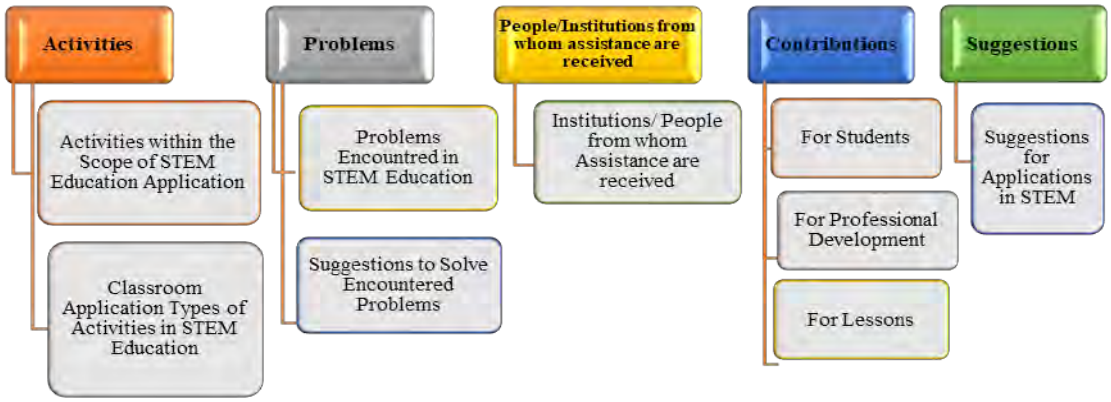

Figure 2. *Science teachers' views on STEM applications*

The opinions of science teachers about their applications within aims of STEM are gathered under five main themes. Activities and problems are two sub-themes. There are three sub-themes under the "contributions" theme, while there is only one sub-theme in the person / institution and suggestions themes. Each theme and sub-themes created are shown in the form of separate figures. Direct quotations from teachers' opinions are included.

The activities of science teachers within the scope of STEM applications are shown in Figure 3.

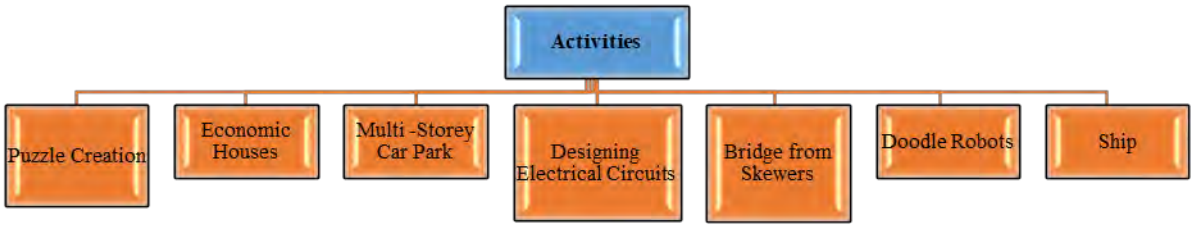

Figure 3. *The activities of science teachers related to STEM applications*

Science teachers stated that they generally carried out many different activities in STEM applications. While T18 of the teachers gave an opinion as "We designed efficient, sun-receiving economical houses.", one of the teachers T1 said that " I had activities to solve a problem they identifyed within the scope of STEM applications. For example, the bridge made of skewers is like a doodle robot from a simple electrical circuit to apply what you learn. " T13 stated ‘‘ We tested the brightness of the bulb by designing electrical circuits. Again, T14 "Construction of a multi-storey car park." and T5 said that "We designed a ship using a simple electric circuit and engine in line with the requests of the students".

The opinions of the teachers about how they apply the activities within the scope of STEM applications in the science lesson in the classroom are shown in Figure 4.

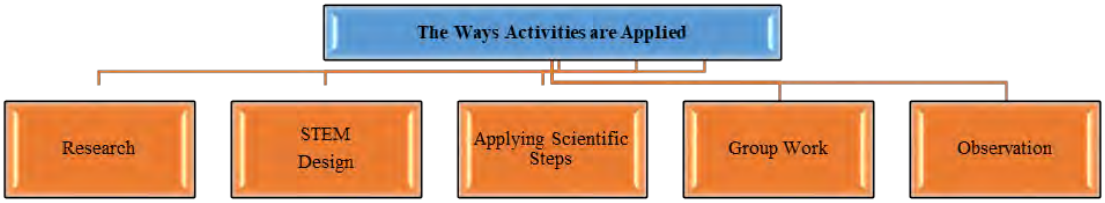

Figure 4. *Teachers' opinions about the way they apply the activities in the classroom*

Science teachers stated that they applied STEM activities in the classroom as "STEM design, doing research, making observations, group work, applying scientific steps". One of the teachers, T2, ‘The problem was determined in the first week and why the problem was chosen and its importance was discussed. In the following days, the drawing was made and the design in accordance with the drawing was started. ". S13 gave an opinion as" The students were guided by following the steps of the scientific study.”. Again, T21 stated “The students watched an example of a problem situation and a solution proposal with videos. They did not understand when I explained it, so they understood my expectations with an example by watching a video "and T25 gave an opinion as " We tried to find environmental problems by observing our environment and discussing the solutions. "

The problems teachers encounter in the activities they do within the scope of STEM applications in the science lesson are shown in Figure 5.

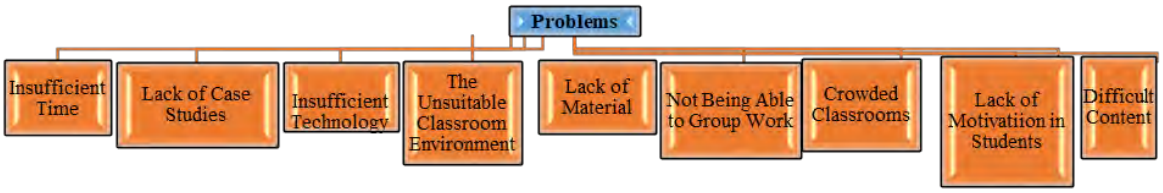

Figure 5. *Science teachers' opinions about the problems they encounter in their activities*

Science teachers, while performing STEM applications, stated that they faced problems due to insufficient time, lack of case studies, lack of technology, unsuitable classroom environment and lack of materials. Besides, science teachers believe that they faced problems due to the inability to do group work, crowded classes, lack of motivation in students and the difficulty of the content of the science course.

One of the teachers T8 gave opinion as, ‘The problem is that I am inadequate in terms of technology as a teacher. In other words, rather than producing a product in sense of technology, bringing technology-design projects” and stated that she encountered problems while performing STEM applications due to her lack of technology in terms of professional development. T9 believes that “The unit could have been more productive by giving more interesting examples. The working steps for students are complicated. Especially some words have remained abstract for students. ”He stated that he faced problems while performing STEM applications due to the difficulty of the content of the science course teaching program. Again, one of the teachers, T21 stated that‘ Developing a product was a problem for the students. They had no supplies either. Also, my school is an unsuccessful

school, my students are very mediocre. They do not have the knowledge and equipment to develop a product. " T27: "Because the classes are crowded, there may be noise problems when we divide the classes into groups. Students at this level do not like such practices." They stated that they faced problems while performing STEM applications due to lack of materials, crowded classes, not being able to do group work and low motivation of students.

The opinions of the teachers about how they solved the problems they encountered in the activities within the scope of STEM applications in the science course are shown in Figure 6.

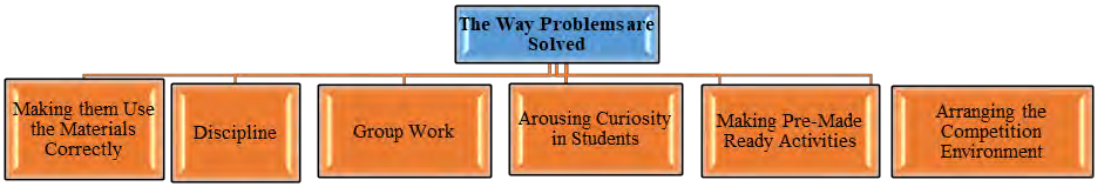

Figure 6.*Science teachers' views on how they solved the problems they encountered in STEM activities*

Science teachers stated that while performing STEM applications, they tried to solve the problems with practices such as making students use the materials correctly, providing discipline, making group work to solve the problems they encountered. Again, science teachers stated that they solved the problems they encountered while performing STEM applications by arousing curiosity in students, by doing previously made activities and organizing a competition environment. T12, one of the teachers, stated that `` I showed some application features that were done before in the classroom to increase student motivation and tried to increase their curiosity ". Stating that they aroused curiosity in students in order to increase the motivation of the students, the teacher T22 said `` Many students focused on the design paper, and I tried to ensure that some students obtain their products with materials such as plastic bottles, cardboard boxes, and fabrics found as waste in their homes " and stated that he/she solved the problem of lack of materials by asking students to bring easily obtained materials.

The opinions of teachers toward getting help about STEM applications are shown in Figure 7.

Figure 7. *Science teachers' opinions about the people / institutions they receive assistance from or not receiving assistance in STEM applications*

While some of the science teachers stated that they did not receive any assistance while performing STEM applications, other science teachers stated that they received assistance from classes, websites and coursebooks. Again, some teachers stated that they received in-service training on STEM applications. T28 stated that he did not receive any assistance from any person or institution by giving his opinion as "I did not receive it." Also, teacher T10 stated that he benefited from the internet by stating that `` I got the assistance of plans and applications from science groups on the Internet. " T18: "I participated in STEM education, which was opened with the cooperation of provincial national education and Ar-GE. " - stated that he participated in the in-service training about STEM.

The opinions of science teachers about the contributions of STEM applications to students are shown in Figure 8.

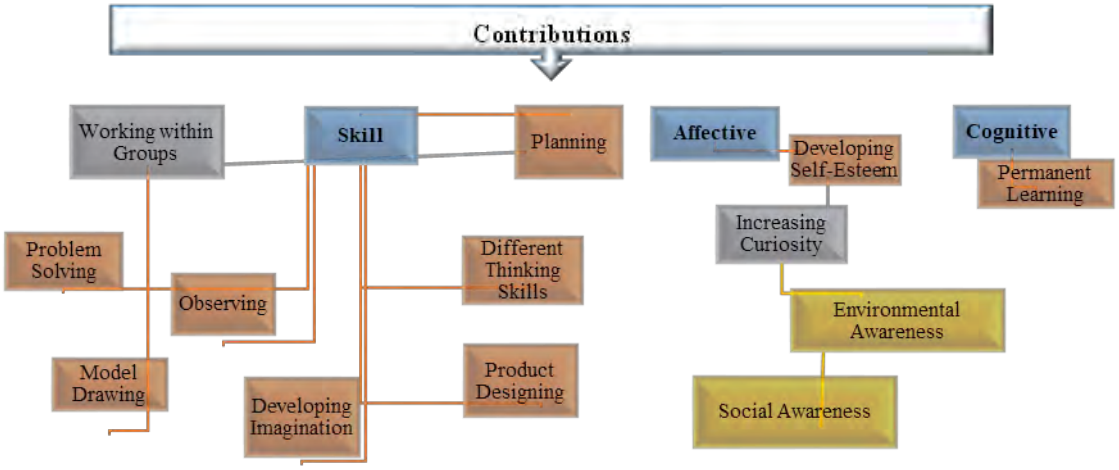

Figure 8. *Science teachers' opinions about the contribution of STEM applications to students*

Science teachers stated that STEM applications contributed to students in terms of skills, cognitive and affective. Science teachers stated that STEM applications provided students with "planning, problem solving, drawing models, different thinking skills, product design, working in groups, observing, developing imagination" skills. Science teachers also stated that STEM applications provide students with permanent learning, environmental and social awareness, develop students' imagination, increase students' curiosity, and develop students' self-confidence. One of the teachers ,T3 stated that, "I think STEM applications contribute to the students. Students were able to observe their surroundings, identify a problem, defend the discourse about how to solve this problem and defend the discourse about how to solve this problem and draw a model" and also said that STEM applications provide students with problem solving and model drawing skills. T22 "It has contributed to my students who strive to produce something successful and questioning. It has contributed to individuals who are more sensitive to their environment, who think and question " stated that students gained environmental awareness.

Again, one of the teachers, T18: ''They attended the lesson actively, they were not bored. They regained self-confidence in order to produce a product. " he stated that STEM applications enable students to participate in the lesson and develop self-confidence in students. Also, one of the teachers, T19: ''I think it contributed. I think that learning will become permanent and provide gains such as exploring while doing the activity, creativity, problem solving, and producing alternative solutions. " S11: " Yes, imagination and creativity, handcraft have been beneficial in terms of self-confidence and cooperation." , they stated that STEM applications provide students with different thinking skills such as creative thinking, critical thinking, collaboration skills, and develop students' imagination.

The opinions of science teachers about the professional development of STEM applications and the contribution to the lesson are shown in Figure 9.

Figure 9.*Science teachers' views on the contribution of STEM applications to the teaching profession*

Science teachers stated that STEM applications contributed to their own professional development in the dimension of "thinking differently, a perspective on science", and they also stated that they contributed to the science course in the form of "providing an active learning environment, providing interdisciplinary integration, being student-centered".

T6 ‘‘It definitely happened. When I progressed according to the steps, it contributed to how I could develop my idea and put it into practice” stated that it has changed the perspective on science. 11 teachers stated that “Yes, I think so. My doing new research has contributed to my new projects” " He stated that he changed his point of view towards science. About the contributions of STEM applications to the lessons T12 stated, “My doing new research has contributed to my new projects. " and expressed that STEM applications have provided more active learning environment in the classrooms that they were applied. Again, one of the teachers, T23, stated that "Science, engineering, mathematics and technology contributed a lot to our lesson because they are already intertwined with our lesson" and expressed that STEM education applications enables science course to integrate with other disciplines.Science teachers' suggestions for STEM applications are shown in Figure 10.

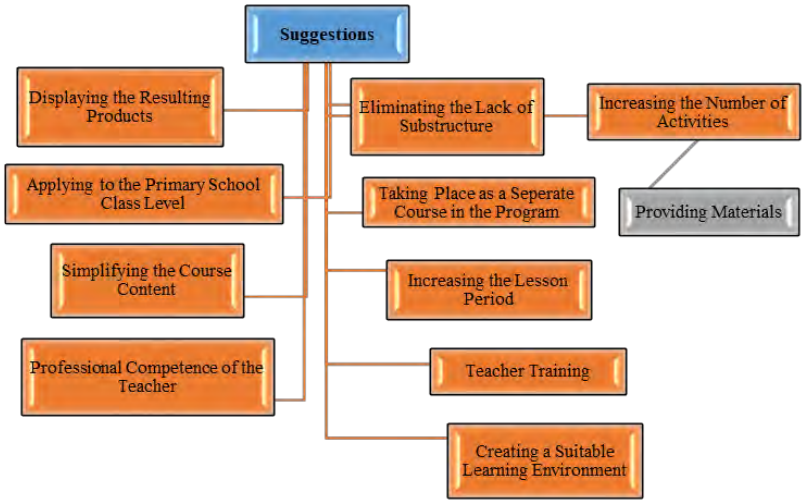

Figure 10.*Suggestions of science teachers about making STEM applications more effective*

Science teachers have made many different suggestions for STEM applications. Science teacher T4 stated , ‘‘I think these practices would be much more beneficial if they were supported by the school. It would be nice if this unit was one of the first units and students brought products and said that these products will be exhibited at the end of the year” and suggested that the product resulting after STEM application should be displayed. T21: ‘‘It is dysfunctional that it’s in the last unit. It can be put forward a little more. Students can practice these applications is primary school. They can learn easier if they get used to it” and suggested that STEM applications can be used in primary school. T1‘‘Lesson hours should be increased, more sample projects should be included in course books, course books should be organized in accordance with this”, T3 ‘‘To be more efficient teachers should receive training even if it is just a few days. There should be a lot of materials in schools.” And expressed that lessons hours should be increased, teachers should receive training about STEM. T9 ‘‘5. Grade students understand colorful, basic, wit plenty of examples and concrete concepts better. Therefore the unit can be organized in this way.” And suggested that activity number should be increased.

Findings regarding the opinions of fifth grade students as well as the opinions of science teachers about STEM applications are given below.

Fifth Grade Students' Views on STEM Applications

Opinions of fifth grade students participating in the study on STEM applications are given in Figure 11.

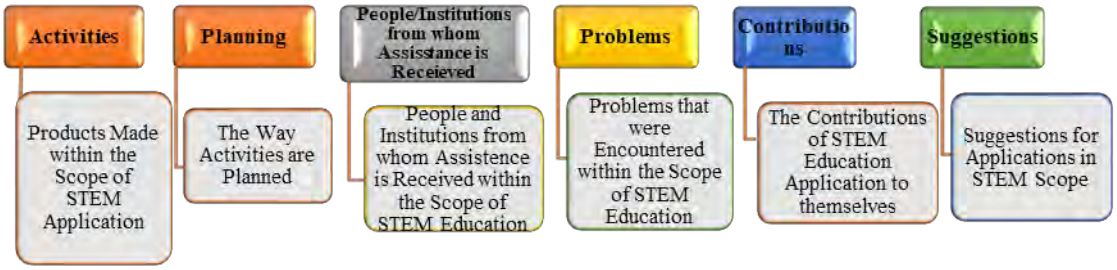

Figure 11. *Fifth grade students' views on STEM applications*

As it can be seen in Figure 11, opinions of fifth grade students on STEM applications are gathered under themes such as "Activities, planning, people / institutions from whom assistance is received, problems, contributions and suggestions". There is one sub-theme under each theme. Sub-themes related to each theme created were shown in the form of separate figures, direct quotations from student views were included. The activities of fifth grade teachers within the scope of STEM applications are shown in Figure 12.

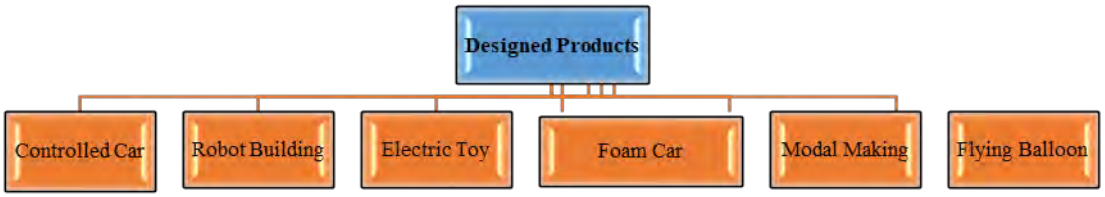

Figure 12. *Products created by fifth grade students as a result of STEM applications*

As it can be seen in Figure 12, fifth grade students stated that as a result of STEM applications in their science lessons, "controlled car, robot building, electric toy, foam car, model making, flying balloon" products emerged. One of the students, S55 ‘‘Controlled Car’’. S82‘‘We made cars with foam.’’ S103 ‘‘We built robots with skewers’’ expressed that in STEM applications they made different products such as, controlled car, foam car, and robot. Again, one of the students S20” First, we built an electric toy, and then we tried to find a solution to a problem”, S124 “Electric circuits, sun, moon earth models” expressed that they made electric toys and models.

Students' opinions about planning STEM activities are shown in Figure 13.

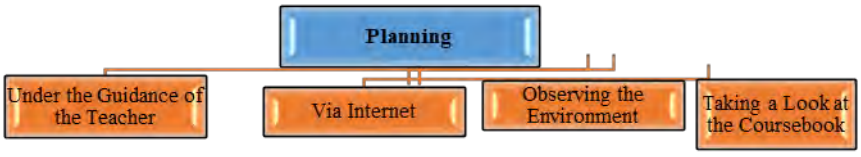

Figure 13. *Opinions of Fifth- Grade Students Regarding How They Plan STEM-Related Activities*

As seen in Figure 13, they stated that they planned the activities within the scope of STEM applications by observing the environment under the guidance of the teacher. Again, some of the students stated that they planned their activities by doing research on websites and looking at how the activities in the science coursebook were planned. One of the fifth-grade students, S27 “We made it with our teacher.” And expressed that they planned the activities under the guidance of the teacher. S62 ‘‘Taking into account the applications in the book.’’ And stated that they took into account the applications in the coursebook as they planned the activities. Again, one of the fifth-grade students S50: ‘‘I checked it on the internet.” and S149: ‘‘First I identifyed a problem from my environment, and then I brought the materials and made it” stated that they planned their activities by researching via internet and observing the environment.

The people or institutions from which fifth grade students receive assistance for STEM applications are shown in Figure 14.

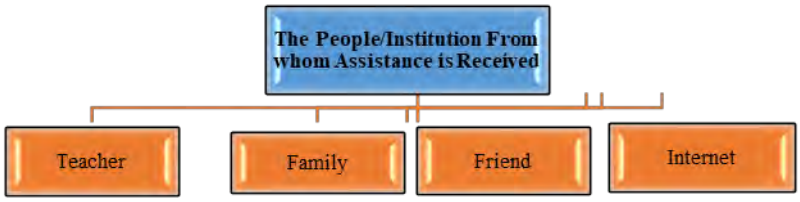

Figure 14. *Students' opinions about the people or institutions they receive assistance from within the scope of STEM applications.*

When Figure 14 is examined, fifth-grade students stated that they received help from their teachers, friends, family and the internet while performing STEM education. One of the fifth-grade students, S50 stated ‘‘From my teacher and my family”. S80 “From my class-mates” and S87 ‘‘I got it via internet.’’ and they stated that they received assistance from their teachers, families, friends, and internet while performing STEM applications. The problems faced by the students in the activities within the scope of STEM applications are shown in Figure 15.

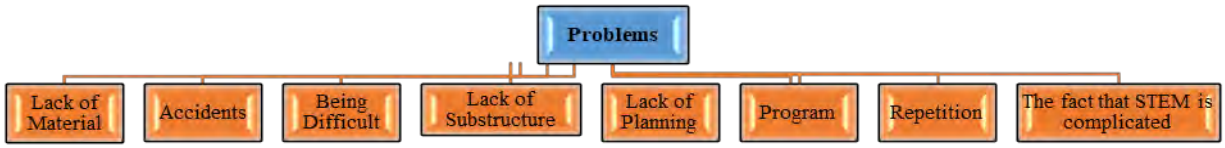

Figure 15. *Students' opinions about the problems they encountered in the activities they did within the scope of STEM applications.*

Fifth-grade students stated that they encountered problems such as lack of materials, accidents while designing products, difficult activities, lack of substructure while performing their applications within the scope of STEM. Again, the students stated that they faced problems due to the lack of substructure and planning, the program, the complexity and repetition of STEM. One of the fifth-grade students, S96 “There has been some trouble because some of the friends didn’t bring all the materials” and S4 stated that ‘‘Yes, it did, we couldn’t design because we didn’t have the substructure.” And expressed that there is a lack of material and substructure. S136 ‘‘The burning of our teacher’s hand during the experiment” and mentioned that there has been some accidents. Again one of the students, S45 said, “There are some things that I don’t understand. You don’t understand some things because they are complicated.” S78 ‘‘It did. This unit was the last topic of the term, we didn’t really process it because of the exams and other topics” and expressed that STEM applications are complicated, and the STEM applications are included in the last unit of the science teaching program.

Fifth grade students' opinions about the contribution of STEM application to them are shown in Figure 16. Examining Figure 16, students stated that STEM applications provided them with "planning, problem solving, creative thinking, product design, imagination, model drawing" skills. Besides, fifth grade students stated that STEM applications increased their willingness to work, aroused curiosity, and raised environmental and social awareness. Again, the students stated that they gained knowledge through STEM applications.

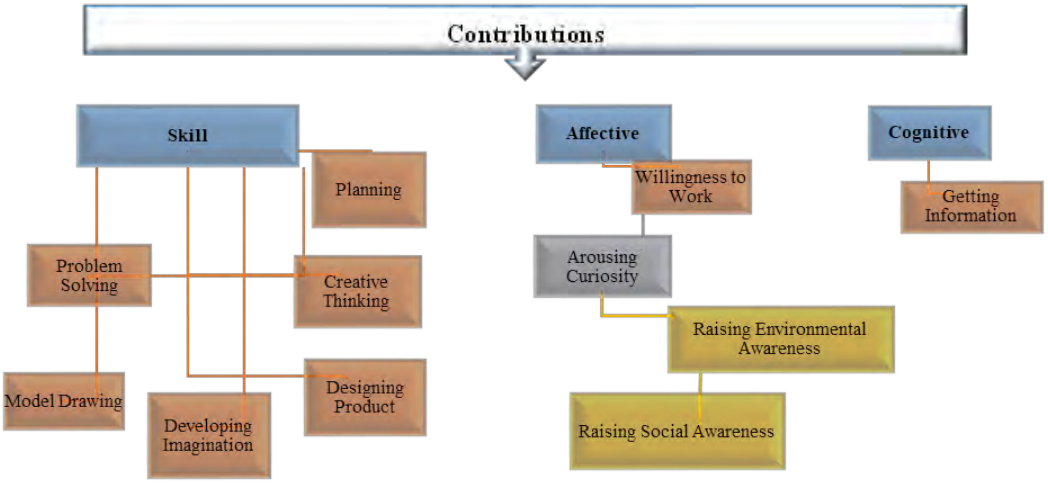

Figure 16. *Students' opinions about the contribution of STEM applications to them*

S19 ‘‘Our teacher told us to determine a problem, and then draw the thing that we will make. And then we brought the materials, made them and showed them to our teacher.” S8 ‘‘We learned what problems do we have around us and, how to solve them.” And expressed that they gained the skills of drawing a model, designing a product and environmental, awareness while performing STEM applications. Again S61, “Yes I think so our imaginative and designing sides and S88 ‘‘It did, I consolidated and learned how to study organized. And stated that he/ she developed his/her imagination, and learned to study in an organized way. S9 ‘‘There has been some contributions, for example I learned things that I did not know before.

Suggestions of fifth-grade students regarding STEM applications to be more effective are shown in Figure17.

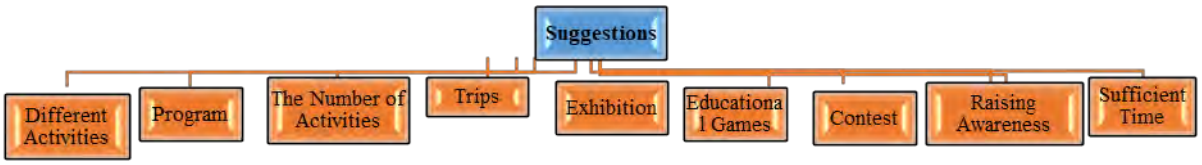

Figure 17. *Students' suggestions for STEM activities to be more effective*

Fifth grade students made suggestions such as "different activities, programs, number of activities, trips, exhibitions, didactic games, competition, awareness raising and enough time" for STEM applications to be more effective. S4 ‘‘I would prepare posters and distribute them so that everyone can become conscious” S59 states “Related projects and trips can be determined to the STEM activities.’’ and suggested to raise awareness and determine projects and trips, so that STEM applications can be more efficient. S86 ‘I think if more entertaining activities are added, and STEM is STEM lasted longer, it would be nicer” and expressed that the time should be sufficient, and activities should be more entertaining. S23‘‘It can be given more in this way. STEM themed games can be played.’’and suggested that games about STEM should be played. S105 ‘‘More different activities can be done. More challenging.’’ Suggested that various activities should be done. Besides, S24 “ I think logic should be added and coursebook should be clearly understood.” And suggested that in science coursebook should be clear and easily understood.

4. Discussion, Conclusion and Suggestion

In this section, the results obtained from the findings mention to determine the experiences and opinions of science teachers and fifth-grade students on STEM education and implementation process

are presented. It is seen that teachers perform many different activities within the scope of STEM applications. Teachers stated that while implementing STEM activities in the classroom, they asked students to make observations about their surroundings and identify a problem and to work in groups in accordance with scientific steps. They stated that they encountered some problems during the applications. These problems are, lack of time, lack of case studies, lack of technology, unsuitable classroom environment, crowded classes, lack of motivation of students and difficult content. In this context, teachers stated that they solved the problems they faced by enabling students to use the materials correctly, do group work and by providing discipline.

Again, the teachers stated that they tried to solve the problems they encountered by arousing the students' curiosity, organizing a competition environment, and having students make previous activities. Teachers stated that they got help from the groups, in-service training, and they got help from websites and coursebooks in order to realize STEM applications, and some teachers stated that they did not get help. They stated that STEM applications contributed to the students, their own professional development and the course, changed their perspective on science and made them think differently. It can be observed that according to the teachers' opinions, STEM applications provide students with skills such as, "working within groups, observation, making plans, solving problems, drawing models, designing products and thinking differently. It also develops students' imaginations and self-esteem, increases their curiosity, and enables them to learn permanently, and arouses environmental and social awareness. Besides it has been revealed from the teachers' opinions that STEM applications are student-centered, provide interdisciplinary integration and contribute to the course by providing an active learning environment. It is seen that science teachers have made many suggestions for STEM applications to be more effective. These suggestions include the implementation of STEM applications at all grade levels, eliminating the lack of substructure, creating a suitable learning environment, supplying materials, simplifying the course content, increasing the number of course hours and activities, including STEM education as a separate course in the program, and the results of STEM applications, the exhibition of the products, training the teacher to be professionally competent.

Considering the results obtained based on the findings of fifth-grade students regarding STEM applications, they stated that they designed many products as a result of STEM applications. Besides, they stated that students plan within the scope of STEM applications by conducting research on the internet and coursebooks, observing the environment in which they are located and under the guidance of teachers. They stated that they received help from the internet, teachers, friends and family while carrying out STEM activities and they did not receive support from any institution. They stated that they encountered problems such as lack of materials, accidents, difficulty and complexity of STEM activities, lack of substructure and planning, due to the science teaching plan and repetitions while carrying out the activities. From the expressions of the students, it is seen that STEM applications improve imagination, getting new ideas, thinking skills, planning, designing models, problem solving and thinking skills. Besides, they stated that STEM applications aroused curiosity, increased their desire to work, and created environmental and social awareness. They suggested that in order for STEM applications to be more effective, there should be different activities, increasing the number of activities, organizing trips and exhibitions, including educational games in STEM applications, organizing competitions, raising awareness, and having sufficient materials and time.

When the results, in which the opinions of both science teachers and fifth grade students on STEM applications are determined, are evaluated, it can be said that views and experiences that support each other are shared. The basic principle in STEM applications is that students design a concrete product as a result of identifying a problem situation from their environment and solving this problem. Therefore, it can be said that science teachers and students carry out STEM applications in accordance with the nature of STEM. It shows that STEM education improves students' problem solving skills (Çorlu & Aydın, 2016; Dewaters & Powers, 2006; Fortus, et al., 2005). In this context, it is seen that students raise awareness of existing problems by establishing a connection with their close environment. Science teachers and fifth-grade students in the fifth-grade in which STEM applications were carried out stated that they encountered some problems during STEM applications. It is seen that both teachers and students are talking about common problems. Similar problems are mentioned when

the literature is examined (Bakırcı & Kutlu, 2018; Siew et al., 2015; Wang, Moore, Roehring, & Park, 2011; Yıldırım, 2018). Science teachers and students agree on the contribution of STEM applications to teachers and students. Teachers stated that STEM applications contributed to the skills, affective and cognitive development of students. Teachers stated that students developed their working in groups, problem solving, and different thinking skills. It can be said that these skills are related to 21st century skills, and STEM applications improve students' 21st century skills (Jorgenson, Vanosdall, Massey, & Cleveland, 2014; Bryan, Moore, Johnson, & Roehrig, 2016). There are studies in the literature on the contributions of STEM education practices to teachers and students, and the results of these studies support the results of this research (Çavaş, Bulut, Holbrook, & Rannikmae, 2013; Eroğlu & Bektaş, 2016; Park & Yoo, 2013; Strong, 2013; Yamak, Bulut and Dündar, 2014). Therefore, it can be said that STEM education is an effective approach for the multidimensional development of according to the participants' opinions.

Science teachers have made some suggestions for more effective implementation of STEM applications. These suggestions can be evaluated in the context of the program, physical conditions and the teacher. The main physical conditions are eliminating the lack of material and substructure and providing a suitable learning environment. Eroğlu and Bektaş also (2016) stated that there is a shortage of time and materials during STEM applications. Regarding the science teaching program, it has been suggested to simplify the content and increase the number of lesson hours and activities. The suggestion for teachers is that teachers should receive education on this subject. Therefore, professional development of teachers has an important place (Abazoğlu, 2014). Besides, students also made suggestions for STEM applications. These recommendations are mostly related to the activities within the scope of STEM. The students suggest that there should be different and fun activities within the scope of STEM and there should be time and material support for implementation.

In conclusion, with this study, it was tried to determine what kind of environment should be for STEM applications of teachers and students trying to apply STEM activities, what kinds of activities can be applied more effectively, what kinds of deficiencies of teachers have about STEM and how to overcome these deficiencies with a qualitative design. It is thought that, with the inclusion of STEM education in the Science Teaching Program, the experiences and opinions of teachers and students will shed light on the process and it is important for the teaching program to reach its goals.

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Authors

Alaattin ERDEM, Eskisehir Osmangazi University, Faculty of Education, Eskisehir (Turkey). erdem.alaattin1905@gmail.com

Burcu ANILAN, Eskisehir Osmangazi University, Faculty of Education, Eskisehir (Turkey). anilan.burcu@gmail.com; burcud@ogu.edu.tr

Zeynep KILIÇ, Eskisehir Osmangazi University, Faculty of Education, Eskisehir (Turkey). zeynepk@ogu.edu.tr

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