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Grade-7 Students' Product Promotion During an Engineering Design Task on Space Pollution Subject

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Abstract

The aim of the study is to investigate grade-7 students' engineering design and product promotion on space pollution subject. The study was conducted with 52 students (19 female and 33 male) from a middle school in a city located in East Black Sea Region, Turkey. In this study, a holistic single case study method was used. The data was collected through worksheets, audio records, and peer evaluation forms. Content analysis was used in determining engineering design levels and content analysis and descriptive analysis was used in determining the qualities of product promotion. Results indicated that groups generally performed well in the steps of choosing the best solution, building the prototype, and presenting it. It was found that groups did not perform well in the steps of problem specification, developing solutions to the problems, and testing of prototypes. It was seen that the designed products were suitably qualified. It was found that qualities such as appearance, display, and cost of the design got higher points in peer evaluation. The groups used different strategies in product promotion. It was found that the qualities of the arguments groups used in oral presentations were successful while they couldn't perform well in quality levels of their answers. Implications were provided in line with these results.

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Introduction

Entrepreneurship and engineering design skills are described as the basic skills expected from students in 21st century (Ministry of National Education [MoNE], 2018). Accordingly, individuals with engineering design skills are stated as individuals who identify a problem based on real world problems and design a product with interdisciplinary perspective to solve the problem (MoNE, 2018). In the program, entrepreneurial individuals are defined as individuals who solve problems, promote products, and determine cost price and sale price. Consequently, educators must implement strategies that encourage students to create solutions for problems and cultivate the abilities to present their ideas to a target audience. In recent years, STEM education provides a space for designing learning environments in achieving design and entrepreneurship skills by its interdisciplinary approach (Atkinson & Mayo, 2010; National Science Board [NSB], 2012; U.S. Department of Education, 2011). Furthermore, entrepreneurship can be transferred to learning environment through STEM education (Flanagan, 2014).

In STEM education, the engineering discipline actualizes science course learning outcomes while simultaneously developing design skills (Kolodner, 2002; Leonard, 2004). Therefore, it is necessary to use engineering design process in the integration of engineering discipline within a science course (Bozkurt Altan, 2017). While various approaches exist for the engineering design process, it has been noted that common steps include problem definition, solution identification, optimal solution selection, testing, development, and presentation (Ercan, 2014). According to Deveci (2017), students' leadership performance is enhanced when STEM education is combined with entrepreneurial thinking, which is why entrepreneurship should be incorporated into the engineering design process. In this sense, the curriculum states that students are expected to define a problem in a daily life, to think solutions to this problem, to choose the best solution, to design a product, and to calculate cost, material, and time in problem solution (MoNE, 2018). Afterwards students are expected to present the product they have designed and develop the product following testing process.

Upon examining the engineering design process and entrepreneurship separately in the literature, it becomes evident that the process of product promotion is not extensively studied in relation to entrepreneurship. There are few studies examining secondary school students' product promotion and engineering design skills by combining these two fields (Yüksel, 2019). Research indicates that seventh-grade students lack the entrepreneurship skills of their junior counterparts (Deveci, 2018; Ortaakarsu & Can, 2019). As a result, the study's sample was decided to consist of students in the seventh grade.

Literature on EDP indicated that students have difficulties in building a prototype (Çiftçi, 2018; Gök, 2019; Koç, 2019; Okulu, 2019; Soysal, 2019), engaging in shared decision making and producing ideas steps (Gök,

2019; Soysal, 2019), externalizing their design ideas (Gök, 2019; Yüksel, 2019), choosing the best solution (Özer, 2019), and executing mathematical operations (Çiftçi, 2018; Okulu, 2019). Koç (2019) notes that students had problems at the beginning, but they get better at EDP throughout the process, but they require extended period of time (Alinak Bozkurt, 2018).

When studies on product promotion process are examined, it is seen that the number of the studies conducted according to the activities defined in the program (MoNE, 2018) are limited (Deveci, 2016; Yüksel, 2019). There are studies examining students' product promotion in their entrepreneurship skills process in science (Deveci, 2016; Yüksel, 2019) whereas only one of them is related to middle school students (Yüksel, 2019). In this study conducted with middle school students, changings in students' entrepreneurship skills by using engineering design process and the way they follow while promoting a product were examined. Students designed a logo to promote their product, built an advertisement scenario and videotaped the advertisements and then they presented their products in a science fair. In this study, it was observed that students had difficulty in branding, slogan creating and using time efficiently which requires creativity, imagination and designing skill (Yüksel, 2019). In another research (Deveci, 2016) conducted on preservice teachers, entrepreneurship education modules were prepared. One of the modules included product promotion process. Deveci (2017) stated that prospective teachers had difficulty in processes such as producing new ideas, cost analysis and deciding on materials. In literature, most of the studies conducted in secondary school level are based on evaluating entrepreneurship skills (Deveci, 2018; Kurt & Bayar, 2019; Ortaakarsu & Can, 2019; Vurgun & Bektaş, 2019). It is seen that there are few studies thoroughly examining students' entrepreneurship skills in the scope of product promotion. Therefore, this study aims at examining grade-7 students' product promotion during an engineering design task on space pollution subject.

Methodology

In this study, holistic single case study method was used. In this way, we examined the students' ideas and experiences while they present their products during an engineering design process. The case study pattern, which is one of the qualitative research methods, is a situational approach getting in depth and detailed information by using various data collection means about a situation and real life (Creswell, 2013).

Participants

The study was carried out in the fall semester of the 2019–2020 academic year at an imam hatip middle school situated in an East Black Sea Region city center. There are five classes for grades 7 out of the total seventeen classes in the school. For the seventh grade, there are two classes of female students and three classes of male

students. The first writer was the science teacher for one of the two male and one female seventh-grade classes used in the study. The female class has nineteen students, one male class has seventeen, and the other male class has sixteen. The first author had three years of experience working at the study's school and has nine years of teaching experience. The first author had worked with the students on engineering design projects in the past. At the start of the semester, engineering design exercises covering the subjects were given to the new students. The first author finished the Scientix STEM education workshop, the STEM basic and advanced level trainings, and the STEM science, technology, and mathematical applications seminar.

Implementation Process

By increasing awareness and curiosity, integrating real-world problems into the engineering design process can encourage students to actively participate (Soysal, 2019). When it comes to putting STEM education into practice, astronomy topics are useful because they foster students' imaginations and pique their interest (Okulu, 2019). The topic of space pollution is chosen in this instance. The exercises were carried out in groups.

Worksheets were first distributed to the groups to ascertain their prior knowledge. Groups then received the documents containing the engineering design process. The smart board displayed the problem scenario. The issue was recognized by the groups. They began by analyzing the needs of the situation and looking for relevant solutions using computers, periodicals, and books. Once the groups had decided on the best solutions and materials based on the criteria, they created drawings of prototypes. The cost and sale prices were decided upon by the students. They then got to work building the prototypes. Following the construction of the prototypes, the groups tested their creations using the worksheet questions as a guide. The features to be improved were mentioned. They finished the processes of marketing and presenting the product at the very end. Using the provided materials, the students created a poster and gave five-minute promotional presentations. Using the peer evaluation forms, the groups assessed their presenting peers concurrently. Following the presentation, critiques and remarks were made by the other groups. The presentation's presenting groups addressed these critiques and remarks. The researcher recorded the students' voices in the interim. The engineering design cycle's "Develop" step only allotted time for the presentation and improvement suggestions. The groups were not given the opportunity to modify their designs in response to peer feedback. The implementation process of the study is shown on Table 1.

Table 1. Research Implementation Process Plan

Date	Lesson Duration	Implementation Process and Explanations
1st Week 15/10/2019-16/10/2019	40+40 minutes	• Grouping the students • Applying "What Do I Know" activity to determine the students! Prior knowledge • Starting MTS "Fight with Space Junk" activity • Taking field notes by the teacher • Examining the students' worksheets
1st Week 17/10/2019-18/10/2019	40+40 minutes	• Continuing "Fight with Space Junk" activity • Taking field notes by the teacher • Examining the students' worksheets
2nd Week 22/10/2019-23/10/2019	40+40 minutes	• Applying "Evaluate and Develop" activity • Applying "Now Advertisements" activity • Examining the students' worksheets
2nd Week 24/10/2019-25/10/2019	40+40 minutes	• Applying "Product Promotion and Marketing" activity • Examining the students' worksheets • Taking voice recordings

Data Collection and Data Analysis

Worksheets for engineering design and audio recordings were used to gather data. The "EIE-Engineering is Elementary" program's design-based science education approach and the engineering design cycle's steps were used to prepare the worksheets. During the "develop" phase of the engineering design cycle, audio recordings of students promoting their products were made.

Based on the information found in the students' worksheets and audio recordings, content analysis was utilized in this study to identify the design and product promotion processes (Yıldırım & Şimşek, 2006). The various facets of the student audio recordings' product promotion processes were examined using descriptive analysis. The engineering design process, the product evaluation, and the peer evaluation rubrics were used to analyze the engineering design levels examination. The oral introduction analysis rubric and the quality analysis of the answers rubric were used to analyze the examination of the qualities that promote the product.

Based on argumentation literature, the oral presentation rubric is divided into four categories. Only the claims are included in the first level sentences, which are categorized as "improvable." The second level evaluates the claims, justifications, and non-scientific terminology as "medium." The "good level," or third level, is

composed of arguments, assertions, and scientific terminology. Claims, justifications, backings, and rebuttals are included in the fourth level, which is rated as "very good level."

The quality analysis of the answers rubric was arranged based upon “Argumentation Quality Determination Rubric” prepared by Venville and Dawson (2010). This rubric is made of four levels. In the first level, the students give reasonless answers such as “Yes, No, or I don’t know” to the questions from their friends, this stage is organized as “improvable”. In the second level, there are reasons in the answers. This level is accepted as “medium”. In the third level the reasons in the answers are expressed scientifically and it is defined as “good”. The fourth levels, there are reasons, backings and rebuttals in the answers. This level is accepted as “very good”. This rubric was used in the analysis of the quality level of the groups’ answers.

In this study, validity and reliability were provided with Lincoln’s and Guba’s (1986) credibility, transferability, dependability, and confirmability criteria. In credibility, various data collection tools were used, the researcher and the consultant frequently had meetings to evaluate the situation. In transferability, purposeful sampling was used as sample preference, and implementation process was transferred to the reader without adding any interpretation. In dependability, the documents and the data from the voice records were compared. Interrater reliability was conducted as 74% (Miles & Huberman, 1994). In confirmability, the data was presented in quotes.

Findings

Two categories the findings for engineering design processes and the findings for product promotion processes were created from the data analysis results.

The Findings Regarding Product Promotion Processes

In this section, the findings of the content analysis of promotion stages in the groups’ engineering design worksheets and the findings of the descriptive analysis of the product promotion processes the students used during their presentations were written. Firstly, the product promotion strategies the groups used during oral presentations were examined in five categories developed by the first and the second authors beforehand (see Table 2).

Table 2. Product Promotion Strategies of the Groups

		Groups											
Categories	**Sub Categories**	**B 1**	**B 2**	**B 3**	**B 4**	**C 1**	**C 2**	**C 3**	**C 4**	**E 1**	**E 2**	**E 3**	**E 4**
Product Concept	Working Procedure	X	X	X	X	X	X	X	X	X	X	X	X
	Cost	X	X	X	X	X	X	X	X	X	X	X	X
	Sale Price	X	X	X	X	X	X	X	X		X	X	X
Technical Components	Material	X	X	X			X	X	X	X	X	X	X
Brand Positioning	Name		X	X			X	X	X				
	Slogan		X	X	X	X			X				
Communication	Specifying Colleagues	X	X										
Advertising Message	Specifying a Goal			X								X	X

When Table 2 is examined, it is seen that all the groups mentioned about their designs' working procedures while promoting their products. For example, the E4 group explained their product's working procedure as follows: "*There is a handle in our space craft. It throws a net into space with this handle and catches the space trash. It transfers them into the laser inside it. The trash is melted with the laser and put into the storage room, and then they stay there. After all the trash goes through the same process, we put them in a small cube and send them to the World.*"

It is seen that all of the students mentioned about the total cost during product promotion. For example, the B1 group explained their cost as follows: "*We used 7 giant pipes and they cost 182 liras. We used a magnet and it cost 55 liras. We used 4 aluminum plates and they cost 476 liras. We used a giant laser and it cost 660 liras. The total cost of the materials is 1408 liras.".* Only one of the groups didn't mention about the sale price during product promotion. The B3 group explained the sale price as follows: "*Our cost is 8833 liras, but our sale price is 10.000 liras. We need to give money to the workers so there is also labor cost. Thus, we sell the product for 10.000 liras."*

When the groups are examined in terms of technical components, it is seen that ten of the twelve groups mentioned about the materials they were going to use while promoting their products. For example, the C3 group mentioned their group materials as follows: "*Materials; infrared camera, 2 aluminum plates, 4 giant magnets*".

When the groups are examined according to their situations of stating design name and slogan in terms of brand positioning strategy, it is seen that five groups mentioned about their designs' names. To give an example, the B2 group explained the name as follows: "*Cosmic Cleaner, it means 'kozmik temizleyici' in Turkish*." Five of

the groups mentioned about the slogan during their presentations. For example, the B2 group explained their slogan as follows: "*Our slogan is 'Bırakın cleanlesin' and it means 'Let it clean, we don't need to do anything! It cleans by itself.*'"

When the groups are examined according to their situation of specifying colleagues in terms of communication strategy, it is seen that only two groups mentioned the names of their colleagues during their presentations. For example, the B2 group introduced their colleagues as "*Büsre, Esma, Eslem and İrem*" and B1 group introduced their colleagues as "*Gülesma, Zeynep, Hümeyra and Zekiye*".

When the groups' situations regarding their specifying a goal in accordance with advertising message strategy were examined, it is seen that three groups mentioned their goals for their designs during the presentations. To give an example, the B3 group explained their goal as follows: "*Our aim is to help space research by cleaning space. Because there will be more extensive research when space is cleaned. The desired result is to clean up at least 75% of space. In this way, the goal is to reduce space pollution increasing every year. Let's save space and make a way for future. We may not clean 100%, we may not have that much time. So we clean 75% of space as much as possible. But we aim at 100%.".* Advertising message can be defined as emphasizing the benefits of the product's features and the value of the product. In this case, it can be said that the B3 group's explanation has an advertising message.

When the groups' product promotion strategies are examined, it is seen that B2 and B3 groups used the most strategies and E1 group used the least strategies. It is observed that the B2 group that used 7 strategies made a good design and the design got high points in product design. The C4 group that got the lowest points in product design and engineering design steps evaluation used 6 promotion strategies. The E1 group that used the least promotion strategies got medium points in design evaluation. This group got good points when the qualities of engineering design steps are examined. It is seen that the other groups showed similarity when their engineering design steps level and product promotion ordering are compared. It can be said that the performance in engineering design steps has a role in determining product promotion strategies.

Below are the findings from the content analysis of promotion chapters in engineering design worksheets (see Table 3).

Table 3. Group Codes Regarding Promotional Tools

Codes	Number of Groups
Television Commercials	4
Advertising Boards	1
Social Media	3
Banner	3
Promotion Stand	1
Explanation with Slogan	2
Making a Poster	2
Internet Advertisement	2
Public Service Advertisement	1
Premiere	1
Video Shooting	1
Newspaper	1
Brochure	1
Participation in Project Competitions	1

In the findings from the answers of the question "*Which advertising methods would you use to promote your design?*", television commercials is the most preferred method and social media comes after it (see Table 3).

Table 4. Group Codes Regarding Target Audience

Codes	Number of Groups
Astronauts	3
Scientists	3
Astronomers	1
Manufacturer Aerospace Companies	3
NASA	5
Turkey Space Agency	4
Space Explorers	2
SpaceX	1
Aselsan	1

According to the findings from the answers of the question *"Who is the target audience of your design?",* five groups stated NASA and four groups stated Turkey Space Agency as their target audience. It is observed that none of the groups wrote the leading space agencies of the world such as India, China, Europe, Russia, and Japan (see Table 4).

When Table 5 is examined, it is seen that all the groups stated an advertising method for their products' promotion. Eight groups mentioned television commercials and five groups mentioned social media. Two groups each mentioned poster, newspaper, internet sites, and visual and oral communication methods while one group each mentioned promotion methods such as slogan and posters. The opinions of the C3 groups are as follows: "*We can organize a premiere and introduce the product. We can advertise on television for the ones*

who couldn't come to the premiere. We can make a poster.". The opinions of the B3 group are as follows: *"We can introduce the product in a science fair. We can prepare banners for the ones who couldn't attend the science fair."*. The opinions of the B4 group are remarkable: "*We can introduce the product by promoting on social media, displaying it in different places. It should be informative, and we should introduce the contents nicely."*

Table 5. Group Codes Regarding Promotion Tools in "Now Ads" Activity

Promotion Methods	**Number of Groups**
Banner	2
Science Fair	1
Newspaper	2
Visual and Oral Advertising Methods	2
Internet Sites	2
Social Media	5
Product Promoting Stand	1
Project Competition	1
Poster	1
Premiere	1
Public Service Advertisement	1
Slogan	1
Television	8

In the Table 6 below are the findings from the answers to the question *"How would you promote your product to your target audience?"*.

Table 6. Student Codes Regarding Ways to Follow in Promoting Their Products

Promoting Ways	**Number of Group**
Appearance	1
Introducing how it functions	1
Having high quality	2
Specifying properties with attention to detail	4
Making an ad that impresses everyone	4
NASA tour chance (Free Gift)	1
Applying to the Turkish Space Agency	2
Trying to spread as much as possible	1
Having famous and reliable people in our ad	1
Total	17

According to the Table 6, the student groups expressed the ways they would follow to introduce their products to their target audience in various ways. Four of the groups emphasized on making an advertisement that impresses everyone, other four groups emphasized on the need to specify the properties of the products, two

groups emphasized on highlighting the quality while introducing the products, two groups emphasized on the need to get in contact with several space agencies, one group emphasized on having famous and reliable people in ads and one group emphasized on the need to highlight the importance of the appearance.

The opinions of the C4 group are as follows: "*We can make lots of ads. We can apply to Turkey Space Agency. We can make ads that impress everyone. We can introduce the product by specifying properties with attention to detail*.". A similar example to this is the opinions of the E3 group. The E3 group emphasized on the importance of the properties with their expressions as follows: "*We can sale the space craft by introducing the properties of it*." It is seen that the B1 group paid attention to their product's "Durability and Appearance" factors in their opinions about the product promotion. The opinions of the E4 group are remarkable. They emphasized that they could arrange a free gift event for the target audience with "NASA tour chance" slogan.

Oral presentation quality analysis rubric develop by the researchers was used in the evaluation of the qualities of the students' arguments they used in their presentations. An example of the "very good" level regarding the evaluations of the analyzed groups is shown below (see Table 7).

Claim: We decided on 2000 liras as the sale price, we don't have any profit or loss. Reason: It costs 1295 liras. This includes labor cost. We need to make it economic for our country. Justifier: There shouldn't be loss of money a lot in our country. The cheaper it is, the more our country will develop. Thus, it is economic. Rebuttal: We sell it cheap now but there will be more profit as it develops. This explanation is scored as level 4, "very good", because it includes reason, justifier, and rebuttal.

Table 7. Quality Level of the Groups' Oral Presentations

Groups	Improvable	Medium	Good	Very Good
B1		X	X	X
B2	X	XXX		X
B3		X	XX	XXXXXX
B4			X	X
C1		X	XX	
C2	XX		XX	
C3	X			XX
C4		X	X	
E1		X	X	
E2				X
E3				X
E4			X	XX

An evaluation was made with the developed rubric to determine the quality of the answers students gave to the questions from their friends during their presentations. An example of "level 2" regarding the quality of the groups' answers was shown in this part (see Table 8).

In the answers of level 2, "medium", there are a claim and a reason supporting the claim. The groups may include their beliefs, unscientific data, and their misconceptions into their reasons while they make a claim. For example, it draws attention that it has misconception when the E2 group's claim is examined.

Question: How does the trash go to the Sun when you hit the piston? Answer: The trash will break into pieces because it will get hot as it gets closer to the Sun. Reason: It will get hot as it gets closer to the Sun.

The claim of the E2 group is correct. Its reason is acceptable. Because breaking into pieces of the trash thanks to the Sun's heat is a factor but the reason of the trash melt is not the warmth, it is the heat. The group is in level 2 because of the misconceptions. If making a claim is about convincing the other person or group, reasons should be solid. Therefore, data in reasoning sentence should be based on scientific basis and it shouldn't include misconceptions (Şahin, 2014). The students presented a reason with evidence but the reason they presented was classified as "medium" because of the misconceptions in it.

When the groups' oral presentation levels are observed, it is seen that the B3 group often used the "very good" level. It is observed that this group is one of the groups that used the most strategies in product promotion strategies shown in the Table 2. In the E1 group, no sentences were found at the "very good" level. This group is also the one that used the least strategies in product promotion strategies.

Table 8. Quality Level of the Groups' Answers

Groups	**1st Level "Improvable"**	**2nd Level "Medium"**	**3rd Level "Good"**	**4th Level "Very Good"**
B1	X			
B4			X	
C2			X	
C3	XX		X	
E1	X	X	X	
E2	X	XX	X	
E3	X		X	
E4	X	X	XXX	

No questions were asked four groups among twelve groups. When the quality of the other eight groups' answers is examined, it is seen that six groups gave Level 1 answers, three groups gave Level 2 answers and seven groups gave Level 3 answers. The B1 group has one "improvable" level; the B4 group has one "good" level;

the C2 group has one "good" level; the C3 group has two "improvable" levels and one "good" level answers. In addition to these, the E1 group has one "improvable" level, one "medium" level and one "good" level; the E2 group has one "improvable" level, two "medium" and one "good" level; the E3 group has one "improvable" level and one "good" level answers. It is remarkable that the E4 presented acceptable reasons to three questions out of five questions. It is observed that this group also made "very good" level presentations in oral presentation quality level in Table 7.

Results, Discussion and Implications

The results related to product promotion strategies, oral presentation quality and quality of the students' answers are shown under this title. The groups' promotion strategies were analyzed in terms of product concept, technical components, brand positioning, communication and advertisement message. Product concept is the stage where the product's features and differences from other products are expressed (Kaya, 2018). In the study, this stage is divided into subcategories as working procedure, cost and sale price. It can be said that all the groups showed a successful marketing strategy performance as product concept. It is thought that the working procedure, cost and selling price of the product in the poster prepared by the groups helps them to use the product concept strategy while promoting the product. It is observed that none of the groups planned for an advertisement budget. It can be said that the groups generally followed a successful strategy in financial issues except for the advertisement budget. Not having a separate section for advertisement budget in the worksheet might be the reason of the groups' not emphasizing on this issue. It is known that worksheet is an important element helping to fulfill the learning outcomes as long as it is designed well (Uslu, 2011). In fact, a teacher will not need to always emphasize important parts with the use of a worksheet of which questions and instructions are well built (Proctor et al., 1997).

When the groups are examined in terms of specifying the materials in their designs in the promotion stage within the technical components strategy, it is seen that ten groups used this strategy. Therefore, it can be said that the students generally performed successfully in the direction of technical components strategy. It is thought that emphasizing material choices and the features from the very beginning of the engineering design process helps the students specifically include technical components sections.

The groups' design names (Brand) and the slogans were examined within brand positioning strategy. All of the activities such as sticking in target group's mind, standing out from other rivals, creating a special place for the brand are called as brand positioning (Kaya, 2018). Brand is the combination of name, symbol, design, shape or all of these elements, which identify a product or products of a group of sellers and differentiate them from their rivals' products (Odabaşı & Oyman, 2002). It can be said that the five groups, that include their products'

names (Brand), have come a positive way in line with brand positioning strategy. It was found that five of the groups included slogans. Slogans, which involve attention grabbing brief writing about the product, require using creativity and design skills as well as brands do. Most of the groups were insufficient in terms of creating product name (Brand) and slogan and this might be the result of the difficulties they had in transferring these skills to the process. If it is considered that one of the features of an entrepreneurial individual is producing designs by using imagination (Deveci, 2018), it is thought that the students in the successful groups were successful in creating brand and slogan by using imagination. In his work with 5th grade students, Yüksel (2019) stated that the groups had difficulties in developing brand and slogan for the greenhouses they designed, and it is necessary to make use of STEM activities to improve the students' creativity and design skills.

Two groups included communication strategy in product promotion processes. It is seen that people who cooperate in the group appreciate each other by saying their names. This can be accepted as a promotion strategy convincing the target group. It can be said that these two groups used communication and self-confidence skills effectively in promotion strategies. The reason why the two groups used this strategy was interpreted as a positive cooperation in the group throughout the process and an expression of the effort by everyone's equal work. In his work with 5th grade students, Yazıcı (2019) states that the groups' job sharing and group members' volunteering in distribution of tasks are the reasons of the students' being successful in product promotion stage. He also states that this situation contributes positively to the students' communication and self-confidence. Communication is thought to be an important medium in promotion strategies. Student groups can be shaped accordingly to provide motivation to be able to maintain intra group cooperation and voluntary participation in the activities throughout the engineering design and product promotion process.

Advertising message is the features of the product, the value of the product and to use these with written and visual themes (Kaya, 2018). Three groups were observed to use advertising message strategy when the groups tried to express the value of the product by defining its target. It can be said that these groups used future planning skills to convince the target group to buy the product. In his study with 7th grade students within social studies course, Tarhan (2018) designed activities which help students gain entrepreneurship skills. One of the activities he designed aims to improve job plan skills. In the results part, he mentioned his students had knowledge of preparing job plan in entrepreneurship activities, the problems they might encounter and the goals.

When the findings from "Evaluate-Develop" worksheet, which includes the groups' opinions about product promotions, are examined, it is seen that most of the groups mentioned mass communication such as television and social media in the first place and then banner, poster and brochure in the second place. In the same way, the high number of television and social media codes in the findings of "Now Advertisements" worksheet

supports this result. In this case, the importance of television and social media in terms of spreading advertisements nowadays is once again seen. In addition, it can be said that social media is a growing advertisement channel and a popular advertising way which is important for students. It is thought that the students' spending time with television and social media, which are the mass communication they mostly use daily, and observing the advertisements there affect this result. In his study with university students to investigate whether social media advertisements have an impact on purchasing behavior or not, Çağlıyan et al. (2016) found out positive relation between the students' purchasing behavior and using social media. He stated that the reason of this is the youngsters' spending too much time in social media and having chance to examine the products.

In science instruction program (MoNE, 2018), it is mentioned to use newspapers, television, Internet advertisements and short movies as promotion tools to market products in developing student's entrepreneurship skills. In the results of this study, the students similarly mentioned these promotion tools while additionally expressing promotion tools such as project competitions, billboards, science fairs, banners, promotion stands, brochures and social media. It is thought that the students' participating in projects like 4006 science fairs organized in schools might influence the students' answers. It is seen that students can use their previous experiences in similar situations. TÜBITAK supported science fairs are known to provide a rich environment in developing students' skills and experiences (Doğanay, 2018). Science fairs allow students to present and introduce their designs (Roberts, 2012). Activities can be made with different promotion tools to help students gain experience in promoting activities stage of engineering design activities. When it is thought that science fairs, project competitions and science exhibitions provide students experiences and they transfer these experiences into new situations, students' promotional qualities can be improved by using these activities often.

While choosing the target group, none of the groups wrote the names of world's leading space agencies such as India, China, Europe, Russia, and Japan Space Agency. The groups generally mentioned about NASA, Türkiye Space Agency and SpaceX. This may be because of NASA's being one of the oldest space agencies, being popular and carrying out a lot of duties. On the other hand, it is remarkable that a group mentioned about SpaceX, which is a USA origin company, except for NASA. It is thought that factors like SpaceX's attracting attention for its aim to colonize Mars and building interesting spacecrafts might have an effect on the students' giving its name. Türkiye Space Agency's (TUA), which was founded in Turkey towards the end of 2018, being a popular target group among the students is important in terms of awareness. This result can be thought as reflection of a work happened in a close region of the students. Lastly, one of the groups is seen to use gift as a strategy to attract the target group. Free gifts prompt purchasing behavior instantly and quickly (Yalman & Aytekin, 2014). This might be related to the group's choosing and using the tools which attract the attention

and interest of the target group. In his work, Tarhan (2018) stated that the students used promotion skills in entrepreneurship practices.

When the quality levels of the verbal presentations of the groups are examined, arguments from every level of argumentation are detected. It is seen that most of the groups used claims, reasons, backings and rebuttals during their presentations. Only two of the groups used both backings and rebuttals in same sentences while other groups used them in separate sentences. It can be said that the groups have lacks in forming sentences with rebuttals. The students' having not many argument-based activity experiences may have an effect on this. In his work with 8th grade students, Kutluer (2020) stated that when he examined the students' argument levels by using various activities about matter cycles, the reason of the students' having difficulty in using backings and rebuttal elements could be not having higher cognitive knowledge, consideration and discussion. Students can produce higher level arguments by increasing the number of the argumentation supported engineering design process activities.

When the analysis of the groups' answers to the questions of other students during the presentations is made, a considerable amount of the groups gave level 1, short and reasonless answers to the questions. This might be because of the students' having difficulty in giving evidence-based answers. In fact, people of every group of age have difficulty in forming justified sentences according to the previous studies (Sadler, 2004). In his work with 6th grade students, Jan (2009) stated that the students had difficulty in presenting reasons to strengthen their claims. It is remarkable that none of the groups is in the level 4 which is the best level in this study. This level involves the arguments which includes backings and rebuttal. However, none of the groups included backing and rebuttal in their answers. In the findings regarding the forms of the sentences the groups used during their presentations, it is seen that only two of the groups used backings and rebuttals in the same sentences. In the study, the students' having problems in using backings and rebuttals might be because of their having not many argumentation-based activity experiences. It may be also because of not having questions which allows them to justify against opposing views in the worksheets which includes promotion process. In her work with 5th grade students, Demir (2017) stated that the students had problems in forming rebuttals in argument quality, and the reason of this might be the insufficiency in the students' model notebooks. Another issue is that four of the groups in the study weren't asked any questions. One of the reasons of it may be the groups' being shy about discussions and avoiding from looking the product with a critical eye. Researchers emphasize on the necessity of creating democratic discussion and conversation environments where the students' opinions are cared (Sadler, 2006).

Engineering design worksheets, having supportive questions, can be designed to help the students form rebuttals to defend against opposing views during promotion processes. Undoubtedly, information and

communication technologies are one of the indispensable ways of product promotion nowadays. In future studies, how students conduct product promotion processes with information and communication technologies and qualities of these can be investigated.

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