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Original article

Primary and Elementary School Students' Profiles of Scientist Images

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Abstract

It is thought that students' images of scientists based on the expectation that they work like scientists are directly or indirectly affected by various features in the learning process. Affective characteristics such as motivation and interest in science teaching process are some of them. While positive views may contribute to the increase in the desire to learn science and science and the development of science in the following period, negative views may create resistance to science and science learning with the opposite effect. Based on this, the aim of this study was to determine the scientist images of primary school 3rd grade and middle school 6th grade students and to determine whether there are differences between these groups in terms of drawings. Accordingly, 28 3rd grade students from a primary school in the South Marmara region and 28 6th grade students from a middle school were used as the sample. These students were instructed "Can you draw a scientist at work?" and they were expected to complete the picture without any intervention. In addition, 12 students were asked open-ended questions on a form about the scientist's field of study, appearance and what he/she was dealing with. The data obtained from the drawings were analyzed through DAST- m, while the data obtained through the form were analyzed in the computer environment. As a result of the study, it was found that students in both groups had traditional profile drawings. Accordingly, it was found that traditional images were defined as a man dealing with chemical materials and the sky, alone, working indoors, experimenting or working around a desk. In this framework, various suggestions were made.

Keywords: Science Literacy, Science teaching, Draw A Science Test (DAST).

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INTRODUCTION

The change of scientific knowledge and the way to keep up with this change is through education and training. The way to keep up with development and technology is referred to as science literacy and is included in the science curriculum with the dimension of the nature of science (Republic of Turkey Ministry of National Education, 2018). The subject of Nature of Science (NOS) begins with efforts to define science and its characteristics in various sources (Flick & Lederman, 2007; McComas et al., 2002). It is thought that NOS and its teaching have a facilitating effect directly and indirectly on academic achievement (Driver et al, 1996).

Today's curriculum and literature studies on science education try to emphasize a science education in which students are involved in studies "just like a scientist" (Ayvaci & Yurt Tarakci, 2016, Tan & Temiz, 2003; Republic of Turkey Ministry of National Education, 2018). Inspired by this, the question "So what is a scientist for children?" comes to mind. It is thought that students' views on scientists will contribute to their interest in science. Yontar Togrol (2000) states that students' views on scientists will affect their views on all other elements related to science. In other words, it can be said that negative views affect motivation to learn science and other elements related to science. In terms of science teaching, it is thought that students' views and mental images about concepts directly related to science such as science, scientist and research can be handled as a direct and indirect component of motivation and other processes related to learning, and even these views and images of students can be used in learning processes.

In order to determine students' opinions about scientists, a test called "draw a scientist" (DAST) is encountered. Developed by Chambers (1983), DAST has been applied until today and has been easily used in applications for illiterate preschoolers to adult individuals (Basay & Aytar, 2019; Duran & Bayar, 2019; Nacaroglu & Arslan, 2020; Ruiz-Mallén, & Escalas, 2012; Yazici, et al., 2021). Seven indicators of standard scientist drawings are presented in student drawings (Chamber, 1983): (1) lab coat, (2) glasses, (3) facial hair, (4) research symbols, (5) knowledge symbols, (6) technological product, and (7) various writings. This is taken as an indication of the standardization of the drawings in general. According to these symbols, the drawings are classified and graded. According to Chambers (1983), according to the intensity of the presence of standard elements, drawings with ordinary (stereotypical) type or alternative images (such as fear elements...) are classified as alternative type.

The rubrics for the DAST application have been updated over time and different forms have been derived (Farland, 2003). The biggest concern in addressing the DAST was to find a valid and reliable way of scoring drawings (Farland- Smith, et al, 2012). In a related study, the DAST-C (DAST-Checklist) was presented (Finson, et al, 1995). It offers the possibility of scoring according to the presence of images in a checklist created by compiling items shared in different studies. Farland-Smith et al (2012) presented the DAST-m (DAST-modified) rubric as an updated form that offers the opportunity to score

between 0 and 3 according to the status of the variables within the DAST- C form related to the categories of location, appearance and activity for the compilation of data obtained through DAST. Accordingly, DAST-m provides the classification and scoring of drawings as "*sensationalized, traditional* and *border than traditional*" (Farland- Smith et al., 2012; Farland- Smith, 2017). In addition, as a result of validity and reliability studies, DAST-m was presented as a rubric used in the classification of scientists and related images.

Based on all these, it was aimed to determine the scientist images of primary school 3rd grade and middle school 6th grade students and to determine whether there is a difference between these groups in terms of drawings.

MATERIALS and METHODS

Research design

The study was conducted in a primary school and a secondary school located in the city center of the South Marmara region in the 2022-2023 academic year. In accordance with the purpose, the survey model, one of the qualitative research designs, is considered appropriate.

In order to determine the views of primary and middle school students towards scientists, 28 students from the 3rd grade of primary school and 28 students from the 6th grade of middle school were included in the sample through convenience sampling method. In this study, it was deemed appropriate to work with students in the 3rd grade, where students have not yet encountered science lessons, and in the 6th grade, where they have formed an adaptation to the environment after changing schools. In addition, being economical in terms of time and accessibility is another factor (Balci, 2009).

Data collection procedure

The studies were shaped by the question "Can you draw a scientist at work?" to a total of 56 3rd and 6th grade students in their classrooms. Upon this question, they were given one hour to freely draw scientists on a white paper.

In addition, primary school (6 students) and middle school (6 students) students who participated in this activity were asked to describe the scientist they drew. On a white sheet of paper, students were asked to provide information about who the scientist was, where he/she worked, what surrounded him/her and what he/she was doing. Since these responses represented the students' drawings, they were taken as explanations of the situations in their drawings.

Data analyse procedure

The pictures collected from the students were digitized with a character number determined for each student. The documents were labeled as "Atlas ti 24" and the shapes and details related to the scientist in each picture were named as code units. Categories were created with these. Since the number

of scientists in each picture is different, the amounts between the categories and the total number of students in the group may be different. These categories are "working style and environment", "elements of appearance" and "fields of endeavor". Each figure is named and the frequency of repetition f and the %f values corresponding to its percentage value in the total frequency related to the total subject are shared in the findings section. Two field educator teachers were consulted about the code groups obtained. In addition, each drawing was scored by two researchers with the help of the DAST-m rubric developed by Farland-Smith et al, (2012). In this scoring, students' drawing preferences of appearance (0 to 3 points), location (0 to 3 points) and activity (0 to 3 points) were scored according to the appropriate categories. The scores were converted into averages of appearance, location and activity scores, and 0 points were assigned to "*can't be categorized*"; ($0 < point \leq 1$) points "*sensationalized*", ($1 < point \leq 2$) "*traditional*" and ($2 < point \leq 3$) and "*border than traditional*" types compared.

The field educator teacher was also consulted about the coding and scoring. In addition, secondary researcher agreement was utilized for reliability. Kilic (2015) recommends Cohen Kappa coefficient (κ) to determine the reliability of the agreement between two researchers. For the indicator of agreement between the researchers, $\kappa = .74$ ($p<.05$). Accordingly, it was presented that the agreement between the coders was at a good level ($.61 <\kappa<.80$, good agreement). This provides evidence that the coding and scoring were acceptably unbiased and reliable. The code groups for the images and symbols and the word/word groups for the coded images were shared in the findings section with their frequencies and percentages within the groups. In addition, the sensationalized, traditional and border than traditional categorization of the drawings between the groups is presented in terms of comparing the group profiles.

In addition, the writings of 12 students were analyzed and the explanations of their drawings were coded and shared in the findings section in the form of sections taken from their drawings and their explanations.

RESULTS and DISCUSSION

The frequency and percentage frequency findings of the data on the working style and environment of scientists obtained by analyzing the students' drawings are shown in Table 1.

Table 1. Scientist's working style and environment

Names of images	3rd grade		6th grade	
	f	%	f	%
The place of work is outdoors or indoors.	28	100	28	100
○ works indoors	17	60,71	21	75
○ could not be understood on or off.	10	35,71	6	21,42
○ works outdoors	1	3,58	1	3,58
Works alone or with a group.	28	100	28	100
○ works with group	8	28,57	13	46,43
○ works alone	20	71,43	15	53,57
Accessories in the working environment	28	100	32	100
○ refrigerator	1	3,57	1	3,13
○ experiment or study table	15	53,57	19	59,38
○ closet	4	14,28	6	18,75
○ windows or pictures (various)	1	3,57	1	3,13
○ clock, pendulum	0	0	2	6,24
○ signage (laboratory, study-experiment-computer room)	5	17,87	2	6,24
○ warning, warning, etc.	2	7,14	1	3,13

When Table 1 is analyzed, 60.71% of 3rd graders and 75% of 6th graders draw scientists in an enclosed location. However, while there was an equality in 6th graders in terms of group (46.43%) and solo (53.57%) work, it was found that 71.43% of 3rd graders drew scientists working alone. When the accessories in the working environment are examined, 18.75% in the 6th grade are cabinets, When the accessories in the working environment were analysed, 59,38% in 6th grade chose "experiment or study table" and 18,75% chose "closet" as popular objects, while 53,57% in 3rd grade chose "experiment and study table", 17,87% chose "signboard (laboratory, study-experiment-computer room)" and 14,28% chose “closet” as popular objects.

Table 2 shows the frequencies and percentages at the classroom level regarding the appearance characteristics of scientists.

Table 2. Scientist's appearances settings

Names of images	3rd grade		6th grade	
	f	%	f	%
Types of accessories	32	100	37	100
○ *Apron (White, Red, Brown, Blue, Purple, Purple, Pink, Black, Black, Green, colored or colorless)*	21	65,63	17	45,95
○ *goggles*	6	18,75	10	27,03
○ *masks*	1	3,12	6	16,22
○ *gloves*	1	3,12	2	5,4
○ *pens in pockets*	0	0	1	2,7
○ *clothes (with star, national flag... etc.)*	3	9,38	1	2,7
Hair style	34	100	44	100
○ *short hair*	21	61,77	8	18,18
○ *tangled, spiky or messy hair**	9	26,47	13	29,55
○ *long and thick hair*	3	8,82	12	27,27
○ *white color*	1	2,94	1	2,27
○ *red, blue, or multi color*	0	0	7	15,91
○ *brown and blond color*	0	0	2	4,55
○ *gray color*	0	0	1	2,27
Gender	34	100	44	100
○ *man*	15	44,12	25	56,82
○ *woman*	13	38,24	16	36,36
○ *not understand*	5	14,71	3	6,82
○ *scientist (bilim adamları... kadın)**	1	2,93	0	0
Facial expression	34	100	44	100
○ *happy face*	20	58,82	27	61,36
○ *ambigious face*	3	8,83	6	13,64
○ *scared face**	4	11,76	4	9,09
○ *sad face*	3	8,83	3	6,82
○ *anxious face**	4	11,76	4	9,09

When the drawings in Table 2 related to the appearance of the scientist were analysed, it was found that scientists wore aprons in both groups. When the hair characteristics were analysed, it was found that 61.77% of the 3rd graders drew scientists with "short hair" and 26.47% with "messy, upright and dishevelled hair", while 29.55% of the 6th graders drew scientists with "messy, upright and dishevelled hair" and 27.27% with "long and collective hair". When the gender characteristics of the students about the scientist were analysed, it was seen that 44.12% and 56.82% of the students in the 3rd and 6th grades, respectively, were male. Here, it was found that one of the responses was a drawing of a woman in response to the text "scientist". When the facial expressions seen in the students' drawings were analysed, it was seen that the scientists were happy in both groups, but those who were scared were 11.76% in the 3rd grade and 9.09% in the 6th grade. The same results and rates were found for the anxious facial expression.

The findings related to the fields of endeavor and work of scientists are presented in Table 3 as frequency and percentage values of the classes.

Table 3. Scientist's fields of endeavor

Names of images	3rd grade		6th grade	
	f	%	f	%
about living or non-living beings	2	2,82	12	12,83
○ *human-like living experiments**	1	1,41	7	7,37
○ *microscope*	0	0	4	4,21
○ *butterfly*	0	0	1	1,05
○ *glass in pots*	1	1,41	0	0
about electricity	1	2,82	12	12,64
○ *iron, copper, etc.*	0	0	3	3,16
○ *battery*	0	0	2	2,11
○ *coils*	0	0	2	2,11
○ *cables*	0	0	2	2,11
○ *light bulb*	1	1,41	1	1,05
○ *blue wires in jar*	0	0	1	1,05
○ *lightning- thunderbolds*	1	1,41	0	0
○ *socket or electrical switch*	0	0	1	1,05
about space or sky	17	23,96	10	10,53
○ *telescope*	1	1,41	3	3,16
○ *blue colored round, etc. (like earth)*	0	0	2	2,11
○ *Sun, moon, crescent moon and stars (5- pointed)*	6	8,45	2	2,11
○ *earth model*	2	2,82	1	1,05
○ *celestial body (*	2	2,82	1	1,05
○ *black hole*	0	0	1	1,05
○ *Saturn*	3	4,23	0	0
○ *solar system*	2	2,82	0	0
○ *clouds*	1	1,41	0	0
about chemicals and materials	22	30,99	41	43,15
○ *colored liquids*	15	21,13	23	24,23
○ *beaker glas, test tube etc*	2	2,82	12	12,63
○ *atom depiction*	0	0	1	1,05
○ *explotion (bomm!! and mushroom smoke)*	5	7,04	1	1,05
○ *injector*	0	0	1	1,05
○ *chemical equation*	0	0	1	1,05
○ *tong*	0	0	1	1,05
○ *potion and mixtures*	0	0	1	1,05
about others	29	40,86	20	21,05
○ *notes (notpads, board, etc.)*	14	19,72	9	9,47
○ *computes, phones, tablets and TV etc.*	5	7,04	6	6,32
○ *robot*	3	4,23	3	3,16

○ *book cabinet*	1	1,41	1	1,05
○ *mathematical operations*	2	2,82	1	1,05
○ *pi value*	1	1,41	0	0
○ *cube shape*	1	1,41	0	0
○ *descriptions writings (electric skate, izolator, corona floppy hats, plastic bottles, remote controls, etc.)*	4	14,29	1	2,94
○ *colored lights*	2	2,82	0	0

When Table 3 was analysed, it was found that the frequency values of students' drawings related to "living and non-living beings" were more intense in the 6th grades. In this subject, the frequency of "human-like living experiments" drawings of the 6th graders were higher with 7.37%. It is also seen that the frequencies of the 6th graders are high in the fields related to electricity. When the percentage distributions on the sky and space are examined, it is seen that 3rd grade students stand out in this subject. This subject was found to be "sun, crescent and star (five-pointed)" with a frequency of 8.45% for 3rd graders. In the drawings related to "chemicals and materials", it is seen that these drawings were made around 30% in the 3rd grades and over 40% in the 6th grades. Accordingly, it can be said that the majority of the drawings on this topic in both groups were "colored liquid" drawings. When the codings related to other subjects are analysed, it is seen that there is an accumulation in the image related to "notes (notebook, board)". It was found that the trendiest drawings of the students related to the fields of interest were "notes (notebook, board, etc.)" with a rate of 19.72% and "colored liquids" with a rate of 19.72% in the 3rd grade, and "colored liquids" with a rate of 23.17% in the 6th grade.

Data on group scores obtained by analysing student drawings through DAST-m are shown in

Table 4. Scores of the groups of location, appearance and activity

	Location				Appearance				Activity			
Point	3rd grades		6th grades		3rd grades		6th grades		3rd grades		6th grades	
	f	%	f	%	f	%	f	%	f	%	f	%
3	4	14,29	2	7,14	10	35,71	6	21,43	3	10,71	9	32,14
2	14	50,00	19	67,86	10	35,71	9	32,14	11	39,29	9	32,14
1	9	32,14	7	25,00	8	28,57	13	46,43	13	46,43	8	28,57
0	1	3,57	0	0,00	0	0,00	0	0,00	1	3,57	2	7,14
Avarage	1,75		1,82*		2,07*		1,75		1,57		1,89*	

When Table 4 is examined, it is seen that the mean of the 3rd grade group in the category of appearance is higher than the mean of the 6th graders and 3rd grades has “border than traditional” profile ($2 < 2.07 \leq 3$); 6th graders, on the other hand, have a traditional profile in terms of appearance ($1 < 1.75 \leq 2$). Although there were averages in favor of the 6th grade in the other category averages, it was found that both groups had traditional profiles in terms of both location and activity. When the averages obtained from the DAST-m rubric were evaluated, it was found that 3rd graders had a traditional profile ($1 < 1.79 \leq 2$); similarly, it was found that 6th graders had a traditional profile in scientist drawings

($1 < 1.82 \leq 2$). On the other hand, it was found that the mean of the 6th graders was higher than the 3rd graders in the total profile scores of the groups (1.79< 1.82).

Table 5 was obtained from the answers given by the students to the questions about their views on scientists.

Table 5. Views of scientists in the form responses of primary and secondary school students

	3rd grades	**6th grades**
1	*Albert Einstein*	*a teacher*
	Laboratory	*Laboratory*
	There are math operations on the wall	*test tubes and materials*
	Unspecified	*making games*
2	*Albert Einstein*	*a teacher*
	Unspecified	*science center*
	has great and important discoveries.*	*test tube and equipment*
	Unspecified	Unspecified
3	*Albert Einstein*	*a friend*
	laboratory (secred)*	*Laboratory*
	Microscobe ve iksirler	*Test tube, different liquits*
	Unspecified	Unspecified
4	*Albert Einstein*	*a friend*
	Laboratory (magical)*	*works anywhere.*
	iseletors (**), boxes	*lots of test tubes on the table*
	Unspecified	Unspecified
5	*a friend*	*a friend*
	laboratory	*a tidy room.*
	Hoverboard, the glass that show the future*	*Tubes, laptop, fan, microscope, and cleaning ingredient*
	Unspecified	Unspecified
6	*Albert Einstein*	*a teacher*
	laboratory	*laboratory*
	test tubes, protective goggles, machines and lots of cables.	*Test tubes, microscobe, deepfreezer*
	Unspecified	*experimenting*

It can be said that the views seen in bold and italicised text in Table 5 regarding student responses point to alternative images. When the student interviews are analyzed, it is seen that they made explanations of the alternative images seen in the pictures. It is seen that students 3 and 4 in the 3rd grade of primary school described the place where scientists work as "secret" and "magical". Their drawings related to these descriptions are shown in Figure 1.

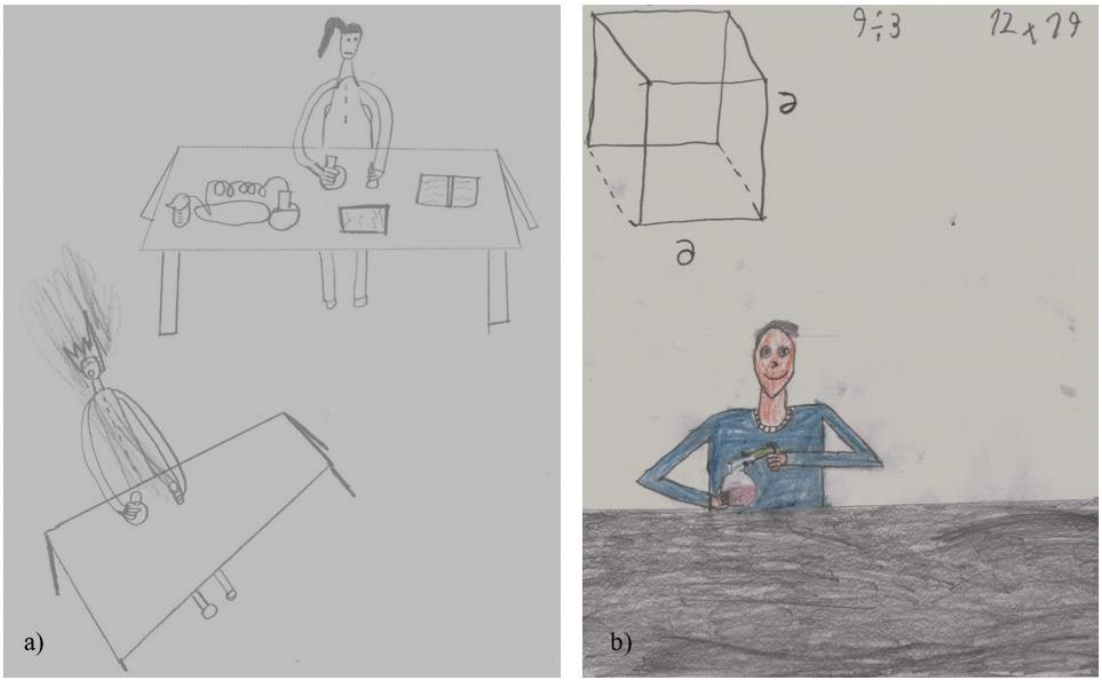

Figure 1. Primary school student drawings (a) 3rd grade student 3, (b) 3rd grade student 4

When Figure 1 is analyzed, picture (a) shows an explosion and a human face covered in smoke. This situation was shared as an alternative image represented as an explosion (Table 3). In addition, Table 4 explains that the students interviewed at the 3rd grade level drew Albert Einstein in their drawings. In this class, only student number 5 stated that he drew his friend as a scientist (Figure 2).

Figure 2. Primary school student drawings section from the drawing of 3rd grade student number 3

When Figure 2 is analyzed, it is seen that the student also mentioned a hoverboard and glasses showing the future in his drawings. These objects can be interpreted as objects encountered in "science fiction" style movies. In addition, it was observed that all of the elementary school students whose drawings were examined included the expression "laboratory" as their working area, but they did not make any comments about what they were dealing with, except for students 5 and 6.

When the expressions of the middle school students are analyzed, it is seen that the expression "laboratory" is used intensively and the student number 5 used the expression "a regular room". Figure 3 shows regular room and laboratory views.

Figure 3. Secondary school student drawings (a) Student 5's drawing of a regular room (b) Student 6's drawing of a laboratory

In another case, unlike the opinions of primary school students, middle school students shared the drawings of a friend and a teacher (Table 4). Similarly, it was observed that students 1 and 6 responded to the question of what middle school students were interested in with the expressions "playing a game" and "experimenting", respectively, while no explanation was given in the other interviews. A few situations that were not encountered in the student interviews but were seen in the drawings were shared in Table 3 as "human-like... creature experiments" as an alternative image. Examples of this are shown in Figure 4.

Figure 4. Secondary school student drawings (a) Student 2's scientist and human figure, (b) Student 3's scientist figure, (c) Student 2's scientist and an animal figure

When Figure 4 is examined, it is seen that the living things shown with a and c and the scientists next to them work with and are interested in these living things. However, these situations can be explained as situations not mentioned in the interview questions. In addition, it can be said that the student in b is a scientist figure but cannot be identified.

Conclusion

Based on all these, the objects and differences in the drawings of 3rd and 6th grade students about the scientist's working style and environment, elements of appearance and fields of endeavor in the drawings about the scientist are presented in the findings section. In both groups, the scientist is attributed as a man who works alone, indoors, around an experiment or a desk. The mean scores obtained with DAST-m from the drawings of middle school and primary school students indicate that both groups have a traditional profile. There are studies supporting similar results in the literature (Yontar Togrul, 2000; Duran & Bayar, 2019; Basay & Aytar, 2019, Ozdemir, 2022). On the other hand, it can be said that there is a difference in favor of primary schools in the students' appearance scores of scientists. While primary school students' drawings of scientists were found to have a border than traditional profile in terms of appearance, middle school students' drawings were found to have a traditional profile. However, it can be said that the mean scores were very close in both groups. It is thought that the fact that both groups have a traditional profile may be related to the fact that they have just started science education. On the other hand, the fact that larger classes were not included in the study can be argued as a limitation of the study. Due to the high school entrance exam in Turkey, 8th grade students were not included. However, it can be said that 7th graders also struggle with an intensive curriculum in all subjects.

It was observed that elementary and middle school students with a traditional profile had some alternative images. Explosions, experiments with humans or living creatures and drawings with various elements of fear were found to be examples of these situations (Chamber, 1983; Farland- Smith, 2012). Chamber (1983) states that the emergence of such a situation in 1 or 2 students at each level cannot be associated with any negative situation. On the other hand, the results about the negative impact of media and social media can be discussed (Demir & Poyraz Rustemoglu, 2022; Esen, et al., 2022). However, in order to make a conclusion about this, it can be suggested that the data of this study is limited and should be repeated with a causal research.

As another finding, when the fields of activity of the scientist shared as another finding were analyzed, it was drawn as a trend that the scientist was dealing with chemical materials or was interested in the sky and space in the 3rd grade group. In 6th grade, it was found that chemicals and materials were drawn as a trend. It is possible to encounter studies with similar results in the literature (Nuhoglu & Afacan, 2007; Kaya, et al., 2008). In this context, students' science.

It is thought that associating people with “about chemical materials” and “about space and sky” can be used as a source of motivation in primary and secondary school groups.

The sample size, which is considered as a limitation, is ignored in the research, which aims to reveal the situations of the groups rather than comparing primary and secondary school students.

However, for such a comparison, it may be recommended to work with a larger sample of primary and secondary school students at different levels.

In addition, it is recommended that science educators be introduced to various versions of the DAST forms in order to see the profiles of the students in their classes and to use them as a source of motivation by identifying the situation in their students.

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