Revista Internacional Educon | ISSN 2675-6722
Volume 3, n. 1, e22031018, jan./abr. 2022
https://doi.org/10.47764/e22031018

Application of the DAST Test in High School: Revealing Stereotypes and Indicating the Path to Change

Aplicação do Teste DAST no Ensino Médio: Revelando Estereótipos e Indicando o Caminho Para a Mudança

Aplicación de la prueba DAST en la escuela secundaria: revelando estereotipos e indicando el camino al cambio

---

JÉSSICA PEREIRA SANTOS [1]

1 Universidade Federal de Sergipe.

ABSTRACT: *For there to be a greater participation of women in the areas linked to Science and Technology, it is necessary to identify the situations that keep them away from these areas. In this work, the DAST test (Draw-a-Scientist Test) was applied to 74 high school students along with a questionnaire, aiming at identifying which knowledge characteristics populate the students' imaginary and if there were distorted views of the sciences. The analysis of the drawings and questionnaires show that the old stereotypes of male scientists, lab coat, smart and crazy, are still present, but as images they may be going through a process of jovialization. In comparison with other DAST applications, there was a greater number of female representations made mostly by girls, revealing the search for representativeness. The presence of a more humanized view of the sciences was noted. It was noticed that the school is not the main creator of such stereotyped conceptions, but it is the main ally to undo them.*
DAST. STEREOTYPES. GENRE.

RESUMO*: Para que haja uma maior participação das mulheres nas áreas ligadas à Ciência e Tecnologia é necessário a identificação das situações que às afasta dessas áreas. Nesse trabalho, foi aplicado com 74 alunos do ensino médio o teste DAST (Draw-a-Scientist Test) junto a um questionário, objetivando a identificação de quais características de cientistas povoam o imaginário dos estudantes e se havia visões deturpadas das ciências. As análises dos desenhos e questionários mostram que os antigos estereótipos de cientistas do sexo masculino, jaleco, inteligentes e loucos, ainda estão presentes, mas as imagens podem estar passando por um processo de jovialização. Em comparação com outras aplicações do DAST, houve maior incidência de representações femininas feitas majoritariamente por meninas, revelando a busca por representatividade. Notou-se a presença de uma visão mais humanizada das ciências. Percebeu-se que a escola não é principal criadora de tais concepções estereotipadas, mas é a principal aliada para desfazê-las.*
DAST. ESTEREÓTIPOS. GÊNERO.

RESUMEN: *Para que haya una mayor participación de las mujeres en las áreas vinculadas a la Ciencia y la Tecnología, es necesario identificar las situaciones que las mantienen alejadas de estas áreas. En este trabajo, a 74 estudiantes de secundaria se les aplicó la prueba DAST (Draw-a-Scientist Test) junto con un cuestionario, con el objetivo de identificar qué características de los científicos pueblan la imaginación de los estudiantes y si existían visiones distorsionadas de las ciencias. El análisis de los dibujos y cuestionarios muestra que los viejos estereotipos de hombres científicos, bata de laboratorio, inteligentes y locos, siguen presentes, pero las imágenes pueden estar pasando por un proceso de jovialización. En comparación con otras aplicaciones de DAST, hubo una mayor incidencia de representaciones femeninas realizadas mayoritariamente por niñas, lo que revela la búsqueda de representatividad. Se notó la presencia de una visión más humanizada de las ciencias. Se advirtió que la escuela no es la principal creadora de tales concepciones estereotipadas, pero es el principal aliado para deshacerlas.*
DAST. ESTEREOTIPOS. GÉNERO.

Introduction

The idea is growing that, in order for there to be positive changes in the world, encouraging science is crucial. The UN to indicate paths for change on the world stage, with the objective of 3 sustainable development goals 17 goals for the global development – "*Global Goals*" (*The Global Goals*, s.d.). Among them, the fourth objective is universal access to quality education, and the fifth objective is to achieve gender equality and empower all women and girls. Such is the need for better quality education and gender equality for a more humane world that these goals are second only to: the eradication of poverty (1st) and hunger (2nd) and access to health and well-being (3rd).

Brazil has a history of low performance in international learning assessment tests. The International Student Assessment Program (Pisa) is one of these tests at an international level. It aims to generate data that can contribute to the discussion of educational quality in participating countries. According to the National Institute of Educational Studies and Research Anísio Teixeira (2020), 79 countries participated in Pisa in 2018. In this context, Brazil ranked between 64th and 67th in science, considering the confidence intervals of the average scores. This result shows a significant deficiency in Brazil in areas related to natural sciences, revealing the urgent need for changes.

Regarding informal occupation jobs, women occupy approximately the same number of vacancies as men, with 43.97% of vacancies occupied by females and 56.03% by males (*Ministério do trabalho*, 2019). In academic settings, the number of researchers is approximately equal between genders (Lazzarini et al., 2018). The number of scholarships funded by the National Council for Scientific and Technological Development (CNPq), provided to women, was already more significant than 50% in the main categories of scholarships funded by the body (scientific initiation, master's, doctoral and postgraduate studies). However, when we look at courses in Exact and Earth Sciences, Mathematics and Computer Science, known as Science and Technology (S&T) areas, it is possible to notice that the gender distribution by course is quite uneven. The number of male CNPq fellow researchers registered is about 20% to 30% more than that of women, while the scenario is the opposite in the case of courses in the area of Biological Sciences, Health, Human Sciences, Social Sciences Applied and Linguistics, Letters and Arts, where the female sex is in more significant number about 20 to 30%. However, the demand of female students for these professions is even more scarce. Among the various reasons that make it difficult for women to search for S&T areas, studies indicate the fact that the image of scientists is stereotyped by the population and the media. (Saboya, 2013; Cunha et al., 2014; Alves, Barbosa & Lindner, 2019).

According to Cunha et al. (2014), one of the situations that keep girls away from scientific careers involving the areas of S&T is stereotypes. For the authors, in addition to the different stimuli provided to boys and girls in family education:

> Another justification for the lag between women and men in the area of Exact Sciences can be associated with social stereotypes, which consider that men and women have different aptitudes

> for certain careers, such as Mathematics. At school, teachers observe that boys and girls up to 12 have similar aptitudes for calculations. However, girls tend to decrease these skills over the years (a fact confirmed by the grades in the subject). The causes of this phenomenon have not yet been proven and may be associated with factors of a social nature, however this stereotype seems to affect girls, discouraging them from following the areas of exact sciences. (Cunha et al., 2014, p. 409)

Therefore, according to Cunha et al. (2014), the low demand by women for areas linked to S&T is due to the existence, in particular, of a stereotype that says that being scientists is a "boy thing".

In order to investigate which were the scientist stereotypes present in the imagination of children and from what age they began to present themselves, researchers asked almost 5000 of them, from different countries, to draw a scientist (Chambers, 1983).

The drawings were analyzed by seven standard indicators. They demonstrated a reflection of gender inequality and how male stereotypes become more present with the advancing age of children and reinforce the notion that professions linked to S&T are characteristics of sex masculine.

Several studies indicate that female representation in the areas of S&T will only be expanded through efforts, made even at school age for girls, to favor their development in S&T skills, empowering them so that they feel free to want to work in these áreas (Agrello & Garg, 2009; Saboya, 2013; Bolzzani, 2017). The initiatives can take different forms, from the concern of natural sciences and mathematics teachers in not treating girls and boys differently regarding their abilities (Marrero, 2006), to projects involving the whole school and/or external people (researchers and researchers), even awards (Cunha et al., 2014; Lima et al., 2015; Alves et al., 2019).

This work belongs to the context of encouraging all students, but especially girls, to follow paths in the areas of S&T. The objective of this research was to investigate the student's perception of a scientist person and their work through the application of an adaptation of the "Draw-a-Scientist Test" (DAST) described in Mason, Kahle and Gardner (1991). With this, the objective was to identify the stereotypes of the scientist person present in the students' imagination of the first year of high school at a state school in Aracaju city, in Sergipe, a Brazilian state.

This research has a qualitative and quantitative approach, with an exploratory nature. This work is characterized as participatory field research in the procedures, as the data collection was monitored and observed throughout the journey. According to Ludke and André (2018), "Although there have already been some attempts to specify the process of data collection and analysis during participant observation, there is no method that can be recommended as the best or most effective" (p. 17). In this work, the data collection method was based on the questionnaire described by Mason et al. (1991). In addition to open questions, students are asked to draw a scientist. After collection, data were analyzed based on Laurence Bardin's content analysis technique (Bardin, 2011).

Furthermore, this work presents the results of the first stage of research that aims to investigate the role of representation of women in science in a school where the teachers who teach in the areas of natural sciences (Physics, Chemistry, and Biology) are of the sex feminine. Students will be monitored throughout their school trajectory. Their conceptions about science and scientists will be analyzed at the end of high school to realize whether the project produced changes in the conceptions and direction of students throughout high school.

1 The DAST: Leading the Way for Change

The DAST (Draw a Scientist Test) was created by David Wade Chambers in 1983. This test arose from the need to investigate which stereotypes of scientists are present in children's imagination and whether they could influence the low demand of students for S&T areas. One of the goals of this study was to determine at what age children first develop images of scientists.

The idea present in people's imagination about the appearance of a scientist has been shaped over time. In engravings from the 18th and 19th centuries, the images about the sciences and their producers (scientists) were quite varied, composing a range of stereotyped figures such as drawings of mad, diabolical scientists, magicians, scholars. The scientists were male and were almost always in laboratories or representing naturalists in field studies. In addition, there were representations of discussions in which scientists defend their opinions (Sherwood, 1970, apud Chambers, 1983).

According to Chambers (1983), the DAST pointed to a strong stereotyping of the scientist profession. The indicators appeared in the drawings since the second grade of kindergarten. As the age of the children advanced, the drawings accumulated more indicators of stereotypes. Later reports of the application of this test or adaptations of it were made over the years, such as that made by Mason et al. (1991), which attested to the same scenario described years earlier by Chambers (1983).

The DAST was applied many other times in several countries where the theme most addressed in the works is the stereotypes linked to gender. In Brazil, in the second decade of the 21st century, several test applications were made in different scenarios. The results of the stereotypes of scientists produced by the students were very similar to those described by Chambers (1983).

Cunha et al. (2014) present data from a survey on the intention of Brazilian students to pursue scientific careers. The survey was carried out by sampling the region. The data pointed to a low general search for a scientific career, especially among girls. In all Brazilian regions, more than 50% of the sample of girls disagreed with the phrase "I would like to be a scientist." In the Brazilian north and northeast, this rate exceeds 60%, highlighting the importance of the debate on the theme of women in science, especially in the north and northeast.

An application of the DAST was carried out with students in the 6th year of elementary school at a school in Santa Maria/RS. Buske, Bartholomei - Santos and Temp (2015) identified the same scientist pattern cited by Chambers (1983). The origin of these standards "may not be directly linked to school education. Works such as those by Buldu (2006), Steinke et al. (2007), and Rodari (2007) point to the media influence, especially television, for the creation of this stereotyped view" (Buske et al., 2015).

Miola, Almeida, Dantas and Cunha (2016) carried out an application of the DAST with children from the 3rd year of elementary school at a private school in the city of Cascavel/PR and identified that the stereotypes drawn by the children are fundamentally a reflection of what circulates in the media. However, in terms of gender, half of the children draw women as scientists. This fact may indicate a direction to break stereotypes.

In another study also carried out in Cascavel/PR, Cavalli and Meglioratti (2018) applied the DAST with a class of the eighth grade of elementary school at a private school. It was possible to conclude that the class had a masculine and stereotyped view of scientists. However, the discussion provided reflection and the initial steps towards a paradigm shift. The authors also discussed the fundamental importance of primary education teachers in this change, in agreement with the notes described in (Buske et al., 2015), as they state that the media influence is primarily responsible for the stereotypical view of children about scientists, but that the school can help in this deconstruction.

Almerindo, Ehrhardt, Costódio, de Bona and Nalepa (2020) applied the DAST test in Santa Catarina, carried out with an audience of children aged 9 to 12 years. This work indicated that almost 50% of the children responded that they did not know scientists, except those from cartoons. The study also revealed a lack of knowledge about the presence of women in science. In addition, there was general ignorance about the profession of scientists, regardless of stereotypes.

Brasil (2020) developed and applied a didactic sequence involving DAST in the city of Vitória da Conquista/BA, with students from the 9th grade of Elementary School. The research indicates that in

comparison with previous works, despite the prevalence of stereotypes of scientists as belonging to the male gender, middle-aged, with glasses and lab coat, there was an increase in the presence of the female gender, in addition to the identification of high school teachers, as researchers.

It is possible to notice that stereotypes are present in children's daily lives, and they are repeated to the point that the child can also reproduce them. Several films, television, children's and children's books convey images of mad scientists (Reis, Rodrigues & Santos, 2006). Both older films, such as "Back to the future" (1985), and the most recent ones, such as "Cloudy with a Chance of Meatballs" (2009 and 2013), "Up" (2009), "Despicable Me" (2010, 2013 and 2017), are of worldwide circulation and replicate these patterns of physical and personality characteristics of scientists. The concept of stereotype in the dictionary is a "standard established by common sense and based on the absence of knowledge about the subject in question." (Dicio, 2020). Reis et al. (2006) indicate works that point to evidence about the responsibility of the media for the transmission of stereotyped and distorted images about scientists and scientific processes. Thus, a false and caricatured image is disseminated. This fact may be related to the absence of young people in careers linked to the areas of S&T.

Reis et al. (2006), in their discussion of this subject, raise the argument that:

> There is nothing wrong with the existence of stereotypes unless there are no "against images", that is, images of scientists that oppose or are different from each other, hence the importance of reflecting on these images in the context of classroom. (Reis et al., 2006, p. 56)

For the authors, the importance of the elementary education teacher in the promotion of "against images" is essential, and there must be personal and professional development initiatives that encourage and support teachers to promote greater clarification on scientific processes. That provides a more natural and human conception of science. The formation of "counter images" can also be carried out through partnerships with universities so that students can get in touch with real scientists from different areas, women and men, making science closer to the reality of students.

Buske et al. (2015) indicate that studies that use the DAST test to investigate students' conceptions of scientists and scientific processes in Brazil are concentrated in students from the South and Southeast regions. The same was verified in the present work, whose only application of the DAST cited outside these regions was the one carried out by Brasil (2020).

This work aimed to understand the stereotypes in the school scenario, considering that these notes will help the teachers' essential work as indispensable actors in the deconstruction of stereotypes in the imagination of children and adolescents. Thus, the present research is relevant because of the need to break stereotypes, so that younger people feel willing to choose scientific careers and for the constitution of greater gender equality in the areas of S&T. It is crucial to create strategies to increase girls' interest in choosing a profession linked to S&T, whose number of researchers is low, and within this, the number of women is even smaller. The greater participation of women in S&T generates a more diverse range of researchers with different perspectives on reality and, therefore, more creative and prone to development.

The present work constitutes the first stage of a larger investigation into the impact on the deconstruction of stereotypes that a specific formation of the teaching staff, added to actions in classes and projects, can entail. Unlike most schools, the students of the curricular components in the area of Natural Sciences and its technologies (Chemistry, Physics and Biology), of the school where this research was carried out, are female. Therefore, the DAST test provided us with indications for the next steps.

2 Methodological Path

This research was carried out in March 2020 and had 74 students from the first year of high school at a public school in the city of Aracaju/SE. The students were between 14 and 16 years old. The application of the research lasted two classes of 50 minutes each and took place in Biology classes. Students were asked to draw a scientist, according to the DAST (Test draw a scientist) proposed by Chambers (1983) and based on the same study, a seven-question questionnaire was applied (Table 01) adapted from (Aulanapractica, 2015). This research was not submitted to the ethics council. However, submission is scheduled for the project's following stages that contain this research, where students will be interviewed.

Item	Question
1	What kind of scientist did you draw?
2	Where is he working?
3	Do you think there are more male or female scientists in the world?
4	Do you think most scientists work alone or in groups?
5	Do they work in the laboratory or in the field?
6	Why do you think so many people believe that scientists are one way?
7	Why are these drawings not accurate about what scientists are like?

Table 01: Questionnaire applied to students after DAST (Aulanapratica, 2015).

To facilitate the analysis of the students' responses, a list of Indicator items for the standard image of a scientist (Table 02) created by Manson, Kahle, and Gardner (1991) and translated for application in this work was used.

After applying the DAST and the questionnaire, the items described in Table 02 were observed in class. For this, the teacher counted items (Table 02) related to the stereotyping of the scientist's image with the students. For this, the teacher counted items (Table 02) related to the stereotyping of the scientist's image with the students. If a student had an item mentioned by the teacher in his drawing, he should raise his hand to indicate that he had reproduced it in his drawing. With this, the students could see the answers of their classmates. The teacher made no indication of what was positive or negative. At the end of counting the points of stereotyped items, the teacher opened a speech moment for students who wished to express an opinion.

Numbering	Indicator
1	Lab coat
2	Glasses
3	Facial hair
4	Search symbols: a) test tubes b) flasks c) microscope d) Bunsen burner e) animal experiments f) others
5	Knowledge symbols

	a) books b) cabinets c) others
6	Technology signs (products of science) a) glass solutions b) machines c) others
7	Subtitle
8	Masculine
9	Signs/labeling
10	Pencils/pens in pocket
11	unkempt appearance

Table 02: Indicators for the standard image of a scientist (Manson et al., 1991).

At the end of the class, the activities were collected. The analysis of the drawings was performed based on the items described in Manson et al. (1991) and culminated in an approach based on qualitative and quantitative analysis. According to Neves (1996), the two points of view are not opposed: they complement each other and can contribute to deepening the understanding of the phenomenon studied, since "research can reveal the concern in diagnosing a phenomenon (describing and interpreting); the author could also be concerned with explaining this phenomenon, based on its determinants, that is, the causal nexus relations" (Neves, 1996).

According to Bardin (2011), "Categories are rubrics or classes, which bring together a group of elements (record units, in the case of content analysis) under a generic title, a grouping made due to the common characteristics of these elements" (p. 147). As this work deals with the application of a test already known in the literature, the categories described by Manson et al. (1991). In addition, analysis categories were created from the coding of the questionnaire responses. The results obtained will be presented in the next section.

3 Results and discussion

Seventy-four (74) students participated in the DAST test. Initially, they made their drawings of scientists and then answered the questionnaire described in Table 01. Finally, a brief analysis of the responses was developed with the class, resulting in a debate about the scientist profile indicated in the drawings.

These 74 drawings were analyzed according to the categories described in Table 02, based on (Manson et al., 1991). The results of the analysis of the drawings are described in Table 03. This table presents the data of the total audience by gender.

Gender	**Feminine**		**Masculine**		**Total**	
Nº of students: by gender / total	**31**	**%**	**43**	**%**	**74**	**%**
1. Lab coat	20	64,52	39	90,7	59	79,73
2. Glasses	22	70,97	31	72,09	53	71,62

3. Facial hair	4	12,9	14	32,56	18	24,32
4. Search symbols:						
a) test tubes	21	67,74	28	65,12	49	66,22
b) flasks	28	90,32	37	86,05	65	87,84
c) microscope	2	6,45	4	9,3	6	8,11
d) Bunsen burner	0	0	1	2,33	1	1,35
e) animal experiments	3	12,90	5	11,63	9	12,26
f) others	13	41,94	11	25,58	24	32,43
5. Knowledge symbols:						
a) books	8	25,81	6	13,95	14	18,92
b) cabinets	7	22,58	19	44,19	26	35,14
c) others	6	19,35	10	23,26	16	21,62
6. Technology signs (products of science):						
a) glass solutions	27	87,1	34	79,07	61	82,43
b) machines	3	9,68	1	2,33	4	5,41
c) others	0	0	1	2,33	1	1,35
7. Subtitle	5	16,13	7	16,28	12	16,22
8. Masculine	12	38,71	40	93,02	52	70,27
9. Signs/labeling	10	32,26	8	18,6	18	24,32
10. Pencils/pens in pocket	3	9,68	4	9,3	7	9,46
11. Unkempt appearance	7	22,58	20	46,51	27	36,49
12. Closed environment	30	96,77	33	76,74	63	85,14
13. Color (white)	28	90,32	38	88,37	66	89,19

Table 03: Analysis of the frequency with which indicators for the standard image of a scientist appeared in student drawings.

Among the indicators for the standard image of a scientist, the lab coat appears in almost 79.7% of the drawings. Looking at the drawings by gender, lab coat appears in 90.7% of the boys' drawings, in contrast to 64.5% among the girls. The glasses appear in about 70% of the drawings and equally between the genders.

Facial hair appeared in a much smaller proportion than indicated in older applications of the DAST (Chambers, 1983; Manson et al., 1991), which indicates a change in the characterization of the stereotype of a scientist. Few drawings of facial hair corroborate the answers that portray a young scientist. In Table 04, in the "age" analysis category, it is possible to notice how the students described the scientist's youth. The use of the word “new” was very present to mention the scientist, and there was also an exact indication of age with phrases such as “the scientist is young, 30 years old”. Age mentions were only expressed for scientists aged 40 years or younger (mentions were at 25, 29, 30, 35, and 40 years). This

indicator may show that there is a process of bringing young people closer to scientific careers. Some television and streaming series also points to this trend of jovialization of the characters as a whole. An indication of the difference in perception by gender is the percentage of students who drew lab coats: these were represented by 64.5% of the girls while they appeared in 90.7% of the drawings made by boys. Is may indicate that girls are more likely not to reproduce stereotypes.

Regarding research symbols, the most cited items were bottles, with 87.8%, and test tubes, with 66.2% of occurrences, both with equal distribution between genders. Animals were mentioned in only nine drawings, equivalent to 12.3% of the total number of students. In the item "others," we perceive a range of elements in equal proportion between the genres in this same category. The most cited object was the magnifying glass (6.8% of the total number of students). The other items are listed in descending order of the number of citations. With two quotes: poison, atom symbol, experiments, computers, clipboard, and masks, and with just one quote, gloves, emergency shower, hood, front mirror, plants, tools, and rockets appear.

There was no important occurrence of any specific knowledge symbol. In this case, the cabinets were represented in the most significant number of drawings (26), totaling 35.1% of the drawings. Books appeared in 18.92% of the drawings and were 10% more portrayed by girls than boys, which may be related to their higher general performance in studies than boys, except for mathematics (Saboya, 2013). Still in the category of symbols of knowledge, in the item "others", the most cited symbol was the blackboard (9.5% of the students), in whose drawings it was filled with formulas or graphs. The second most cited item was the computer (5.4%). The other items cited were boxes, the Periodic Table, formulas, and references to a researcher lecturing.

In technology signals, in item "c" (others), a student draws antennas representing 1.3% of students in this category. No mention is made of machines as research products. However, 82.4% of students refer to glass solutions. Legends appear in 12 drawings (16.2%) and refer to descriptions. Of these, ten students, or 13.5% of the total, used the word "laboratory" as a caption. The other two captions refer to virus names and "science".

Labeling appears in 24.3% of the drawings, with the most cited terms "care/danger" appearing in 18 drawings (9.5%) of the drawings and mentions of "exit", "poison" and formulas appearing tied. With three mentions each (4%). Other labels that appeared only once were institute symbols (NASA), an atom, and a plaque with the researcher's name. The girls' drawings were richer in details that specified the environment (signs/labeling).

In the age of computers, pencils or pens in the pocket no longer represent scientific research. This stereotype indicator appeared in only 9.5% of the drawings.

The drawings by girls showed a significant difference in the indicator "sloppy appearance", as they were present in only 22.5% of the drawings, against 46.5% present in the drawings by boys. Girls are less attached to this stereotype.

Notably, in both genres, the indicators "closed environment" and "color (white)" appear in 85.1% and 89.2% of the drawings, respectively. The color indicator demonstrates that black people are not seen with people who do science. As for the notion that scientists always work in closed environments, it is necessary to present students with different contexts where scientific research takes place, both in terms of physical location (laboratories and field), and in a diversity of areas, such as the Humanities, for example. As the term "sciences" is used from an early age in the school curriculum to refer to topics in Biology, Chemistry, and Physics, it seems to constitute another stereotype, which carries the term "sciences" as something unrelated to areas other than Natural Sciences and math.

As for the scientist's gender, only 38.7% of the girls drew men in solid opposition to 93% of the boys who drew male scientists. This result highlights the remarkable awareness of student girls regarding the possibility of being in any work area, recognizing that women also do science.

Observing the local context in which the scientists were drawing, it is noted that only two students drew the scientists on vacation. However, one of them alleges that the scientist is on vacation at a congress, referring to the idea that scientists have most of their lives dedicated to working.

Analyzing student responses to the question, "What kind of scientist did you draw?" it was possible to group the answers in the following categories of analysis: referring to the age of the scientists, to the professional training course, to the mood. There are also references to the place where scientists work and the scientist's local situation when the idea for the design was formed (present moment). In addition, there were the scientist alchemists/mages.

Among the characteristics of the type of scientists portrayed in the drawings, there are two allusions to Einstein, there is one who is on vacation, but in a congress, one who makes explosives, one who researches the cure for cancer, and one "ugly and tall" (words of the student). Only one student made a drawing that referred to the image of Marie Curie, and only one student drew a scientist of each sex in the same drawing, alluding to the fact that individuals of any gender can produce science.

Analysis category	groups	Nº mentions
Age	Young	19
	Middle aged	5
	Old	2
Training / work	Chemical	8
	Biology and the like	3
	Math	1
	Alchemist	1
Characteristics / personality	Crazy	17
	Centered/serious	9
	Nerd	2
	satisfied with work	3
	Intelligent	3
	LGBT	1
	Physical characteristics	2
	Emotionless	3
Relating to present moment of the drawing	Test chemical formulas	2
	Research the cure of diseases	2
	scientist researching	3
	Vacation	3

Table 04: Question analysis categories: "What kind of scientist did you draw?" (Table 02).

As for the question "Do you think there are more male or female scientists in the world?" a total of 62 students said that most scientists are men. In percentage numbers, this means 83.8%. Higher value 70.3% of the drawings in which male scientists were portrayed. It indicates that a part of the girls who drew women believe that most scientists are men, and despite this belief, they stated the desire to change this scenario in their drawings. Students who stated that most scientists are women add up to 12.2% (9 students). Of the students who indicated that most scientists are women, five were female, and four were

male. Only one student (1.4%) said that the number of scientists is the same between the two genders, and two did not know or did not give an opinion (2.6%).

The answers to the question "do you think scientists work in groups or alone", showed the students' awareness that science is built with collaboration, as 58 students (81.1%) stated that scientists work in groups; in this group, two students consider that scientists sometimes do work alone. Only eight students said that scientists work alone (10.8%), and six did not know or did not give an opinion (8.1%).

When analyzing Table 2, it is possible to notice that the scientist's profile is a young man, chemist, crazy and severe. Personality traits also indicate that he is studious and intelligent, but also that he can be emotionless. One scientist was described as being LGBT, which demonstrates the students' search for diversity and representation.

In the analysis category "Regarding the present moment of the drawing", most descriptions refer to work situations. However, three students indicated that the scientist is on vacation, indicating an approximation of a more human view of the people involved in scientific processes.

On why students think so many people believe that scientists are one way, the students were incisive in stating that the perception of what a scientist is like comes from the media. When asked why drawings are inaccurate about what scientists are like, students had difficulty answering, and most said they did not know the answer. However, those who responded said that there are other types of scientists, alluding to the areas of humanities and social sciences, or that "TV makes it seem like there is only one type of scientist".

Our results were similar to other studies, presenting the scientist as a man in a white coat surrounded by glassworks and science dependent on the scientific method to be developed. It was possible to perceive that the school is not the only one to influence such conceptions of the students. It was also noted that girls are less prone to replicating stereotypes than boys, and there is an emerging awareness of girls regarding the female capacity to act in the areas of S&T.

Final considerations

The objective of the present work was to carry out the application of the DAST test in a public school in Aracaju/SE and verify the image of a scientist present in the students' imagination. This study contributed to mapping the stereotypes of scientists of students in a city in northeastern Brazil, favoring the optimization of strategies to show more students that it is possible to be a scientist, without the need to adhere to these stereotypes, encouraging insertion in areas of S&T. From the surveys obtained with the drawings, it was possible to promote a class discussion about the male stereotype of the scientist and the participation of women in science.

The analysis of the drawings (DAST) and the questionnaires (Table 02) resulted in an expressive presence of female images, appearing in about 60% of the drawings made by girls. Considering the total number of students who took the test, the number of drawings by women drops to 30%. Despite being a value less than half of the number of students who took the DAST, this value means a growing trend compared with data from surveys that applied the DAST.

According to most of the drawings, the stereotypical scientist profile remains with new nuances: a white man with a lab coat and glasses, but who now appears young and without a beard. As in previous works, the workplace also appears as expressed by a laboratory full of glassware. Through the representations of popular scientists and famous characters from television programs, it was still possible to notice that there is a strong influence of the media on the construction of stereotypes.

It was evident that most students still have a stereotyped view of scientists and scientific processes. However, the analyses carried out show that there are slight differences in the scientist's profile. A small group of students presented a more humanized view of science and its actors. In addition, the students showed evidence of the search for representation since most of the girls drew women.

These results provided evidence for promoting more effective projects aimed at achieving greater student participation in science as a whole, but especially in areas related to S&T, aiming to expand the professional possibilities of students, especially girls. The future perspectives for this research are to carry out more applications of the DAST in the search to broaden and diversify the group of students so that the new applications of the test must be made in other schools in the state: in the private and public schools, integral education (the case of this research), traditional schools, and night schools.

Acknowledgments

I thank teachers Marilia Fraga Vieira and Rosângela Maria Passos de Jesus for administering the tests.

References

Agrello, D. A. & Garg, R. (2009). Mulheres na física: poder e preconceito nos países em desenvolvimento. Revista brasileira de ensino de física, *31*(1), 1305.1-1305.6. DOI: 10.1590/S1806-11172009000100005

Almerindo, G. I., Ehrhardt, A., Costódio, P. F. S., de Bona, T. F., & Nalepa, K. T. (2020). Mulheres na ciência para crianças: um relato de sala de aula. *Química Nova na Escola. 42* (4), 344-350. DOI: 10.21577/0104-8899.20160217

Alves, M. R., Barbosa, M. C., & Lindner, E. L. (2019). Mulheres na Ciência: a busca constante pela representatividade no cenário científico. Anais do XII *Encontro Nacional de Educação em Ciências*. http://www.abrapecnet.org.br/enpec/xii-enpec/anais/resumos/1/R0194-1.pdf.

Aulanaprática. (2015). Atividade Desenhe um Cientista. https://aulanapratica.wordpress.com/2015/08/28/atividade-desenhe-um-cientista.

Bolzani, V. S. (2017). Mulheres na ciência: por que ainda somos tão poucas? *Ciência e cultura. 69*(4) 56-59. DOI: 10.21800/2317-66602017000400017.

Brasil, K. B. N. (2020). "Desenhe Um Cientista": As Concepções Dos Estudantes Do Centro Juvenil De Ciência E Cultura Sobre Os Cientistas. *Cenas Educacionais*, 3, N. E8670, P. 1-15, 2020. *3*(8670), 1 -15.

Buske, R.; Bartholomei-Santos, M. L. & Temp, D. S. (2015). A Visão Sobre Cientistas E Ciência Presentes Entre Alunos Do Ensino Fundamental. X Encontro Nacional De Pesquisa Em Educação Em Ciências, 24.

Cavalli, M. B. & Meglhioratti, F. A. (2018). A participação da mulher na ciência: um estudo da visão de estudantes por meio do teste dast. *Actio: Docência Em Ciências*, *3*(3), 86-107. DOI: 10.3895/actio.v3n3.7513.

Chambers, D. *Stereotypic Images Of The Scientist – The draw a scientist test*. (1983). *Science Education.* 67, 255-265.

Cunha, M. B., Peres, O. M. R., Giordan, M., Bertoldo, R. R., De Quadros Marques, G., & Duncke, A. C. (2014). As mulheres na ciência: o interesse das estudantes brasileiras pela carreira científica. *Educación Química*, *25*(4), 407-417. DOI: 10.1016/S0187-893X(14)70060-6.

Dicio. (s.d.). Dicionário Online De Português. https://www.dicio.com.br/estereotipo/.

Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. (2020). *Brasil no pisa 2018*. Brasília: Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira.https://download.inep.gov.br/publicacoes/institucionais/avaliacoes_e_exames_da_educacao_basica/relatorio_brasil_no_pisa_2018.pdf

Lazzarini, A. B., Sampaio, C. P., Gonçalves, V. S. P., Nascimento, É. R. F., Pereira, F. M. V., & França, V. V. (2018). Mulheres na ciência: papel da educação sem desigualdade de gênero. *Revista Ciência em Extensão*, *14*(2), 188-194.

Lima, B. S., Braga, M. L. S. & Tavares, I. (2015). Participação Das Mulheres Nas Ciências E Tecnologias: Entre Espaços Ocupados E Lacunas. *Revista Gênero. 16*(1). DOI: 10.22409/rg.v16i1.743.

Ludke, M., & André, M. (2018). *Pesquisa em educação: abordagens qualitativas* (2ª ed.). Rio de Janeiro: E.P.U.

Marrero, A. (2006). *El asalto femenino a la universidad: un caso para la discusión de los efectos reproductivos del sistema educativo en relación al género*. *Revista argentina de sociología*, *4*(7), 47-69.

Mason, C. L; Kahle, J. B. & Gardner, A. L. (1991). *Draw-A-Scientist Test: Future Implications*. *School Science And Mathematics*, *91*(5), 98-193.

Ministério Do Trabalho (s.d.). Relação Anual De Informações Sociais (Rais) 2019. http://Pdet.Mte.Gov.Br/Rais?View=Default .

Miola, D. , Almeida, A. F., Dantas B. P. & Cunha M. B. (2016). Crianças Do Ensino Fundamental E As Imagens De Ciências. Anais do IXVIII *Encontro Nacional de Ensino de Química.* https://eneq2016.ufsc.br/anais/busca.htm?query=Crian%E7as+Do+Ensino+Fundamental+E+As+Imagens+De+Ci%EAncias.

Neves, J. L. (1996). Pesquisa qualitativa: características, usos e possibilidades. *Caderno De Pesquisas Em Administração*, *1*(3), 1-5.

Reis, P., Rodrigues, S. & Santos, F. (2006). Concepções sobre os cientistas em alunos do 1º ciclo do ensino básico: "poções, máquinas, monstros, invenções e outras coisas malucas". *Revista Electrónica de Enseñanza de Las Ciencias*, *5*(1), 51-74.

Saboya, M. C. L. (2013). Relações de gênero, ciência e tecnologia: uma revisão da bibliografia nacional e internacional. *Educação, Gestão E Sociedade*, *3*(12), 1-26.

The Global Goals. (s.d.). *The global goals for sustainable development*. https://www.globalgoals.org/ .

About the Author

JÉSSICA PEREIRA SANTOS
https://orcid.org/0000-0003-2374-171X
Mestre em Ensino de Física (2018) pelo MNPEF, polo 11 (UFS). Possui graduação em Física pela Universidade Federal de Sergipe (2014). Leciona Física na educação básica desde 2014, como professora integrante do quadro permanente da Secretaria de Educação do Estado de Sergipe. Atualmente é professora do Colégio Estadual Leandro Maciel.
Currículo Lattes: http://lattes.cnpq.br/5219482330780745.
E-mail: jpereirafisica@gmail.com

Submitted: Marc. 1, 2021.
Accepted: Aug.. 23, 2021.