

Article

Has the Stereotype of the Scientist Changed in Early Primary School-Aged Students Due to COVID-19?

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Abstract: The image that students have of scientists and their context appears distorted by multiple factors. The detection and modification of this image is important because this is related to scientific vocations. This research analyzes the drawings made by 128 early primary school-aged students (58 girls and 70 boys) from 6 to 8 years to determine the image they have regarding the scientist, their activity, and their environment, and how the current situation due to COVID-19 may affect this image. The analysis rubric defined in the modified Draw A Scientist Test-prompt was used. Results indicate that the image that the students have, in general, is far from the traditional one. Thus, the students draw both young women and men working in science, the girls being the ones who most habitually represent scenes broader than traditional. In addition, the influence of the COVID-19 crisis is perceived in some of the illustrations.

Keywords: scientist image; early Primary; COVID-19; draw a scientist; gender; mDAST



Citation: Quílez-Cervero, C.; Diez-Ojeda, M.; López Gallego, A.A.; Queiruga-Dios, M.Á. Has the Stereotype of the Scientist Changed in Early Primary School-Aged Students Due to COVID-19? *Educ. Sci.* **2021**, *11*, 365. <https://doi.org/10.3390/educsci11070365>

Academic Editor: Beth L. MacDonald

Received: 5 June 2021

Accepted: 17 July 2021

Published: 20 July 2021

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1. Introduction

The scientific education that students receive occurs in a great diversity of places, therefore, the image that students have with respect to the person who is dedicated to science and their work, appears strongly influenced by the information they receive from popular culture and the media [1–3]. Currently, news about the crisis triggered by COVID-19 has flooded the media for more than a year, with the world presently involved in a situation of information overload. The news are disseminated through internet media, friends, traditional media, academic courses, medical staff in healthcare institutions, coworkers, and family members. However, it is not only the large amount of information that can have an impact on families and children. On the contrary, this information overload, especially mixed with false information, causes continuous concern in families and is a cause of stress [4]. Early Primary students are no strangers to this information, and what they are seeing every day on televisions, listening to their parents, friends and siblings, should, therefore, influence the image they have of science and scientists' work.

This image that students are forging with respect to the person who is dedicated to science and around their environment, is an aspect to take into account in the development of attitudes towards science and future scientific vocations [5]. Traditionally, confusing and inappropriate images of science and scientists are considered associated with negative attitudes towards science [6–9], while more realistic conceptions of scientists are necessary for understanding the nature of science, in addition to helping students make decisions about their careers [10].

It is therefore necessary to know the image that the students have of the scientists and their work, and to find a way to make students aware of what the reality of the person who is dedicated to science is like. This can serve to get students excited about science and its

nature so they see science careers as a possibility [10–13]. In addition, these images that are formed become persistent, remaining in time and strengthening as students' progress takes place through the academic years [6,8,9,14–17]. This stereotype of the scientist affects women with greater intensity. They are not represented at all in the images that are usually shown, which finally affects their choice of scientific-technological studies, negatively influencing the construction of their self-esteem [18–20]. However, this stereotypical image of the person who is dedicated to science is changing in such a way that in recent studies there are more representations of women scientists [16,21,22].

One of the first studies in which the image of the scientist is analyzed is Mead and Metraux's [23] p. 384, carried out with American Secondary-school students. In this study, the students showed an interest in "finding out confidentially what you think about science and scientists". The students had to write answers to a series of incomplete questions, which showed the students' views of scientists. They found the image of the scientists as that of an old or middle-aged man with glasses, wearing a white robe and working in a laboratory. That person is surrounded by bubbling test tubes and bottles, and he spends his days doing experiments. This image of the scientist shows two sides, one is positive, as an intelligent man, who is interested in his work and takes it seriously, and another negative side: he is a brain that spends his days locked up, sitting in a laboratory throwing things from one tube to another in a monotonous work. Many other subsequent studies confirmed this stereotypical image of the scientist [24–27].

However, expressing their visions through written texts is difficult for young students. So, one technique that can be used to understand students' ideas is to use drawings. This is due to the fact that the students are immersed in contexts that are rich in images, which makes many of them "visual thinkers" [28]. It is accepted that the illustrations that children make are a representation of how they see the world, so that the images of children contain information that they wish to convey. On the one hand, drawing allows the early student to express ideas and thoughts with limited time and vocabulary [29], creating the possibility of connecting the internal students' translations of external experiences through symbolic representations [30], and, in addition, students can verbalize a lot of information about their drawing that can be useful to the researcher [7]. Therefore, depending on the information that wants to be obtained, this should be the approach to the activity and the subsequent dialogue with the children. It is for all this that the experience of drawing is very common to obtain information from students about how they see some aspects of reality.

Among the different scales used to evaluate the image that students have of scientists [3,28], is the Draw A Scientific Test (DAST), a projective test proposed by Chambers [31] inspired by the investigations of Mead and Metraux [23]. In this test, students are asked to draw a scientist, so that, from the interpretation of this drawing, experts can obtain information about the image that students have of the scientist. In the Chambers test [31] p. 258, seven indicators of the standard image of a scientist are sought:

- (1) Lab coat (usually but not necessarily white).
- (2) Eyeglasses.
- (3) Facial growth of hair (including beards, moustaches, or abnormally long sideburns).
- (4) Symbols of research: scientific instruments and laboratory equipment of any kind.
- (5) Symbols of knowledge: principally books and filing cabinets.
- (6) Technology: the "products" of science.
- (7) Relevant captions: formulae, taxonomic classification, the "eureka!" syndrome, etc.

This method has been widely used in research about what image students have of the person devoted to science [5,8,9,14,17,26,31–35].

Subsequently, Finson et al. [21] designed the Draw A Scientific Test Checklist, DAST-C, with which they tried to facilitate the interpretation of the drawings made by the students, and added to these seven items eight more, thus including new stereotypes that had not been considered in DAST, such as race or gender [21] p. 199:

- (8) Male gender.
- (9) Caucasian.

- (10) Indications of danger.
- (11) Presence of light bulbs.
- (12) Mythical stereotypes (Frankenstein, Jekyll/Hyde, etc.).
- (13) Indications of secrecy (“Private”, “Keep Out”), “Do not Enter”, “Go Away”, “Top Secret”, etc.).
- (14) Scientist doing work indoors.
- (15) Middle aged or elderly scientist.

Then, to complete the test, these authors added a question to gather comments from the student, which can give more information about the meaning of the elements shown in the drawing. Subsequently, different modifications were made to this test by different researchers [36]. This test, DAST, and its versions modified by other researchers, have been the most widely used tools for the analysis of drawings made by students in recent decades [6,28,37].

Of the different adaptations produced in the Dast, the mDAST (modified DAST) [38] has been used in this research. mDAST has an initial approach (prompt) with the aim of directing the student towards three aspects: appearance, location, and activity. Thus, a more complex prompt, referring specifically to these three aspects encouraged students to show more ideas about the person devoted to science [7]. This prompt was as follows:

Imagine that tomorrow you are going on a trip (anywhere) to visit a scientist in a place where the scientist is working right now. Draw the scientist busy with the work this scientist does. Add a caption, which tells what this scientist might be saying to you about the work you are watching the scientist do. Do not draw yourself or your teacher. (p. 111).

That is to say, it allows to extract more information about the student’s perceptions than the single instruction of “draw a scientist”. Thus, mDAST directs the student to represent the “appearance” of the scientist, the “location” in which he works and the “activity” he performs. This test, like the one developed by Chambers [31], requires that the student has the ability to write about what he has drawn. The reason for using mDAST in this study is due to the interest in using the rubric defined by Farland-Smith [38], that allows to analyze the stereotype of the person who is dedicated to science quantifying the aspects of appearance, location, and activity. However, the prompt was modified, since in times of social distancing it is not possible to travel. Furthermore, traveling can make it seem like a distant profession. However, referring to professions that are closer to the student (the profession of a firefighter, a butcher,) can lead the student to the representation that she or he considers real of a person who dedicates to science and their job. To assess these three categories mentioned in the students’ illustrations (appearance, location, and activity), Farland-Smith [38] created a rubric with scoring ranges from 0 to 3.

It must be borne in mind that the way in which the drawing task is carried out may affect the students’ results, therefore this statement should bring as close as possible to a situation that does not induce concrete responses in the students. This is because the student, in general, does not have a unique conception of the scientists and their environment, and can be affected by how the instructions are given [39].

However, a rigorous analysis cannot be made from only the illustration of the student’s drawing. An image represents a static situation. It is true that it will be possible to distinguish some aspects on many occasions (fanciful drawing, explosions, wears glasses, is a male, etc.). However, on many other occasions, the drawings will not reveal what the student intends to represent (many times it depends on their ability) or what the drawn context represents, much less the actions it claims to represent (the “what is the scientist doing”). This is why the researcher must obtain more information from written and oral narratives, obtained from questions asked or from interviews, depending on the ages and characteristics of the students [33,36]. In this way, more detailed and relevant information can be obtained about the images that students have [40]. Thus, in order not to guide the students’ responses or be limited by their ability to express themselves in writing, the information to complete the drawing was carried out through the teacher-student conversation.

The objective of this research is to determine the image of early Primary students, attending to the gender variable, with respect to the person who works in science and how the current COVID-19 pandemic situation is affecting the students' appreciation of the scientist.

2. Materials and Methods

2.1. Participants

The study was conducted on a sample formed by 128 early Primary students (58 girls and 70 boys) from 6 to 8 years from a school in a small town in northern Spain. The socioeconomic status of the students' parents was medium. These students were in the first years of Primary Education: First Grade, 44 students (20 girls and 24 boys), Second Grade, 45 students (20 girls and 25 boys); and Third Grade, 39 students (18 girls and 21 boys). The school was chosen because one of the authors teaches a class there. All the students from the first years of Primary Education participated in the study.

Consent was obtained from the Headmaster of the Centre where the study was carried out. Likewise, all the students and their families were informed of the study objectives and their consent was obtained.

2.2. Instruments

The following instruments were used to collect the information:

- An illustration made by the students with their drawing about the person who is dedicated to science, her or his workplace and activity.
- Individual interviews with students to obtain explanatory information about what they had represented in their illustrations.
- For the analysis of the illustrations made by the students, we used:
- Analysis rubric defined in the modified Draw A Scientific Test-prompt [38].
- Classification Table of drawings based on: (a) the gender represented by the students: female, male, both or not distinguished); (b) the age of the person represented (young person, older person or indistinguishable); (c) the representation of clinical research professionals: if you represent people researching COVID-19, researching in the manufacture of drugs or vaccines, or conducting clinical trials, which has been called "Investigating COVID"; (d) search for an explicit representation of COVID-19 in some part of the drawing, even if it has no obvious connection to the rest of what the drawing represents.

These individual interviews were conducted when the students already had their drawings partially completed. The teacher looked at the students' drawings while they drew and talked to them. These interviews lasted a few minutes, depending on the information to be collected, and did not interrupt the work rhythm of the other students who were already used to the teacher talking to them while they were carrying out the tasks. The questions were intended to obtain information on those aspects that could not be seen in the drawings. If the age or sex of the people was not perceived, the teacher tried to ask the questions in this sense, but without guiding the answers. For example: *Who is ... ? What is it like? What is it doing? What is this that you have drawn here?* It is also common that, from a drawing, the action that students are representing in their drawings is not perceived. The teacher thus took notes of the student's explanations and then categorized the drawings. Some of the students' responses were vague, and did not allow for a classification. For example: they drew "people", they had not defined gender or age; or they did not provide information about the location or the actions they were taking. In Appendix A it can be seen some examples of the categorization according to the Farland-Smith rubric [38], and in Appendix B some examples of the drawings of the students classified as "Investigating COVID-19" or "Allusion to COVID".

2.3. Development of the Activity

The students were asked to make a drawing, based on the following directions: “You know people who are dedicated to different professions, what the place where they work is like and what they do (e.g., the fruit seller, the policeman, the teacher . . .). On this sheet of paper that I am going to give you, you are going to draw, as you wish, a person who is dedicated to science, whose work is science. You should also imagine what that person is doing and what their work environment is like”. All students had the same type of materials to represent the person who is dedicated to science and what their work environment is like. Subsequently, as indicated, in an interview the students were asked information about their drawing, without indicating specific questions that could guide the answers in any way in order to avoid the effect of “question dependence” [39].

2.4. Data Analysis

A quasi-experimental design was applied without a control group. Data analysis was performed using the SPSS v.24 statistical package and GraphPad Prism v9.

The students’ drawings were analyzed according to the rubric of Farland-Smith [38], shown in Table 1, and the Classification Table of drawings, taking into account the responses of the students to the individual interview. The analysis of the drawings was carried out by two researchers and a third researcher resolved the discrepancies.

Table 1. Categories, score and description of the mDast.

Category	Score	Description
Appearance	0	Cannot be categorized: stick figure, a historical figure, no scientist, or a teacher or student.
	1	Sensationalized: contain a man or a woman who may resemble a monster or who has a clearly odd or comic book appearance
	2	Traditional: contain an ordinary-looking white male.
	3	Broader than traditional: drawings include a woman or a minority scientist.
Location	0	Cannot be categorized: may be difficult to determine or that of a classroom.
	1	Sensationalized: contain a location that resembles a basement, cave, or setting of secrecy, scariness, or horror, or with elaborate equipment not normally found in a laboratory
	2	Traditional: a traditional laboratory with a table and equipment (and possibly a computer) in a normal-looking room.
	3	Broader than traditional: include a scene that is not a basement laboratory and different from a traditional laboratory setting.
Activity	0	Difficult/unable to determine.
	1	Sensationalized: may include scariness or horror, often with elaborate equipment not normally found in a typical laboratory; or include fire, explosives, or dangerous work.
	2	Naive or traditional: an activity that the student believes may happen, but in truth, the activity is highly unlikely to occur. Drawings where the student writes, “This scientist is studying . . . or trying to . . . ” but does not show how this is being done.
	3	Broader than traditional: realistic activities that reflect the work a scientist might actually do with the appropriate tools needed to perform these activities. A student may write, “This scientist is studying . . . or trying to . . . ” and shows how this is being done.

Note. Adapted from [38] pp. 111–112.

3. Results

3.1. Results of the Analysis of the Students' Illustrations by Grade and Gender

Below are the results obtained by the students analyzing each Grade separately. Regarding First Grade students, the results of the analysis are shown in Table 2.

Table 2. Results of the analysis carried out on the drawings of 1st Grade students.

Category	Assessment	Total	Girls	Boys	Statistical Significance
Appearance	Cannot be categorized	22.7%	25%	20.83%	26.020%
	Sensationalized	20.5%	15%	24.98%	59.313%
	Traditional	9.1%	0%	16.68%	97.317%
	Broader than traditional	47.7%	60%	37.51%	87.694%
Location	Cannot be categorized	15.9%	20%	12.5%	48.931%
	Sensationalized	20.5%	15%	25%	59.404%
	Traditional	52.3%	45%	58.33%	62.203%
	Broader than traditional	11.3%	20%	4.17%	89.694%
Activity	Cannot be categorized	13.6%	20%	8.33%	73.089%
	Sensationalized	20.5%	15%	25%	59.404%
	Traditional	45.5%	30%	58.33%	95.416%
	Broader than traditional	20.5%	35%	8.33%	97.440%

As can be appreciated, with respect to the appearance category, the highest percentage of students represents broader than traditional aspects, in particular this percentage is higher in girls (60%) than in boys (37.51%), but the differences are not significant (statistical significance: 87.694%). The traditional appearance stands out, representing 16.68% of the illustrations in boys, while 0% in girls; having a significant difference (significance: 97.317%), and the sensationalist appearance, which in boys presents a high percentage (24.98%) compared to girls (15%), although the difference is not significant (significance: 59.313%).

Regarding the location, most of the illustrations have been classified in the traditional category (52.3%) and, although the percentage of boys representing a traditional location is also higher in this case, the difference is not significant (62.203%). However, in this category, there is a high number of girls who represent a broader than traditional scenario (20% vs. 4.17%), even though the difference is not significant (significance: 89.694%).

With regard to the activity carried out by scientists in the illustrations, globally, the majority of the illustrations would be classified as traditional (45.5%). However, the percentages of the illustrations of the girls are more distributed, with a maximum in broader than traditional (35% compared to 8.33% in the boys) finding a significant difference (significance: 97.440%). In this category, the maximum score for boys is in traditional (58.33% vs. 30%) but the difference is not significant (significance: 95.416%).

Regarding the analysis of the gender represented in the illustrations, the age of the scientists represented, and trying to find out whether a professional in clinical or pharmaceutical research professional is represented, or whether an explicit allusion to COVID-19 is made, Table 3 shows the results, for all students and by gender.

Table 3. Results of the analysis of the represented gender, age of the scientists, representation of medical research professionals and allusion to COVID-19, after the analysis of the illustrations of the 1st Grade students.

Variable	Value	Total	Girls	Boys	Statistical Significance
Gender represented	Female	22.7%	25%	20.83%	26.020%
	Male	40.9%	35%	45.83%	53.091%
	Both	13.6%	20%	8.33%	73.089%
	Cannot be categorized	22.7%	20%	25%	30.753%
Age	Young	75%	90%	62.5%	97.976%
	Older	6.8%	0%	100%	100.000%
	Cannot be categorized	18.18%	10%	25%	38.014%
Investigating COVID		15.9%	25%	8.33%	86.747%
Allusion to COVID		29.5%	40%	20.83%	84.113%

As shown in the results, students represent a higher proportion of male scientists (40.9%) than female scientists (22.7%), although the difference is not significant (significance: 88.008%). A higher percentage of girls represent scientists of both sexes (20% vs. 8.33% of boys), although the difference is not significant (significance: 73.089%). On the other hand, a large percentage of students represent young scientists (75%), this percentage being higher in girls (90%) than in boys (62.5%), obtaining a significant difference in the results (significance 97.976%).

In 29.5% of the illustrations there is an allusion to COVID-19, with 40% of the girls and 20.83% of the boys making an allusion, without significant difference (significance: 84.113%). In Figure 1 two illustrations made by the students can be seen.



(a)



(b)

Figure 1. Illustrations made by 1st Grade students. (a) Scientists (male and female) doing clinical trials to find a vaccine. (b) Some students refer to COVID-19 in their illustrations.

The results of the analysis of the illustrations of the 2nd Grade students are shown in Table 4.

Table 4. Results of the analysis carried out on the drawings of the 2nd Grade students.

Category	Assessment	Total	Girls	Boys	Statistical Significance
Appearance	Cannot be categorized	2.22%	0%	4%	69.163%
	Sensationalized	22.22%	15%	28%	72.095%
	Traditional	42.23%	20%	60%	99.726%
	Broader than traditional	33.33%	65%	8%	99.999%
Location	Cannot be categorized	4.44%	5%	4%	15.269%
	Sensationalized	6.66%	5%	8%	31.682%
	Traditional	68.88%	50%	84%	98.934%
	Broader than traditional	20%	40%	4%	99.785%
Activity	Cannot be categorized	2.22%	5%	0%	69.427%
	Sensationalized	6.66%	5%	8%	31.682%
	Traditional	71.11%	70%	72%	14.466%
	Broader than traditional	20%	20%	20%	4.948%

As can be seen, with respect to the appearance category, the highest percentage of students represents traditional aspects, in particular this percentage is higher in boys (60%) than in girls (20%), with a significant difference (statistical significance: 99.726%). On the other hand, the appearance represented by the girls is broader than traditional in 65% of the illustrations, compared to 8% in those of the boys, which represents a significant difference (statistical significance: 99.999%).

Regarding the location, most of the illustrations have been classified in the traditional category, which appears more reflected in that of boys (84%) compared to girls (50%), (significance: 98.934%). However, 40% of girls place scientists in a broader than traditional location, compared to 4% of boys, with a significant difference (significant: 99.785%).

Considering the activity of the scientist, the results are very similar for girls and boys, so that most students place them in a traditional activity.

With respect to the other categories analyzed in the illustrations of the 2nd Grade students, the results are shown in Table 5.

In this case, the students represent a greater proportion of male scientists (62.22%) than female scientists (22.22%), the difference being significant (significance: 99.848%). A higher percentage of girls represent scientists of both sexes (25% vs. 0% of boys), the difference being significant (significance: 99.042%).

On the other hand, a large percentage of students represent young scientists (86.66%), this percentage being higher in girls (90%) than in boys (84%), although the difference is not significant (significance 44.648%).

Of the illustrations, 28% represent scientists related to medical research or conducting clinical trials, and 35.55% of the illustrations contain an allusion to COVID-19 (40% of girls and 30% of boys), without significant difference (significance: 50.906%).

The results of the analysis of the illustrations of the 3rd Grade students are shown in Table 6.

Table 5. Results of the analysis of the represented gender, age of the scientists, representation of medical research professionals and allusion to COVID-19, after the analysis of the illustrations of the 2nd Grade students.

Variable	Value	Total	Girls	Boys	Statistical Significance
Gender represented	Female	22.22%	40%	8%	99.685%
	Male	62.22%	35%	84%	99.977%
	Both	11.11%	25%	0%	99.042%
	Cannot be categorized	4.44%	0%	8%	86.392%
Age	Young	86.66%	90%	84%	44.648%
	Older	4.44%	5%	4%	15.269%
	Both	2.22%	5%	0%	69.427%
	Cannot be categorized	6.66%	0%	12%	93.855%
Investigating COVID		28%	35%	24%	57.371%
Allusion to COVID		35.55%	30%	40%	51.236%

Table 6. Results of the analysis carried out on the drawings of 3rd grade students.

Category	Assessment	Total	Girls	Boys	Statistical Significance
Appearance	Cannot be categorized	2.56%	0%	4.76%	69.353%
	Sensationalized	17.95%	11.11%	23.81%	71.475%
	Traditional	30.77%	5.55%	52.38%	99.982%
	Broader than traditional	48.72%	83.33%	19.05%	100.000%
Location	Cannot be categorized	12.82%	11.11%	14.28%	24.088%
	Sensationalized	12.82%	0%	23.81%	98.988%
	Traditional	61.54%	72.22%	52.38%	81.236%
	Broader than traditional	12.82%	16.66%	9.52%	48.127%
Activity	Cannot be categorized	5.13%	0%	9.52%	86.715%
	Sensationalized	10.26%	0%	19.05%	97.520%
	Traditional	76.92%	88.88%	66.66%	92.417%
	Broader than traditional	7.69%	11.11%	4.76%	52.552%

In the case of Third Grade students, with respect to the appearance category, the highest percentage of students represents broader than traditional aspects (48.72%), due to the large percentage of girls who in their illustrations manifest this (83.33% compared to 19.05% of boys), with a significant difference (significance: 100.000%). Meanwhile, most of the boys represent a traditional appearance of the scientist (52.38% compared to 5.55% of girls), finding a significant difference (significance: 99.982%).

With respect to location, most representations (61.54%) suggest a traditional context in which the person doing science is found, with different percentages for boys and girls, but without significant differences. However, 23.81% of boys represent the scientist in a location that can be considered sensational (compared to 0% of girls), with a significant difference (significance = 98.988%).

Regarding the activity carried out by the scientist, most of the illustrations would be categorized into traditional activity, for both boys and girls, without significant differences.

However, there is a significant difference between the percentage of boys (19.05%) vs. that of girls (0%) who performed a sensationalist activity (significance: 97.520%).

The results corresponding to the other categories analyzed are shown in Table 7.

Table 7. Results of the analysis of the gender represented, age of the scientists, representation of medical research professionals and allusion to COVID-19, after the analysis of the illustrations of the 3rd Grade students.

Variable	Value	Total	Girls	Boys	Statistical Significance
Gender represented	Female	33.33%	66.66%	4.76%	100.000%
	Male	48.72%	11.11%	80.95%	100.000%
	Both	12.82%	22.22%	4.76%	89.691%
	Cannot be categorized	5.13%	0%	9.52%	86.715%
Age	Young	89.74%	100%	80.95%	97.520%
	Older	5.13%	0%	9.52%	86.715%
	Cannot be categorized	5.13%	0%	9.52%	86.715%
Investigating COVID		28.2%	33.33%	23.8%	48.197%
Allusion to COVID		41.03%	38.88%	33.33%	28.209%

As can be seen in the results, the students represent a greater proportion of male scientists (48.72%) than female scientists (33.33%), the difference being not significant (significance: 71.203%). A higher percentage of girls represent scientists of both sexes (22.22% vs. 4.76% of boys), the difference being not significant (significance: 89.691%).

Besides, a large percentage of students represent young scientists (89.74%), this percentage being higher in girls (100%) than in boys (80.95%), the difference being significant (significance 97.520%).

Of the illustrations, 28.2% represent scientists related to medical research or conducting clinical trials; and in 41.03% of the illustrations allude to COVID-19 appears (38.88% of the girls and 33.33% of the boys), without significant difference between genders (significance: 28.209%).

3.2. Results of the Comparison between Academic Years According to Category

Taking into account the scores associated with each possible interpretation of the illustrations according to the Farland-Smith rubric [38] (Table 1), the scores obtained for each grade in each of the categories are shown below.

3.2.1. Appearance

The scores, by academic year, that have been obtained in the appearance category are shown in Table 8.

Table 8. Scores in the appearance category according to the Farland-Smith rubric [38].

Grade	Total		Girls		Boys	
	Mean	SD	Mean	SD	Mean	SD
1st Grade	1.82	1.26	1.95	1.36	1.71	1.20
2nd Grade	2.07	0.81	2.5	0.76	1.72	0.68
3rd Grade	2.26	0.85	2.72	0.67	1.86	0.79

Figure 2 shows the representation of the scores obtained from the interpretation of the illustrations in the appearance category.

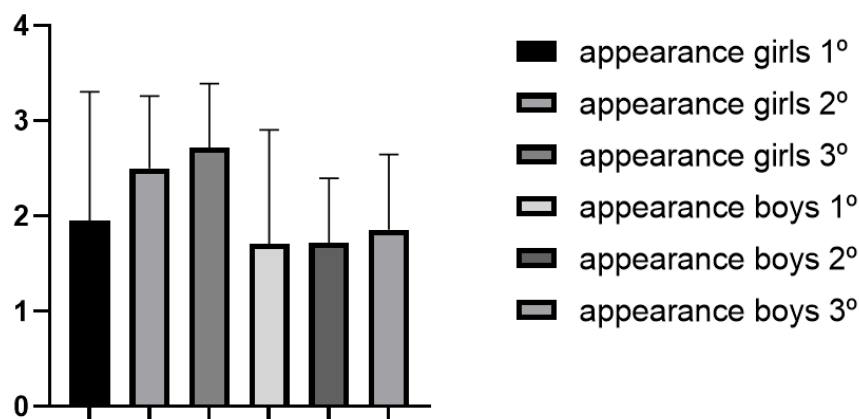


Figure 2. Scores in the appearance category by course and by gender.

It can be seen in the figure that the average value of the score for the appearance category increases as the grade increases, for both girls and boys. However, the Kruskal-Wallis statistic indicates that there are no significant differences between courses or in girls ($\chi^2 = 3.812; p = 0.1487$) nor in boys ($\chi^2 = 0.3211; p = 0.8517$). However, the Mann-Whitney U statistic revealed that there are differences between the appearance score in illustrations of boys and girls, not significant in 1st Grade ($U = 209.5, z = -0.70711, p = 0.4777$); significant in 2nd Grade ($U = 112.5, z = -3.1293, p = 0.00174$); and significant in 3rd Grade ($U = 74.5; z = -3.21159; p = 0.0013$).

3.2.2. Location

With regard to location, the scores, by grade, that have been obtained in the appearance category, are shown in Table 9.

Table 9. Scores in the location category using the Farland-Smith rubric [38].

Grade	Total		Girls		Boys	
	Mean	SD	Mean	SD	Mean	SD
1st Grade	1.58	0.91	1.65	1.04	1.54	0.78
2nd Grade	2.04	0.67	2.25	0.79	1.88	0.53
3rd Grade	1.74	0.85	1.94	0.80	1.57	0.87

Figure 3 shows the representation of the scores obtained from the interpretation of the illustrations in the location category.

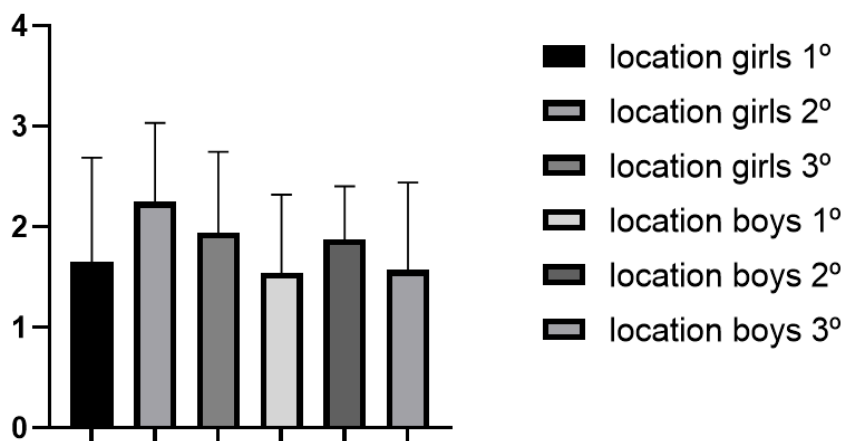


Figure 3. Scores in the location category by course and by gender.

It can be seen that the scores of girls and boys in 2nd Grade are higher than those of their counterparts in other grades. Differences between courses are neither significant for girls ($\chi^2 = 4.390$, $p = 0.1114$) nor for boys ($\chi^2 = 3.429$, $p = 0.1801$). There is also no significant difference between the score of appearance in illustrations of children in each course (1st Grade: $U = 218$, $z = -0.50676$, $p = 0.61006$; 2nd Grade: $U = 166.5$, $z = -1.89585$, $p = 0.05744$; and 3rd Grade: $U = 139.5$, $z = -1.38042$, $p = 0.16758$).

3.2.3. Activity

Regarding the activity category, the scores, by course, that have been obtained in the appearance category, are shown in Table 10.

Table 10. Scores in the activity category using the Farland-Smith rubric [38].

Grade	Total		Girls		Boys	
	Mean	SD	Mean	SD	Mean	SD
1st Grade	1.71	0.97	1.8	1.15	1.67	0.76
2nd Grade	2.07	0.60	2.05	0.69	2.12	0.53
3rd Grade	1.87	0.62	2.11	0.32	1.67	0.73

Figure 4 shows the representation of the scores obtained from the interpretation of the illustrations in the activity category.

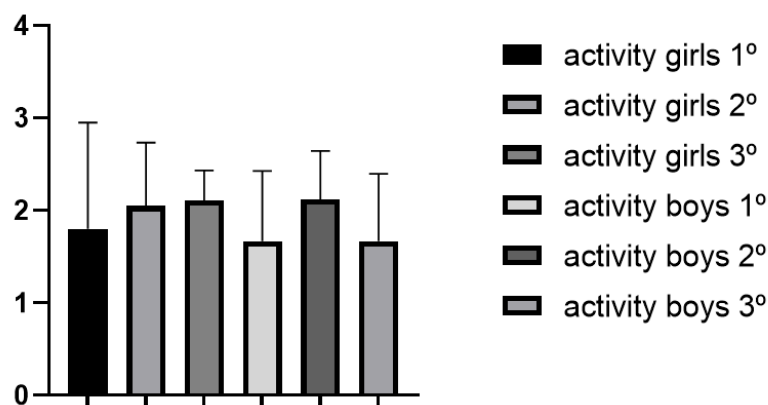


Figure 4. Scores in the activity category by course and by gender.

It can be seen that the score in the activity category, for girls, increases from 1st to 3rd Grade, without significant differences ($\chi^2 = 0.2511$, $p = 0.8820$); and in boys it presents a maximum score in the 2nd Grade, with significant differences between courses ($\chi^2 = 6.636$, $p = 0.0362$). Between 1st and 2nd Grade the difference is not significant ($U = 205$, $z = 1.89$, $p = 0.05876$), however, between 2nd and 3rd Grade the difference is significant ($U = 180.5$, $z = 1.7973$, $p = 0.03593$). Analyzing the differences between girls and boys in each grade, it can be seen that there are neither significant differences in 1st Grade ($U = 210$, $z = -0.69532$, $p = 0.24196$) nor in 2nd Grade ($U = 245$, $z = 0.10279$, $p = 0.46017$); but there are in 3rd Grade ($U = 129$, $z = -1.67622$, $p = 0.04648$).

4. Discussion

As can be seen in this study, the image of the stereotype of the wacky or mad scientist [41] is far from being the image that early-age students have of the person who dedicates to science. Nor is it the image of a mature white male working alone in the laboratory. Most of the students' representations provide a broader than traditional image of the scientist, that is, one in which there are people of different ethnic groups, women or several scientists working together [11,40]. However, there is still a significant percentage of boys who make a traditional representation of the person who works in science. However, a sensationalist

conception of the image of the scientist persists in boys, despite the fact that previous researches indicate that these conceptions are minoritarian in older students [3,42], so, presumably, the image of the scientist adjusts with the age and experiences of the students, even though these stereotypes persist in every generation of students [6,8,9,14–17]. In this sense, it is girls who most often represent female scientists or both genders working together, in line with other studies [6,42]. It should also be noted that most of the students represent young scientists as it also happens in Christidou et al.'s studies [6]. In fact, most of the representations of the scientist show a young person, and, in only one case, a young person was represented next to an older person. This situation proves to be very different from the image that is represented in other studies on the stereotypes of the person who is dedicated to science [3,15,16,35], which indicates that the stereotype of the scientist changes over time [16].

Regarding the gender represented in the illustrations, although the predominant percentage represents a male scientist, there is also a significant percentage of women represented or illustrations in which both genders appear. This change seems to be a consequence of the constant and gradual transformation of roles that is taking place, and was already foreseen in previous studies [16].

Regarding the location, the laboratory context continues to prevail, where the scientist performs his/her work surrounded by glass bottles, flasks and scientific instruments. It can be seen in Figure 3 that 2nd Grade students have higher scores. This may be because the students were confined when they were in 1st Grade. At this age, the evolutionary development of the girl and the boy produces an advance in the understanding of the socio-emotional world, so that the students begin to establish ties of friendship and attachment relationship with other classmates and with the teacher [43]. Thus, it could be that they were more attentive to the conversations of their parents and the information of the mass media that showed information on the investigation of the vaccines and the production systems. However, this point should be researched in depth.

With respect to the activity carried out by the person who is dedicated to science, for most of them, the scientist is represented in an activity that has been called traditional, although the percentage of students who represent such a traditional broader activity is important, especially in the first two grades.

In all this analysis, it should be clarified, in view of the results obtained from the application of the Farland-Smith rubric [38], that the scores of the illustrations of the girls are higher in all grades and in all categories, although only in some items these differences are significant. It is the girls who have a "less traditional" view of the appearance of the person who is dedicated to science, their context and the activity they carry out, in general. As indicated, the existence of scientific stereotypes affects women more intensely, and this affects their choice of scientific-technological studies and has a negative influence on the construction of their self-esteem [18,20]. Then, a greater representation of the female gender in the vision of the person who is involved in science, presumably, will have repercussions in a greater choice of scientific-technological careers and in a better development of self-esteem. Thus, it is the girls who represent more female scientists, or of both sexes, and young people.

In other studies about the image of the scientist [42] a weakening of a stereotyped image has been found in accordance with those obtained in this research. However, in that case they were older students (from 7 years old) and participated in a scientific event, which may be related to a better attitude towards science. A better attitude towards science is accompanied by a less stereotypical image of scientists [42].

Regarding the location, a traditional context predominates: a table with instruments (which can be test tubes, computers, etc.) in a normal room [11]. With respect to the activity carried out by the scientist, in the illustrations of the girls the traditional activity predominates (the scientist is inventing something or discovering something, which represents a naive vision of the students) and then the broader than traditional (the scientist performs an activity close to reality: testing, observing) [11]. On the other hand, the boys represent a

traditional activity for the most part, and a part of them represent a sensationalist activity (the vision that science has to do with magic, intrigue, world domination, explosions, etc.) [11]. In the analysis of the scientist's activity, it is worth highlighting the representation of medical research professionals, searching and testing a prototype of a vaccine against COVID-19. Students are immersed in a situation where they continually receive news about research, trials, the search for a vaccine, etc. Thus, although some of the illustrations do not refer to COVID research, this appears in some of the illustrations (e.g., the scientist is in his traditional laboratory, with his traditional work; however, some students represent a soap dispenser and the image of COVID somewhere in the illustration). In this sense, the highest percentage of female students who represent scientists investigating COVID also stands out. It is possible that girls are more sensitive to this issue and that the information they receive from the media and from their family environment makes them build an image of the scientist-researcher related to the investigation of a cure against COVID, clinical trials, etc.

However, the health crisis, presumably, has not only influenced the fact that a percentage of students represented health personnel, research on the development of vaccines, experimental tests with patients, etc. It is also possible that the large amount of information that reached the homes from the various media and that was present in family conversations [4], impacted on students, modifying their vision about the construction of science, the person who is dedicated to science and the activity in which it is carried out, as well as the scenarios in which scientific research is developed. Thus, studies conducted on how children understand COVID-19 during confinement indicate that they saw it as an enemy to be won and praised the work of doctors to defeat the virus. At the same time, the children made representations of viruses in their drawings during confinement [44,45]. Thus, as it is obvious, COVID was in the children's day-to-day during confinement, and they were waiting for this situation to end to resume contact with their friends and other family members, and return to school, which is their area of socialization par excellence.

As for implications, the authors want to emphasize once again the importance of the vision that students have of the person who works in science. Thus, improving the vision of the scientist or researcher will presumably improve the attitude towards science and scientific vocations [13]. In this sense, the policies of continuous teacher training, particularly in the first grades of Primary Education, must modify the possible stereotypes that the teacher can transfer to the students [2,10], and, on the other hand, as has happened during this pandemic, students have been more expectant of scientific news, and they have been closer to the functioning of science. It would therefore be appropriate for the training of early Primary students to come into contact with scientists and research institutions that allow them to progressively distinguish between school science and the science of scientists.

5. Conclusions

It is necessary to know the image that students have with respect to people who are dedicated to science and the conceptions regarding the work they carry out from the earliest ages. This will allow actions focused on their modification, which will improve scientific vocations by eradicating various existing stereotypes [13]. The data provided in this research with First Grade Primary students reflect a not excessively distorted conception with respect to the person who is dedicated to science: it is appreciated that the students do not have a sensationalist view, in general, of the scientists or of their work. The students do not usually represent "mad scientists" locked in caves or cellars, and, at the same time, they do not represent exclusively male scientists, but rather a broad female representation appears or both sexes are represented; and, in most cases they represent young people. Considering that scientific stereotypes are formed in early ages, starting at 8 [6,8,9,14–17], it would be advisable that educational interventions were orientated to stop the development of these stereotypes at those early ages.

On the other hand, as it can be seen, the current health situation derived from the COVID-19 crisis also influences the perception of students about the work carried out by

the scientist. Some studies show that there has been a positive change after confinement in the social perception of science in adults [46]. Taking into account that much of the information that students of these ages received during confinement and later has been through their parents, it is presumable that this change is not only in stereotypes about science and scientists, but also in a more positive appreciation of science and scientists.

Among the limitations of the study, the location of the educational center should be indicated: an educational center in a small city at the time after returning to school after confinement caused by the pandemic. It would have been relevant to carry out a study of greater geographic scope. Future research will be directed towards the analysis of larger and more diverse samples. Another possible limitation could be due to the presentation of the prompt. It is possible that some students understood that they should draw a single person, a man or a woman, as analyzed in other studies [6]. However, by instructing them to also describe their location and their activity, this invites them to represent the usual situation of a science person, who may or may not be surrounded by people, depending on the student's conception. In fact, many of the drawings depict various people working together.

In the future, the research will be expanded by increasing the sample and expanding the study to other courses and stages, which will make it possible to analyze how the current situation is modifying the stereotypes of students with respect to the people who devote themselves to science and their context. It is likely that the current situation is changing the image of science and the scientist in younger students, and perhaps is also influencing the attitude of students towards science and their interest in scientific-technological disciplines.

At present, the situation is gradually returning to a normal situation. Girls and boys are with their classmates and their teachers, while maintaining social distancing. As vaccination increases within the population, they are also more in contact with relatives and their social interaction is resuming values of "normality". However, an important research question would be to analyze what will happen when some time has passed and the situation is similar to that before the pandemic, when girls and boys had no limitations or fear of a virus of which "only could be saved by science". Will the perception of people who are dedicated to science and their work continue to improve towards more realistic values, or will it decline to more traditional values?

Author Contributions: Conceptualization, C.Q.-C., M.D.-O. and M.Á.Q.-D.; methodology, M.D.-O.; formal analysis, C.Q.-C.; investigation, C.Q.-C., M.D.-O. and M.Á.Q.-D.; resources, C.Q.-C.; data curation, A.A.L.G. and M.D.-O.; writing—original draft preparation, C.Q.-C. and M.D.-O.; writing—review and editing, A.A.L.G. and M.Á.Q.-D.; supervision, M.D.-O. and M.Á.Q.-D. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The investigation was conducted with the permission of the parents and the Heads of the educational center where it was carried out.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

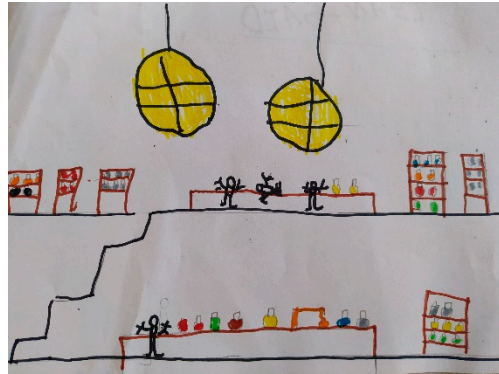
Data Availability Statement: The data are not publicly available for confidentiality reasons. They are only available on request from the corresponding author.

Conflicts of Interest: The authors reported no potential conflict of interest.

Appendix A

In this appendix you can find different examples of the drawings of the students classified according to the rubric of [38] pp. 111–112.

Appearance 0: Cannot be categorized: stick figure, a historical figure, no scientist, or a teacher or student.



Student comment: *I have represented scientists . . .*

Appearance 1: Sensationalized: it contains a man or a woman who may resemble a monster or who has a clearly odd or comic book appearance



Student comment: *A wacky scientist.*

Appearance 2: Traditional: it contains an ordinary-looking white male.



Student comment: *A researcher . . .*

Appearance 3: Broader than traditional: drawings include a woman or a minority scientist.



Student comment: *A young researcher girl.*

Location 0: Cannot be categorized: it may be difficult to determine or that of a classroom.



Student comment: *I don't know . . .*

Location 1: Sensationalized: it contains a location that resembles a basement, cave, or setting of secrecy, scariness, or horror, or with elaborate equipment not normally found in a laboratory



Student comment: *They are in a secret military base.*

Location 2: Traditional: a traditional laboratory with a table and equipment (and possibly a computer) in a normal-looking room.



Student comment: *Man and woman are working in the laboratory.*

Location 3: Broader than traditional: it includes a scene that is not a basement laboratory and different from a traditional laboratory setting.



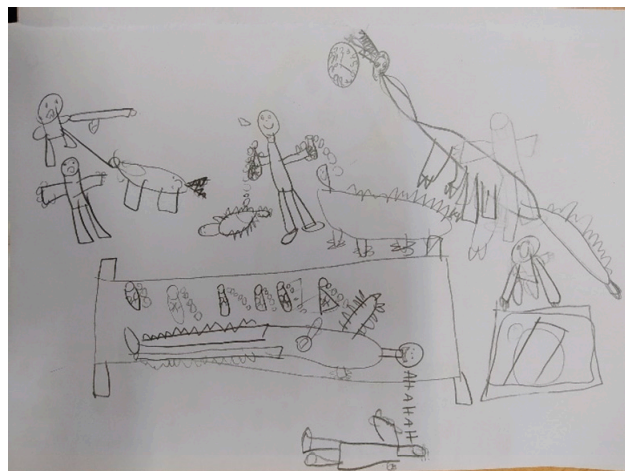
Student comment: *He works in a research center and leaves his office.*

Activity 0: Difficult/unable to determine.



Student comment: *I don't know ... in the lab ...*

Activity 1: Sensationalized: it may include scariness or horror, often with elaborate equipment not normally found in a typical laboratory; or include fire, explosives, or dangerous work.



Student comment: *Experimenting with a person.*

Activity 2: Naive or traditional: an activity that the student believes may happen, but in truth, the activity is highly unlikely to occur, drawings where the student writes, "This scientist is studying ... or trying to ..." but does not show how this is being done.



Student comment: *He is doing experiments.*

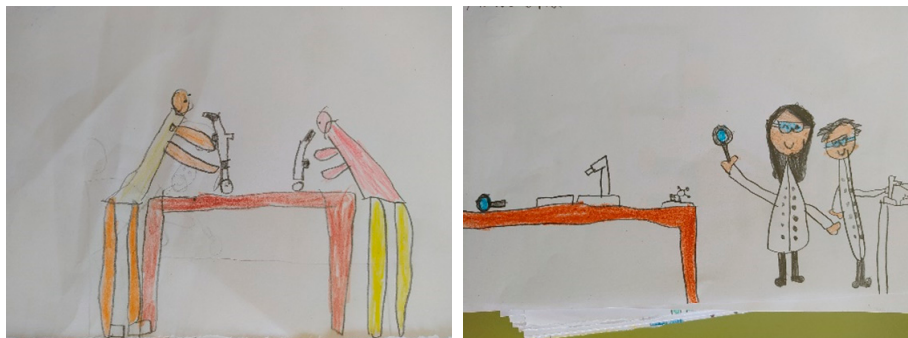
Activity 3: Broader than traditional: realistic activities that reflect the work a scientist might actually do with the appropriate tools needed to perform these activities. A student may write, "This scientist is studying . . . or trying to . . ." and shows how this is being done.



Student comment: *He is taking virus samples to study them.*

Appendix B

Many of the students' drawings depict people researching the COVID-19 virus or doing clinical trials:



Other student drawings allude to the COVID-19:



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