

Is science for me?

Science and scientists in the answers of European children

Daniele Gouthier and Paola Rodari

In order to investigate the imagery of children and adolescents as far as science and scientists are concerned, we set up – along with the “Draw a scientist” test – a simple and brief questionnaire, reproduced in the Appendix, that was firstly tested on a small group of classes and subsequently distributed to the selected sample, as previously mentioned.

Whereas the drawing test directly provides a highly dreamlike imagery, a non-verbal one, that draws on the contemporary popular culture, as much as on the archetypal one, rooted in the mythological heritage, the questionnaire draws, at least partially, on explicit, verbal knowledge. Indeed, some of the questions were about the young people’s interests vis-à-vis science, their expectations on research and the European Union, whereas some others were about their knowledge on the nature of a scientist’s job and their working instruments.

This chapter will deal with the analysis of the answers by the respondents.

European scientists: who are they in the eyes of children?

The first question of the questionnaire required the children to name “three European scientists”. The purpose was not only to understand what and how many scientists are known within the two age groups taken into consideration, but also to realise whether the addition of the “European” adjective would have affected the answers, in order to detect some information about the children’s imagery on the European dimension of research.

Indeed, the first thing to be noted is that slightly less than half of the sample wrote all of the three names required and that up to 27% of the respondents did not name anyone. Unfortunately, there are not many scientist’s names known to children and adolescents, irrespective of the “European” adjective, as explained below as concerns the Italian case.

When answers are sorted by country, the evidence is that 80% of the Polish and Romanian children and adolescents could mention three scientists, whereas in the other four countries it applies to only 30% of the sample. The Czech and Portuguese pupils are those who gave the smallest amount of indications. Indeed, nearly 60% of the former did not write anything, whereas this is true only for 50% of the Portuguese.

In Poland (2.7 scientists per pupil) and Romania (2.6), pupils are apparently more familiar with the names of the scientists and are more able to identify a class of “European” scientists. This familiarity is satisfactory in Italy (1.9) and France (1.7) and below standard in Portugal (1.3) and in the Czech Republic (1.2). As shown also in drawings, the eastern European countries appear to be more active in dealing with the national historical scientific heritage at school, and it can partly explain this result. The data regarding Poland and Romania are considerable also for variety: indeed, the 591 Polish indications make up a list of 65 scientists¹; and the 440 Romanian ones compile a list of 53 scientists².

The total number of names mentioned is 2,101 (1.8 per pupil on average) and they refer to 199 different people. They are more or less well-known scientists, more or less frequently selected – on average slightly more than ten mentions per name – but undoubtedly they make up a very wide and variegated range. The only name that has a stronger representation is Einstein, the icon of science par excellence, although his name does not show any special European characterisation.

Poland and Romania stand out also for their high number of national scientists, some of whom are not particularly well-known throughout the rest of Europe, and also for mentioning historians, geographers, leaders – especially historical ones – who cannot be strictly defined as scientists (Alexander Macedon, Demokrit, Sofocles, Vasco da Gama). In any case, the presence of people other than scientists is frequent also in the answers by pupils from other countries:

¹ Scientists mentioned by Polish pupils: Archimedes, Aristoteles, Armstrong, Becquerel, Bohr, Celsius, Cook, Coulomb, Dalton, Darwin, Demokrit, Edison, Einstein, Fleming, Ford, Frankenstein, Franklin, Gagarin, Galileo Galilei, Gutenberg, Herakles, Hermaszewski, Hyppocrates, Irene Joliot-Curie, Kant, Kelvin, Kepler, Knobel, Koch, Kołodziejczyk, Kopernik, Kuciński, Lamarck, Lavoisier, Leonardo da Vinci, Linneusz, Łukaszewicz, Marconi, Marie Skłodowska-Curie, Marie Skłodowska-Curie, Maxwell, Mendelejev, Modrzewski, Mościcki, Newton, Nobel, Olszewski, Pascal, Pasteur, Pierre Curie, Proust, Pythagoras, Religa, Smoluchowski, Śniadecki, Sofocles, Strandvist, Vasco da Gama, von Hubrick, Watt, Wolszczan, Wróblewski.

² Scientists mentioned by Romanian pupils: Aconite, Alexander Macedon, Ampere, Amundsen, Archimedes, Babes, Bill Gates, Cantacuzino, Celsius, Coanda, Cosbuc, Coulomb, Cousteau, Creangă, Dexter, Diesel, Edison, Einstein, Eminescu, Enzo, Euclid, Fleming, Frankenstein, Franklin, Galileo Galilei, Herodotus, Irwin, Joule, Kopernik, Leonardo da Vinci, Marie Skłodowska-Curie, Mendeleiev, Mihai, Mozart, Mr. Mircea, Napoleon, Newton, Nobel, Otto, Pascal, prof Rainer, Pythagoras, Sadoveanu, Sofocles, Stein, Thales, Toma, Viteazu, Vlahuta, Vlaicu, Vuia, Watt.

All the names are listed with their rankings in table 1.

Einstein	44,47%	Sofocles	0,60%	Otto	0,17%	Sandler	0,09%	Haldane	0,09%
Newton	17,44%	Ohm	0,60%	Napoleon	0,17%	Sadoveanu	0,09%	Greenwich	0,09%
Marie Skłodowska-Curie	12,52%	Ampere	0,60%	Müller	0,17%	Rousseau	0,09%	Giovanni	0,09%
Kopernik	9,67%	Réaumur	0,52%	Mme Lemoine	0,17%	Riquiet	0,09%	Galet	0,09%
Archimedes	6,82%	Euclid	0,52%	Mariucci	0,17%	Rici	0,09%	Gagarine	0,09%
Pascal	6,13%	Eminescu	0,52%	Lucia	0,17%	Ptolomeus Prof	0,09%	Franck	0,09%
Pythagoras	5,35%	Sara	0,43%	Lamark	0,17%	Vendrec	0,09%	Ford	0,09%
Leonardo da Vinci	4,58%	Mme Riquiet	0,43%	Indiana Jones	0,17%	prof Rainer prof	0,09%	focolle chag	0,09%
Galileo Galilei	3,80%	Magellan	0,43%	Hermaszewski	0,17%	Tournesol	0,09%	Flannery	0,09%
Armstrong	3,37%	Śniadecki	0,35%	Hamilton	0,17%	Palacky	0,09%	Fermi	0,09%
Edison	3,28%	Proust	0,35%	Freud Fred et Jamie	0,17%	Oudini Newton,	0,09%	Fabre Espettore	0,09%
Mendeleiev	3,20%	Nieves	0,35%	et Sabine	0,17%	Kepler	0,09%	Gaged	0,09%
Pasteur	3,20%	Mozart	0,35%	Frantisek	0,17%	Mr. Mircea	0,09%	Enzo	0,09%
Lavoisier	2,59%	Mościcki	0,35%	Franklin	0,17%	Montgolfier	0,09%	Eiffell	0,09%
Coulomb	2,33%	Kołodziejczyk	0,35%	Dexter	0,17%	Modrzewski	0,09%	Duss	0,09%
Dalton	2,25%	Knobel	0,35%	Cosbuc	0,17%	Mme Kislin Mme	0,09%	dottor Jack docteur	0,09%
Wolszczan	1,81%	Gutenberg	0,35%	Cartier	0,17%	Bormann Mle	0,09%	Chmit Divens	0,09%
Fleming	1,73%	Gagarin	0,35%	Carducci	0,17%	Belanger	0,09%	Homor	0,09%
Frankenstein	1,64%	Creangă	0,35%	Buffon	0,17%	Mihai	0,09%	Descartes	0,09%
Watt	1,55%	Celsius	0,35%	Bill Gates	0,17%	Melania	0,09%	Demokrit	0,09%
Herodotus	1,38%	Amundsen Alexander	0,35%	Bell	0,17%	Maxwell	0,09%	de la Tour	0,09%
Volta	1,30%	Macedon	0,35%	Beethoven	0,17%	Martin	0,09%	Cook Colonel	0,09%
Thales	1,30%	Vuia	0,26%	Babes	0,17%	Mariotte	0,09%	Giuliaci father	0,09%
Mendel	1,21%	Vlaicu	0,26%	ana rita rodrigues	0,17%	Marconi	0,09%	Colonel Giuliaci son	0,09%
Joule	1,21%	Strandvist	0,26%	Wichterle	0,09%	Lous XVI	0,09%	Those who make the weather forecast	0,09%
Pierre Curie	1,12%	Natta Marie e Pierre	0,26%	Watson	0,09%	Louis XI	0,09%	Caraliiov	0,09%
Nobel	1,12%	Curie	0,26%	von Hubrick	0,09%	Litellaistaim	0,09%	Cantacuzino	0,09%
Chasles	1,04%	Łukaszewicz	0,26%	Voltaire	0,09%	Linneusz	0,09%	Brown	0,09%
Aristoteles	0,95%	Lomonosov	0,26%	Vlahuta	0,09%	Lamarck	0,09%	Bogdanov	0,09%
Spallanzani	0,86%	Kuciński	0,26%	Viteazu	0,09%	Koch	0,09%	Bernisou	0,09%
Laplace	0,86%	Hertz	0,26%	Vincent Veverka brothers	0,09%	Kelvin	0,09%	Becquerel	0,09%
Bohr	0,86%	Diesel	0,26%			Kant	0,09%	Bartolomeu Archimedes,	0,09%
Vasco da Gama	0,78%	Angela Piero	0,26%	Toma	0,09%	Justin	0,09%	Sofokles Angela	0,09%
Olszewski	0,78%	Victor	0,17%	Tiago	0,09%	Joao	0,09%	Alberto andre	0,09%
Kepler	0,78%	Vichterle	0,17%	Stein	0,09%	Jeanne d'Arc	0,09%	pacheco	0,09%
Cousteau	0,78%	Rutherford	0,17%	Stanilas	0,09%	Irwin Irene Joliot-Curie	0,09%	andre	0,09%
Darwin	0,69%	romania	0,17%	Stalin	0,09%			Amerling	0,09%
Colonel Giuliaci	0,69%	Religa	0,17%	Smoluchowski	0,09%	Hyppocrates	0,09%	alessandro	0,09%
Coanda	0,69%	Purkyne	0,17%	Simone	0,09%	Herakles	0,09%	Aconite	0,09%
Wróblewski	0,60%	Pedro	0,17%	Schumacher	0,09%	Hentotoun	0,09%		

Table 1. All the names mentioned by the pupils in the questionnaire.

Einstein was mentioned the most, namely by 44% of the respondents in the sample. Obviously, Einstein is something more than a famous scientist: in some respects, he stands for the idea of science itself. Similarly to the case of drawings, his smiling face, his genius and flexibility, as much as his dual nature as the inventor of a new power, but also of new dangers for humanity, are the qualities universally supposed to be typical for all scientists.

Einstein is seen as an icon rather than as a person really known for his life and works, and this is evident when you consider the long list of different spellings provided for his name: this may imply that his name was only absorbed through brief mentions and was not really read or studied. This research alone gathered an astonishing 76 spellings.

The highest number of references to Einstein was found in Romania (Einstein accounts for 66% of the answers), in Italy (54%) and France (50%). On the other hand, his presence is less relevant in Portugal (30%), and diminutive in the Czech Republic (11%) and Poland (17%). In the Czech Republic he is the most selected person, but only a little more than Newton and Pascal; in Poland he ranks only third, coming after Marie Skłodowska-Curie and Kopernik and, once again, it shows the special focus given to the national scientific tradition, which is stronger in these countries.

Living scientists are missing from the first positions, if not missing from the entire list at all: the children and adolescents' imagery (and maybe the adults' one too) is probably not made of a real and factual knowledge on the scientific work (a data confirmed also by the analysis of the drawings), rather by a pantheon of legendary figures of famous scientists, who are the subjects of "legends", such as those concerning other historical figures. In the children's imagery emerging from our research, the great Scientists are indeed confused and mixed with the great figures from history, as they stand aside Beethoven, Napoleon, Magellan, Mozart and even Stalin.

References to the present time appear here and there in the list, especially with people appearing on TV, such as meteorologists presenting the weather forecast.

Working on science

After the analysis of the reference figures respondents have for a scientist, question no. 3 required the students to classify in four degrees (from very important to not important at all), some activities that altogether make up the job of a scientist, from "making forecasts" to "making discoveries".

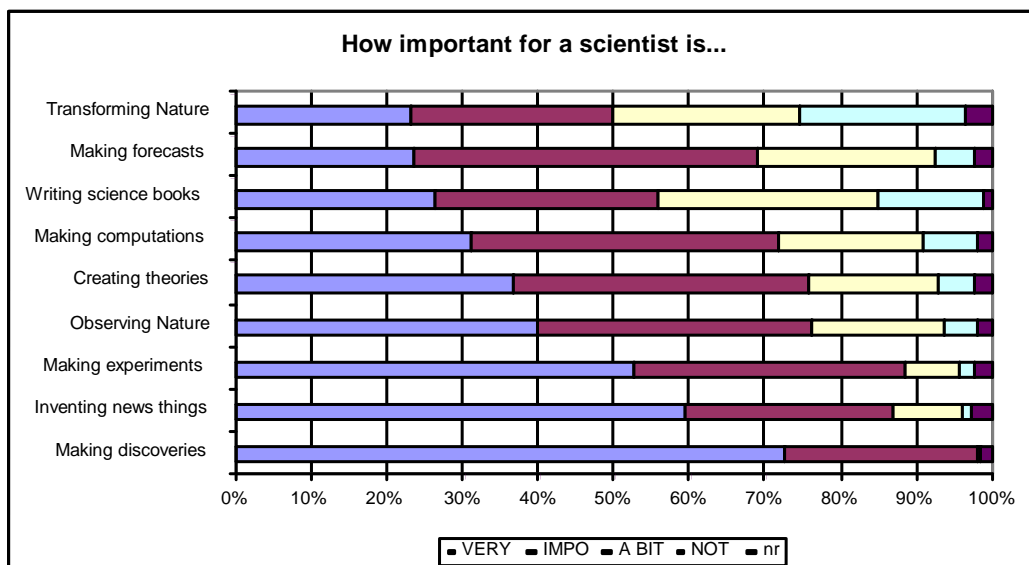


Figure 1. The answers to the questions n.3.

The answers clearly reveal that, according to children, the most important things for a scientist are making discoveries, inventing new things and making experiments (figure 1). It is an experimental and applicative science that appears to be closer to technology rather than to theoretical reflection, without any relevant difference between children and adolescents.

"Making forecasts" is not seen by our respondents as such an important activity for a scientist, in contrast to what happen among teachers (see Gouthier). A simple explanation may be the fact that children and adolescents do not have a clear idea of what "making forecasts" means and are not able to associate it with scientific activities (e.g. those mentioned above) that are widely known and have a general interest.

Likewise, “writing books” is not seen as a crucial point, as it is also part of a vision of the production process of the scientific knowledge, which is probably too sophisticated. Children and teenagers apparently confine scientific writing within the scarcely important activities and therefore, at the end of the day, they see them as quite irrelevant for the development of science.

At the opposite end of the scale, right after “making discoveries” – the scientific activity par excellence – “making experiments” and “inventing new things” interestingly are in a substantial tie. Indeed, both of them are important to science, but they somehow reveal two visions for research. The experiment is the traditional epistemological instrument, with deep historical roots, well-established in the ground of the past science. On the other hand, invention is also a modern aspect of a science that becomes business and follows the new paths of patenting and marketing. By that, it is not meant that inventions have never existed – Archimedes and Leonardo were supreme scientists and inventors, only to mention a couple of them. Nevertheless, the hypothesis we want to suggest is that the contemporary imagery may refer both to a traditional view of a scientist and his/her new position in a society where science and technology are closely linked to the market of products and innovation.

Even so, in the children’s imagery, inventing is also related to another ingenious and creative activity: wizardry, still a very frequent paradigm, as mentioned when discussing the drawings. The most modern vision and one with ancient roots are found to merge in the drawings, as previously reported.

Science in everyday life

After an attempt to analyse the image of a scientist’s job and the “legendary” figures of reference, question no. 4 was aimed at detecting whether children and adolescents can realise how much science is pervasive in their everyday life. Therefore, their task was to mention three objects related to science they can see in their homes.

The vast majority of the children were able to mention three objects and, on average, children and the teenagers mentioned 2.6 instruments (table 2).

Object	Occ	%	Occ/Pup	Object	Occ	%	Occ/Pup
Computer	476	16,49%	41,11%	Radio	26	0,90%	2,25%
TV	301	10,43%	25,99%	Calculator	26	0,90%	2,25%
Books	180	6,24%	15,54%	Electric bulbs	25	0,87%	2,16%
Microscope	158	5,48%	13,64%	Telephone	24	0,83%	2,07%
Telescope	75	2,60%	6,48%	Flowers	24	0,83%	2,07%
Magnifying glasses	60	2,08%	5,18%	Atlas	24	0,83%	2,07%
Microwave oven	51	1,77%	4,40%	Phone	22	0,76%	1,90%
Washing machine	50	1,73%	4,32%	Lamps	20	0,69%	1,73%
Electricity	42	1,46%	3,63%	Clock	17	0,59%	1,47%
Binoculars	42	1,46%	3,63%	Plants	16	0,55%	1,38%
Plants	41	1,42%	3,54%	Encyclopedia	15	0,52%	1,30%
Globe	34	1,18%	2,94%	Cooker	15	0,52%	1,30%
Thermometer	31	1,07%	2,68%	Stove	14	0,49%	1,21%
Mobile phone	30	1,04%	2,59%	Medicine	13	0,45%	1,12%
Bulb	30	1,04%	2,59%	Science books	12	0,42%	1,04%
Water	29	1,01%	2,50%	Maps	12	0,42%	1,04%
Refrigerator	29	1,01%	2,50%	Scientific books	11	0,38%	0,95%
Fridge	27	0,94%	2,33%	Playstation	11	0,38%	0,95%
Test tube	26	0,90%	2,25%	Light	11	0,38%	0,95%

Table 2. The objects mentioned by the pupils for question n. 5. The list includes only the objects that have recorded more than ten mentions.

Quite remarkably, the first three objects – the computer, the television and books – are instruments for communication and learning. Rather than products obtained thanks to scientific principles and technological innovations (which is true for computers and TV-sets, but not for books), apparently they remind of science as they are concentrates of information. Strikingly, the subsequent group consists of microscope, telescope and magnifying lenses. None of them is strictly an object for everyday use; they are not communication instruments, they are real scientific instruments. But their frequency as educational games can be quite high, and this role of theirs may be the reason

why they were mentioned so often. Or presumably, when answering, children have thought about the school context and not the home one.

In any case, pupils proved to be able to identify the contribution of science also in a familiar and everyday environment such as their home: from the washing machine to electricity, from the mobile phone to plants, from bulbs to water, they can realise that science is related to everything.

What emerges is that their homes are full of objects to learn about science, as well as objects that technologically result from it, and both of them intrigue the children.

Science for a sustainable progress

Question no. 5 prompted children and adolescents to mention the issues science should contribute to for a better Europe (“What do you think scientists should study for a better future for Europe? Name three things”).

Despite their young age, both children aged 9 and adolescents aged 14 within our sample have very adult concerns, as this question was answered by many of them (2,399 themes were gathered, over 2 each respondent) and not by mentioning super-technologies featured in science fiction, but rather expressing a worry which is completely rational as concerns the environment they live in. Once again, their descriptions are rich and interesting. They were grouped by similar theme; in table 3 the keywords referring to the themes and their frequencies.

Grouped theme	Occ	%	Occ/Pup	Grouped theme	Occ	%	Occ/Pup
pollution	208	9,90%	17,96%	oil	6	0,29%	0,52%
nature	94	4,47%	8,12%	inventing sun engine	6	0,29%	0,52%
environment	73	3,47%	6,30%	cars	6	0,29%	0,52%
technologies	61	2,90%	5,27%	hydrogen	6	0,29%	0,52%
improving our lifestyle	45	2,14%	3,89%	flying cars	6	0,29%	0,52%
transports	40	1,90%	3,45%	creating new theories	6	0,29%	0,52%
space	37	1,76%	3,20%	perpetum mobile	5	0,24%	0,43%
diseases	32	1,52%	2,76%	people needs	5	0,24%	0,43%
observing nature	31	1,48%	2,68%	new theories	5	0,24%	0,43%
medicines	25	1,19%	2,16%	nature	5	0,24%	0,43%
computer	25	1,19%	2,16%	education	5	0,24%	0,43%
plants	24	1,14%	2,07%	cloning	5	0,24%	0,43%
climate	24	1,14%	2,07%	trash	4	0,19%	0,35%
inventions	23	1,09%	1,99%	machines	4	0,19%	0,35%
energy	22	1,05%	1,90%	inventing vaccines	4	0,19%	0,35%
robots	19	0,90%	1,64%	human body	4	0,19%	0,35%
factories	19	0,90%	1,64%	galaxies	4	0,19%	0,35%
mathematics	16	0,76%	1,38%	foreign languages	4	0,19%	0,35%
chemistry	16	0,76%	1,38%	foods	4	0,19%	0,35%
ecology	15	0,71%	1,30%	flowers	4	0,19%	0,35%
physics	13	0,62%	1,12%	electric cars	4	0,19%	0,35%
experiments	13	0,62%	1,12%	weather	3	0,14%	0,26%
working on better future for Europe	12	0,57%	1,04%	warm water	3	0,14%	0,26%
water	12	0,57%	1,04%	volcanoes	3	0,14%	0,26%
recycling	12	0,57%	1,04%	tobacco	3	0,14%	0,26%
discoveries	12	0,57%	1,04%	to limit pollution	3	0,14%	0,26%
health	11	0,52%	0,95%	to be polite	3	0,14%	0,26%
ecological cars	11	0,52%	0,95%	study nature	3	0,14%	0,26%
vaccines	10	0,48%	0,86%	solar energy cars	3	0,14%	0,26%
writing science books	9	0,43%	0,78%	solar cars	3	0,14%	0,26%
geography	9	0,43%	0,78%	planets	3	0,14%	0,26%
economy	9	0,43%	0,78%	new fuels	3	0,14%	0,26%
waste	8	0,38%	0,69%	nanotechnology	3	0,14%	0,26%
trees	8	0,38%	0,69%	increasing human communication	3	0,14%	0,26%
				heat in schools	3	0,14%	0,26%

electricity	8	0,38%	0,69%	eraser on which you can write (by pen)	3	0,14%	0,26%
history	7	0,33%	0,60%	economy	3	0,14%	0,26%
energy	7	0,33%	0,60%	discovering life in the Universe	3	0,14%	0,26%
Earth	7	0,33%	0,60%	dinosaurs	3	0,14%	0,26%
technologies	6	0,29%	0,52%	conservation species	3	0,14%	0,26%
science	6	0,29%	0,52%	communications	3	0,14%	0,26%

Table 3. The keywords referring to the themes emerging from the answers to question n. 5, and their frequencies.

There is a serious concern for the environment (pollution, nature, transports, climate), as previously shown by the drawings. Subsequently, there is an interest for technology (technologies, computer) and for health (diseases, medicines). The first strictly scientific themes are: space, observing nature and plants.

Children and adolescents seem to have great expectations on the role played by science in the improvement of their everyday life.

The themes regarding the environment, pollution, the relation between development and nature and, in general, the quality of life comes forth in the conceptual maps. It shows that the science-Europe pair is highly oriented towards the need for a sustainable development.

Interests and curiosity

Two questions (no. 6 and no. 7) were conceived as two long lists of topics: in this case students had to select “Yes” only if they were interested in further information about the topics.

Question no. 6 was about the “pure” scientific themes: from stars to the functioning of the human body, from evolution to technology, the aim was to understand what the most interesting themes to our sample are, and if there are any relevant differences between the youngest and the eldest, between boys and girls in the sample. This question drew partially on the questionnaire used by Sjoberg³, also to improve the chance for a comparison with data gathered in several countries of the world.

Question no. 7 introduced the European dimension and required the students to show their possible interest in the issues linked to Europe itself or to scientific research in Europe or to the impact of science on the European social and economic context. The answers to question no. 6 are summarised in figure 2.

³ Sjoberg S., Science and scientists: The SAS-study Cross-cultural evidence and perspectives on pupils interests, experiences and perception, Acta Didactica 1, University of Oslo, Revised and enlarged version, 2002, <http://folk.uio.no/sveinsj/>

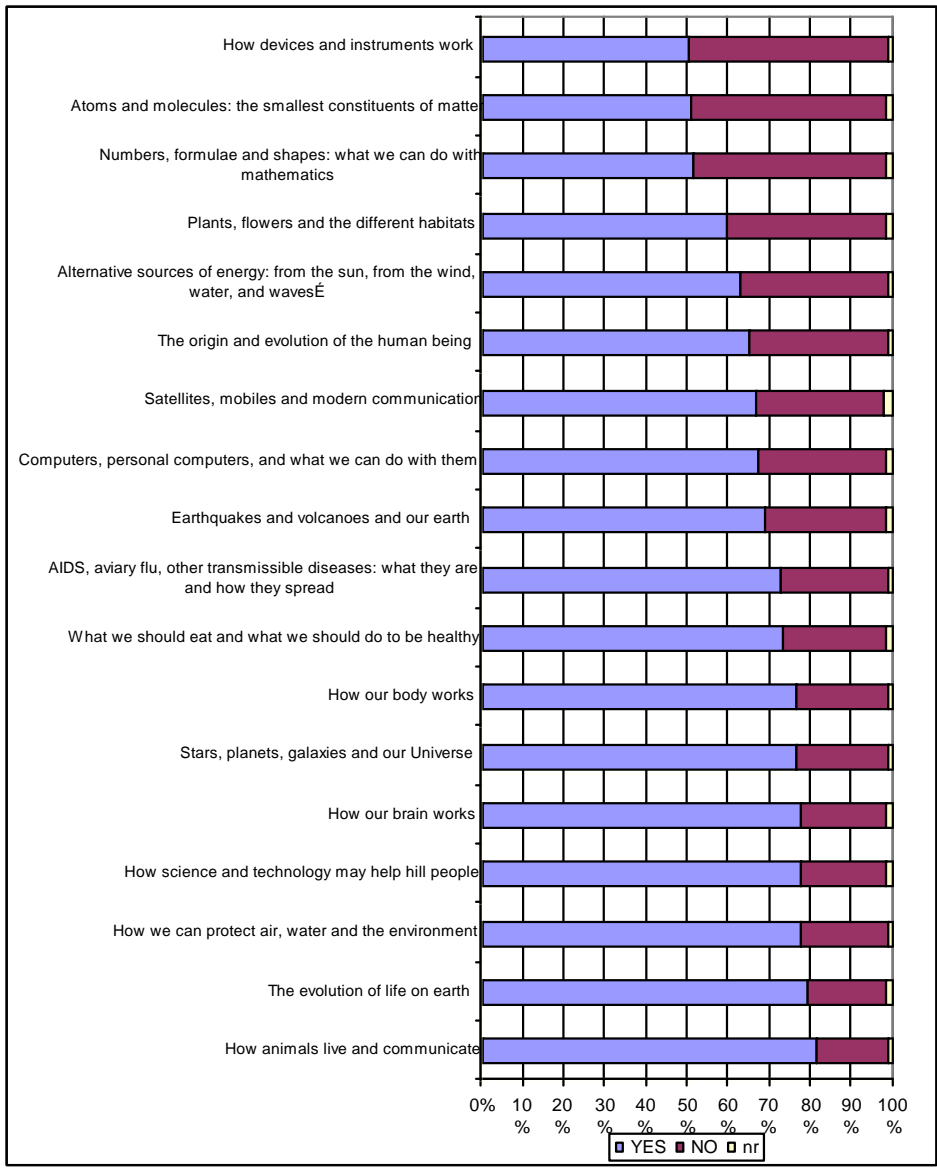


Figure 2 . The answers to question n. 6.

Looking at the results as a whole, without sorting them by age group, the interest shown is mainly about life: “how animals live and communicate” ranks first as a theme, whereas “the evolution of life on earth” ranks second. Except for stars, planets and galaxies, one of the most popular scientific themes ever, not only among children, the first half of the list still sees themes that concern life and health: how science and technology can help to defeat diseases or to protect the environment, the functioning of our brain, and the food needed to keep healthy.

On the other hand, the bottom of the list sees the group of the so-called “hard” sciences (physics with the elementary components of matter, mathematics represented by numbers and formulas), whereas technology comes last (“how things work”).

A further explanation is required at this point. The question was designed to make the respondents select the topics they were most curious about, and not those believed to be the most interesting ones. Owing to its massive presence in our lives, technology is maybe seen as something familiar and consequently it may not be able to arise a special curiosity, although this may not imply an absolute disinterest in children.

The research by Sjoberg actually revealed that the technological issues were the subject of a special interest especially in children from developing countries, who could be more attracted to this kind of novelties, whereas Japanese children, whose everyday life is now pervaded by technology to the maximum extent, were most uninterested in it.

In any case, the choices made by children should be separated from those by adolescents, as at times they are completely different. Indeed, reading the data collected after having sorted them by education degree, what emerges is that children are much more curious about the human body (and the functioning of the brain) than teenagers are (figure 3).

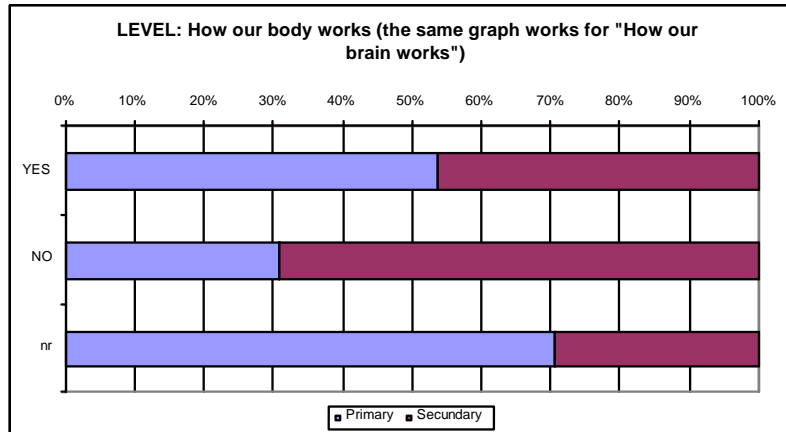


Figure 3 . Age differences in answering question n. 6.

The same applies for “the origin and evolution of the human being” (figure 4).

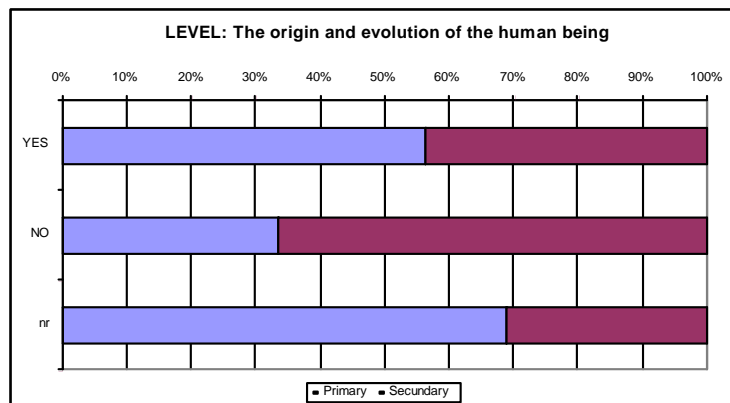


Figure 4 . Age differences in answering question n. 6.

The youngest children are probably more interested in a theme like the evolution, as this is usually explained according to a narrative paradigm that is easier to understand and closer to the imaginative dimension of childhood. Or perhaps teenagers have already heard much about this issue and do not believe they need further information. Another case, still different from the two above, is the unbalance in the theme “plants and flowers”. Whereas children still have a special interest for plant life (expressed also in the drawings), as age increases this theme appears to be too simple, “childish”, to the eyes of adolescents, as also confirmed by other research projects (figure 5).

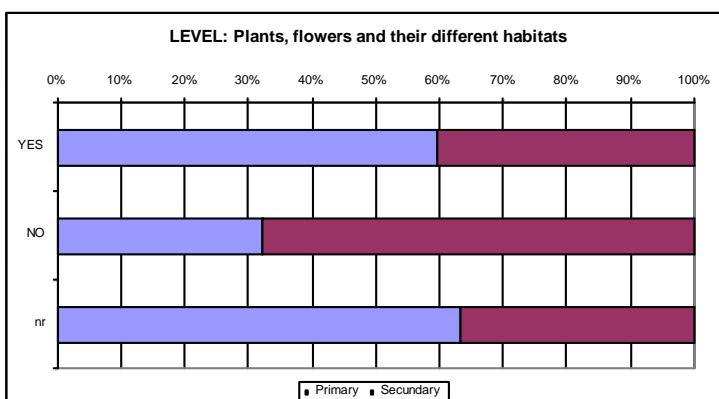


Figure 5 . Age differences in answering question n. 6.

Our data do not highlight a significant gender influence. Only one question is marked by a certain gender gap (figure 6).

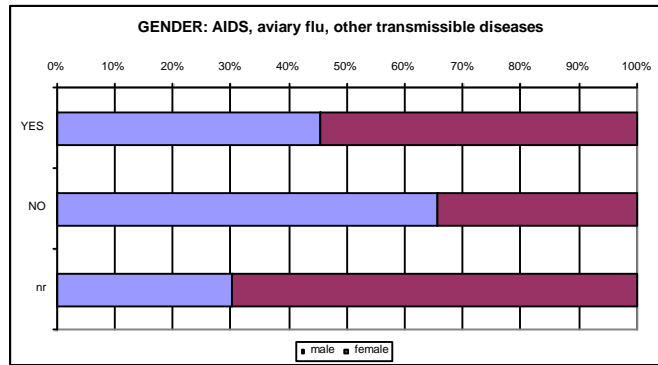


Figure 6 . Age differences in answering question n. 6.

When asked to state whether they are interested in transmittable diseases, such as AIDS and the avian flu, boys tend to say no, whereas girls tend to say yes. In all the other cases, the deviations from the average in the answers of the two genders are irrelevant in every respect.

Answers to question no. 7 are summarised in figure 7.

Inserire titolo: I would like to know more about...

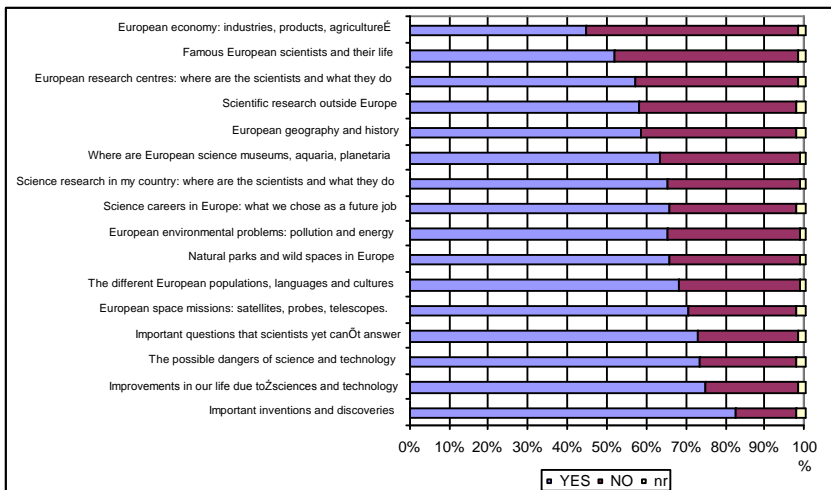


Figure 7 . Answers to question n. 7.

The preferences in our sample are very clear: in first place there are the impacts of science on society, arising from the inventions, the discoveries and, in particular, the improvements that science and technology may contribute to our life, and the possible risks connected to the scientific activity – they are the first three themes chosen from the list. The fourth position is occupied by the limitations of science, including the popular issues scientists have not been able to tackle as yet. On the other hand, the themes that concern Europe are all positioned at the bottom of the list.

The European theme that arises the greatest interest is space missions. Next, there are the European populations, languages and cultures that, even though they are not strictly linked to science, demonstrate a desire to understand better what the European Union is. The strong association between Europe and the linguistic and cultural variety is confirmed also in the conceptual maps, as the most recurrent words concern precisely languages and the European peoples, sometimes even food, poets, songs and other aspects of the local and national cultures.

Let's consider now if we can find country-based differences in the answers to questions 6 and 7.

As previously mentioned, the "hot" issue children and adolescents believe science should work on is the environmental protection. The protection of air, water and nature in general originates a divide between Italian, Portuguese, Romanian and Czech students on one hand, and French and Polish students on the other hand (figure 8).

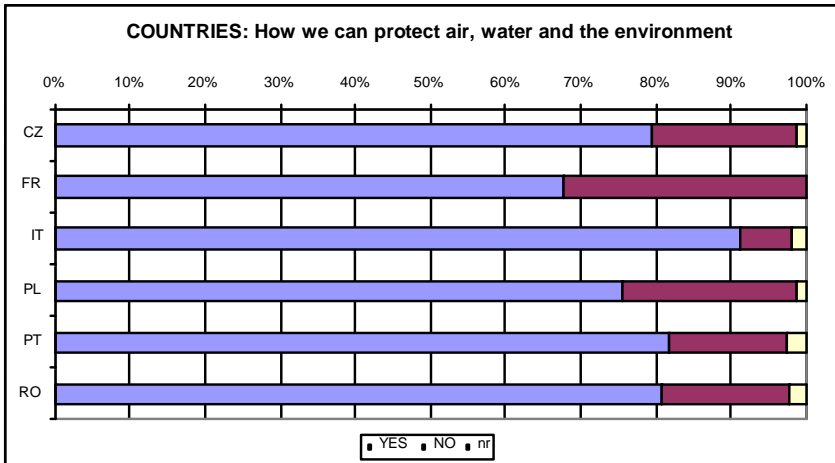


Figure 8 . Country-based differences in answering question n. 7.

In Italy, the interest in this subject is extremely high, and perhaps this is because in this country the environmental culture is limited or totally inexistent. Facing the environmental and urban disasters occurring in their country, the Italian young people cannot but be alarmed and in need of better information and interventions. Apparently, in France the situation is completely an opposite one, at least in the area represented in the survey.

The gap in the interest in the environment is confirmed by the opinions collected on alternative energy sources, once again showing the highest interest level in Italy, Romania and Portugal (figure 9).

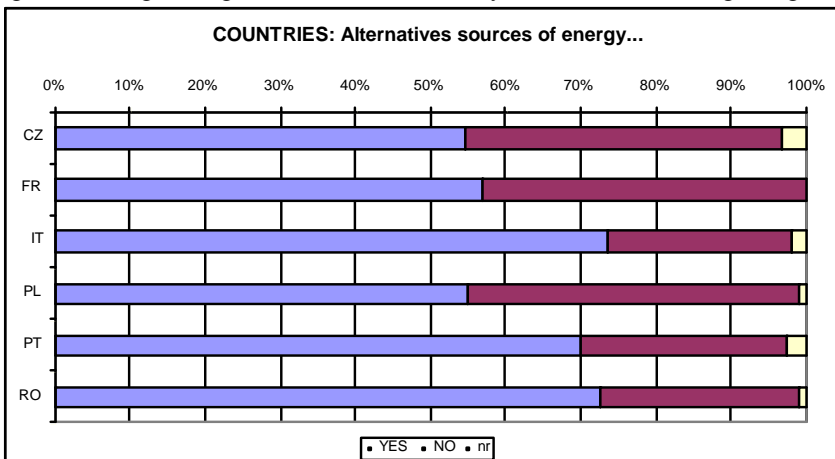


Figure 9 . Country-based differences in answering question n. 7.

As regards the issue of natural protection, the level of interest in the specific issue of the energy sources decreases by over ten per cent in all cases.

The famous European scientists, as shown in the general list, are of little interest, as demonstrated by the fact that less than 50% of the respondents express their interests in this subject. Positive exceptions can be found in Italy and, most of all, Romania, which shows a very high interest (figure 10).

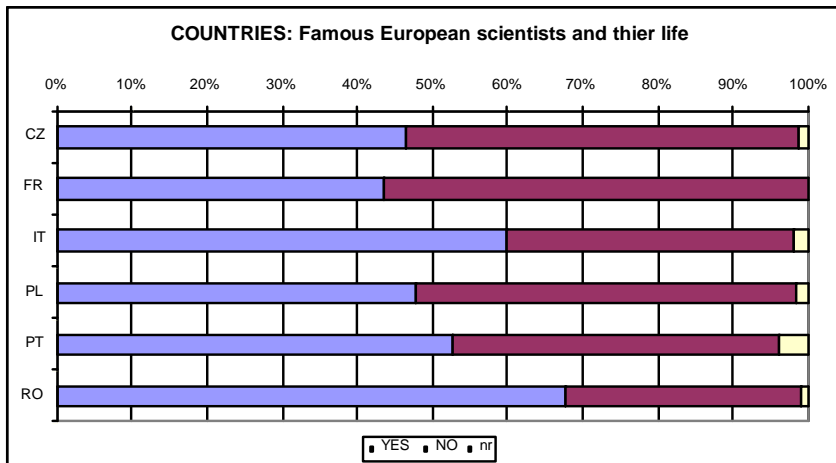


Figure 10 . Country-based differences in answering question n. 7.

The interpretation is not easy. Maybe the biography of scientists is not appealing in general, or the adjective “European” sounds bureaucratic and not really evocative.

The last comparison between countries regards the interest in “science research in my country” (figure 11).

To this respect, countries are divided in three groups. The children from the Czech Republic and Poland are not very interested in the national dimension; on the other hand, they are very good at expressing it when asked to mention famous scientists or to portray them in the drawings; probably they are less interested as they believe they are sufficiently informed on these issues. In contrast, the Italian and Romanian children tend to be very interested. The history of science is not a common subject in Italy, neither in general history classes, nor as an aspect of the scientific education. Such an evident interest demonstrated by the pupils is quite interesting and it should be an inspiration for teachers.

The figures recorded in France and Portugal fall within the average, yet this interest exceeds by far 50%.

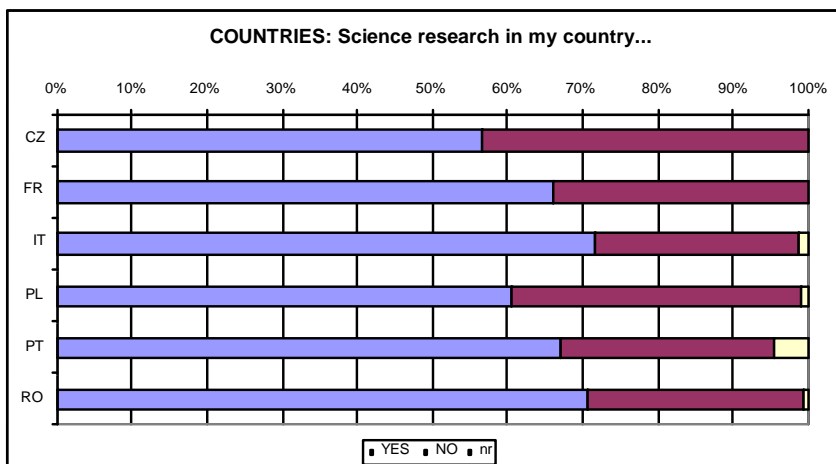


Figure 11 . Country-based differences in answering question n. 7.

The interest in the national dimension of science is clearly higher than the one in the research at European level. Maybe this happens as the European identity is still a weak one in many respects, and therefore a child does not feel emotionally pushed to know what happens in a supranational dimension. Certainly, neither “European” science has a strong or successful image, nor laboratories and bodies working on this dimension are widely known. Maybe pupils simply record the lack of a communication policy. On the other hand, still referring to the conceptual maps, the more Europe is associated to the dimension of cultural variety, the less it is associated to research.

Would you like to be a scientist? Why?

When asked “Would you like to be a scientist?”, children are split in two nearly equal groups between yes and no (figure 12).

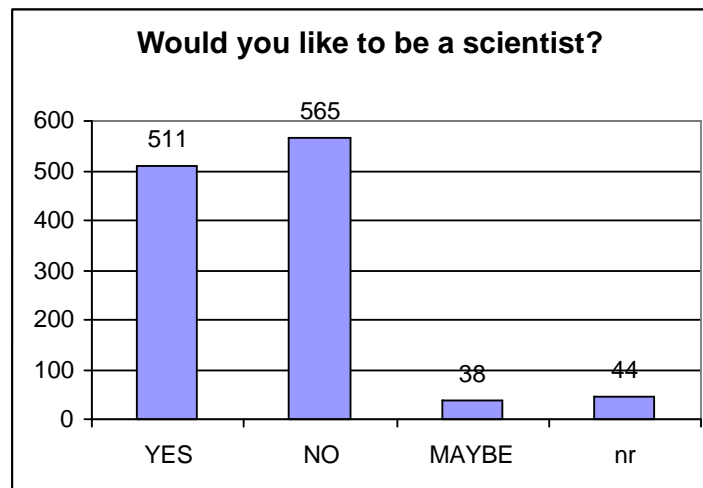


Figure 12 . Answers to question n. 8.

However, the most interesting aspect is to read the reasons they wrote for their positive answers, even though they are not always consistent with the content of other sections of the questionnaire: indeed, some who said they are not interested in science highlight a great interest when explaining their rejection; otherwise, some respondents gave a positive answer, but their statements have a worried, perplex or even negative tone.

Some crucial themes emerge when the respondents support their answers.

As concerns the positive answers, children want to become scientists because science can help the world:

“Yes.scientist help to the world and care about the future” (PL)

“Yes.I want to do something good for society and environment” (PL)

“Yes because I could invent things to improve life of people and reduce pollution” (IT)

“Yes I'd like to be a female scientist because I could discover new things that could improve mankind” (IT)

Because science can treat diseases (a popular theme also in drawings):

“Yes. I would like to be a scientist. I would study diseases to help persons with diabets, handicap, obesity, coeliac disease” (IT)

“Yes. Because I could help people and cure the most dangerous diseases” (RO)

Another reason is because a scientist leads an exciting life:

“Yes. Scientist can travel a lot and learn a new things” (PL)

Because scientists are well-known and well-paid:

“Yes. I will do some inventions and I'll famous in whole Europe” (PL0308)

“Yes. I need a good pay work and society respect” (PL0701)

“Yes. I will become a celebrity, I will be smart ...” (RO0409)

“Yes. Because as scientist you have access to a large amount of information and you may discover amazing new things, that were not yet discover. You will have your name known, not only in your country, but on the entire Earth.” (RO)

“I am not sure. it can gives money and fame but it is boring” (PL)

“Yes, I would like to be a scientist but only in a specific domain. The science is an interesting and complex domain, but it offers a lot of jobs very well paid all over the Europe” (RO)

Working in a laboratory is fun (as is travelling into space!):

“Yes. I want to be a mad scientist and spend time in laboratory” (PL)

“Yes. If I will become a scientist I will experiment and I will find forms of life in space” (RO)

“Yes. I would like to visit space and to see asteroids.” (FR)

“Yes, the job of scientist is appealing to me. I will go in space and on the Moon. I love also biology.” (FR)

“Yes, because I wish (I have a dream) to travel on Mars, and to find out if other intelligent creatures live in the Universe” (RO)

Children want to become scientists because they are seen as smart people, even though it may make them feel inadequate:

“Yes, to have a smart mind, know more than others, to discover new formulas and new theories to write books” (IT)

“No because scientists are wise but not the normal ones, super wise. I'd like to be a biologist” (PT)

Some have a problem with mathematics:

“No because I don't like mathematic and it's difficult for me” (FR)

“I am not sure. i am not good in math and phys” (PL)

“No because I'm not able to formulate alone an hypothesis and I don't like to do it, but I like to hear it made by other people” (IT)

“No because there is no place with imagination in sciences. It is necessary to prove by calculations” (FR)

Also the danger implied is an issue (the same applies to liquids!):

“No, because it is very dangerous and there are many risks, and I would never put my life in danger for discovering some new idea.” (RO)

“yes, i could go to space and work with chemical reagents but i know it's dangerous” (PT)

“I don't know, because it may be dangerous, but it could be nice” (FR)

“I am not sure. you can help but M. Curie died because of radiation” (PL)

“It depends. Because I don't want to travel in space and if there was an explosion or things that destroy my lung” (FR)

“No, because i don't like liquids” (PT)

In any case, a common belief is that scientists have to work hard – and probably on their own:

“I don't know. In one hand yes because i would like to find solutions in the other hand no because it's too much work” (PT)

“No, I am not interested in this field. Nowadays, children can find no satisfaction in spending 7 days out of 7 in a room, in front of mathematics and formulas. We should study more arts, and especially every kind of design” (RO)

“No. it is interesting but I need a contact with people in my future work” (PL)

The past few years have seen an increase in the awareness of little girls that science may be part of their professional future, that one day they could be scientists too. It can be seen through their drawings, and in the texts of their answers. Their attention is focussed on sciences studying life rather than technological applications, and on observation, rather than experiment. They spontaneously consider science as one of their possible professional paths and it is a trend worth noticing.

They have removed any sort of estrangement, any exceptionality. In a normal context, a girl may imagine to be a future scientist. The gender issue is almost totally missing in the answers given by children.