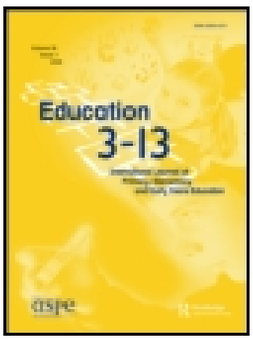

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Perceptions of primary school students toward learning about science: the case of Spain

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ABSTRACT

It is vital that the next generation of young people develop scientific skills to ensure global environmental sustainability and the capacity to solve many of the global problems caused by narrow scientific thinking. The aim of this article is to discuss the interest on studying science of primary school students and how to engage them in science education. We explore the perceptions of 709 sixth-grade students from Spain aged between 11 and12 with regard to studying science using a questionnaire entitled Scientific Competencies. Our findings show that there is a growing interest in science motivated by the engagement of primary school students in scientific learning that is transferable to daily life. We discuss how this optimistic result could lead to more students becoming interested in pursuing a career in science. We conclude the article by discussing some of the challenges in relation to maintaining students' positive attitude towards learning about science.

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Science education; transfer of learning; primary education; PISA; gender; type of school

1. Introduction

Primary education plays an essential role in the development of young people, to the extent that access to basic education is a fundamental human right (United Nations 1998). During this early stage of their education, children should receive instruction in essential science, which should be a core element of the curriculum. Essential science includes science and maths, and in secondary education this number is expanded to four closely connected areas of study: science, technology, engineering and maths (STEM). However, despite the many advances in science education research, there is still much to do to convince the wider public and the education community of the benefit of preparing new generations to become scientifically literate citizens (Linder et al. 2011; Hodson 2003). In point of fact, not all children engage with scientific knowledge in the same way. Their motivation to learn about science is influenced by different factors such as their previous knowledge, educational experiences and their capacity to make meaningful connections between science and their personal context. As explained by Garritz (2010), to foster a positive attitude towards science, education should facilitate the transfer of scientific learning in school to the specific context of the student. Nevertheless, teaching science is challenging for teachers, who have to meet curriculum requirements in a form that is stimulating and engaging (Romine and Sadler 2016; Dolin 2007), ensuring that the students also develop correct values and attitudes, and acquire specific scientific and technical knowledge that is relevant to their social and academic development (Martín, Prieto, and Jiménez 2015).

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As suggested by different authors, this initial introduction to science may have an impact on the students' future engagement with scientific learning and their perception of scientific subjects. In the long term, it may influence their inclination to pursue a scientific or technical career (Lupión-Cobos, Franco-Mariscal, and Girón-Gambero 2019; Mato, Espiñeira, and Chao 2014; Yang, LaBounty, and Ekker 2016). The study conducted by Silver and Rushton (2008) with Year 5 students found that although, in general, students enjoy science and develop a positive attitude towards it at primary school, they are not motivated to become scientists. In the Spanish context, similar studies have uncovered some interesting findings with regard to the differences in attitude towards science between primary and secondary school students. Whereas students in primary schools generally have a receptive attitude towards science at this stage (Fernández Cézar and Solano Pinto 2017), secondary school students tend not to have a great deal of interest in the subject, and this attitude only gets worse as they grow older (Vázquez and Manassero 2015; Logan and Skamp 2008).

For some time there has been a renewed interest in promoting scientific literacy, learning and competencies in schools, not only in Spain but also around the globe (Rosales Sánchez, Rodríguez Ortega, and Romero Ariza 2020; Cavas 2015; Laugksch 2000). De Boer (2011) explains this interest according to two interconnected motivations. On the one hand, interest is driven by the belief that a citizenry knowledgeable about science and technology will facilitate economic growth. On the other hand, interest is motivated by the pressure to perform well in international assessments such as the Programme for International Student Assessment (PISA) and the Trends in Mathematics and Science Study, in which the assessment of maths and science is a central element.

This article explores the perceptions of students aged between 11 and 12 who are in the sixth grade (Year 7 in the UK) of primary school with regard to science. It considers their inclination to study and take an interest in science and looks at ways in which they could be more engaged in science education by focusing on their ability to utilise scientific learning outside of the school environment. We follow Georghiades' (2000) idea that an understanding of how primary school students transfer what they have learnt in science to different contexts is central to recognising the sustainability of scientific learning and formulating the students' attitudes towards science education in the future. Behind this idea is the notion that student motivation increases when learning is situated and transferable. There is evidence that shows a meaningful engagement with scientific knowledge during primary school leads to a greater inclination to consider a career in science (DeWitt, Archer, and Mau 2016; Nordine, Krajcik, and Fortus 2011; Arandia, Zuza, and Guisasola 2016).

The complexity of today's society poses educational challenges that require an in-depth debate as to what fundamental knowledge, capacities and skills students should have acquired at the end of compulsory education, with a special focus on what competencies are necessary to achieve 'good' education results (Méndez, Méndez, and Fernández Rio 2015). A discussion on educational competencies must consider the process of transferring knowledge learnt in school to everyday contexts. In more pedagogical terms, this discussion should allow us to check whether the objectives of the curriculum are transferable to daily life. Of necessity, this process of transfer needs to be related to the motivation to learn and the perception of the usefulness of learning. If students are able to transfer what they have learnt to their personal context and recognise the value of that learning, they will be able to develop a positive attitude towards new learning in the future. The transfer of learning needs to be a process that fosters an affective entanglement in which learning is related to the lives of the students in ways that make them 'more passionate but also more just and critical through science' (Zembylas 2016, 549). The transfer of learning from the classroom to real-life situations requires that students understand their new knowledge and are able to make informed decisions about how to use it. It also entails a commitment from teachers to engage in innovative pedagogies and develop stimulating learning environments (García-Carmona and Acevedo-Díaz 2018).

For this research, we collected data from students who were in the sixth grade of primary education during the 2018–2019 school year. From the data obtained, we draw conclusions as to how children aged between 11 and 12 are introduced to the study of science (through the national curriculum) and how the possibility of translating scientific learning to real-life situations influences

their interest and early scientific bent. The results also allow us to explore different responses in relation to gender and the type of school. On the one hand, looking at gender differences, we propose to indicate to what extent the traditional tendency to associate scientific knowledge with males is still present in schools. On the other hand, looking at the differences between schools will allow us to explore whether the type of school influences the perception of scientific learning.

2. Method

The data for this descriptive and exploratory study have been collected using a questionnaire entitled Scientific Competencies for the Sixth Grade of Primary Education. This has been designed and validated through the research project FCT-13-6766, which is supported by the Spanish Foundation for Science and Technology. For the development of this research tool, the previous work of Pérez (2005), Vázquez and Manassero (2007, 2018) and Rodríguez Mantilla and Fernández Díaz (2015) has been taken into account to ensure the validity and reliability of the survey. The internal consistency of alpha 0,9073 shows good reliability, indicating that the tool covers the full breath of the construct.

The questionnaire has 30 items distributed across 4 variables and the responses are presented in a 4-point Likert scale. It is preceded by some demographic questions intended to capture the personal and academic characteristics of the participants. For the purposes of this study, we focus our attention on those variables that describe involvement in scientific learning and the transfer of that learning from the classroom to 'real'-life situations. The Studies conducted by Romine and Sadler (2016) at college level, and Toma and Greca (2018) with fourth grade students, have followed a similar methodology to explore the attitude of young people to studying sciences. These studies were based on the use of standardised questionnaires to measure the impact of different strategies to make the study of sciences more attractive to students.

To avoid the researchers disrupting work in the classroom we asked primary teachers to distribute the questionnaires to their own students. The teachers who participated in this research were recruited from the researchers' own contact networks. They were provided with detailed information about the research project and training in how to apply the questionnaire. Teachers collected the data in May because at this time of the school year it is expected that schools will have completed the teaching curriculum in the various subjects. We processed the responses from the students, taking a quantitative approach in the form of descriptive statistics. This form of examining data as Gorard (2021) explains 'requires care, scepticism and determination' (6) and enables us to provide a simple, but meaningful interpretation. Underpinning this approach, is the intention of making our study accessible to a wider audience. Finally, we discuss the results with the intention of providing further guidance for schools and teachers on how to introduce innovations in teaching methods and improve the learning experience and motivation of students as far as science is concerned.

Participants

This study was conducted in 21 primary schools, of which 10 are state schools and 11 semi-private schools.[1] The sample comprises 709 students from the sixth grade of primary education, of which 292 (41.2%) are from state schools and 417 (58.8%) are from semi-private schools. In terms of gender, 360 students are males (50.8%), which represents 22.1% of the total from state schools and 28.6% of the total from semi-private schools, and 349 students are females (49.2%), which represents 19% of the total from state schools and 30.2% of the total from semi-private schools. The sample is reasonably homogeneous in terms of its distribution in relation to the gender and type of school variables, but students from semi-private schools predominate slightly. This information is represented in Table 1, which provides the frequency distribution of gender and type of school.

Table 1. Contingency Table: gender and type of school.

Gender and Type of School					
			Type of School		
			State	Semi-private	Total
Gender of participants	Male	Count	157	203	360
		% Gender	43,6%	56,4%	100,0%
		% Type of centre	53,8%	48,7%	50,8%
		% of the whole sample	22,1%	28,6%	50,8%
	Female	Count	135	214	349
		% Gender	38,7%	61,3%	100,0%
		% Type of centre	46,2%	51,3%	49,2%
		% of the whole sample	19,0%	30,2%	49,2%
Total		Count	292	417	709
		% Gender	41,2%	58,8%	100,0%
		% Type of school	100,0%	100,0%	100,0%
		% of the whole sample	41,2%	58,8%	100,0%

Ethics

This study was approved by the Ethics Committee of Pontifical University of Salamanca. All children participating in the study read and signed forms of informed consent specifically designed for this project. Local administration, head teachers, teachers and parents were also asked for consent. The consent forms and the information about the project were presented in an accessible form for children of 11 years old, ensuring that they understand the aims and processes of the study and that their participation was voluntary. Questionnaires did not include personal data, so all the data were collected and held anonymously.

3. Results

The analysis of the results on student experience and teaching method provides an introductory evaluation of the students' views on the teaching and learning process in general. This is relevant to understanding how they perceive the process of learning about science.

Figure 1 represents the mean value for the four main variables. Involvement in scientific learning has the highest mean value (3.13), followed by learning transfer (2.86). Student experience (2.84) has a very similar value to learning transfer. Finally, teaching method (2.24) has the lowest value.

Figure 2 provides an overview of the responses to the different items of the questionnaire. This representation provides relevant information about the different elements used to explore the perception sixth-grade primary school students have of the teaching, learning and transfer processes in science education. In this article, we focus our attention on the last two variables: involvement in scientific learning and learning transfer. The highest score among the first 20 items (student

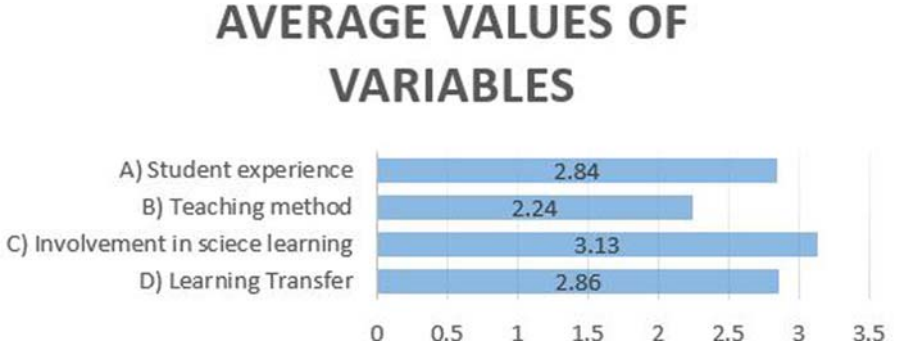

Figure 1. Average values.

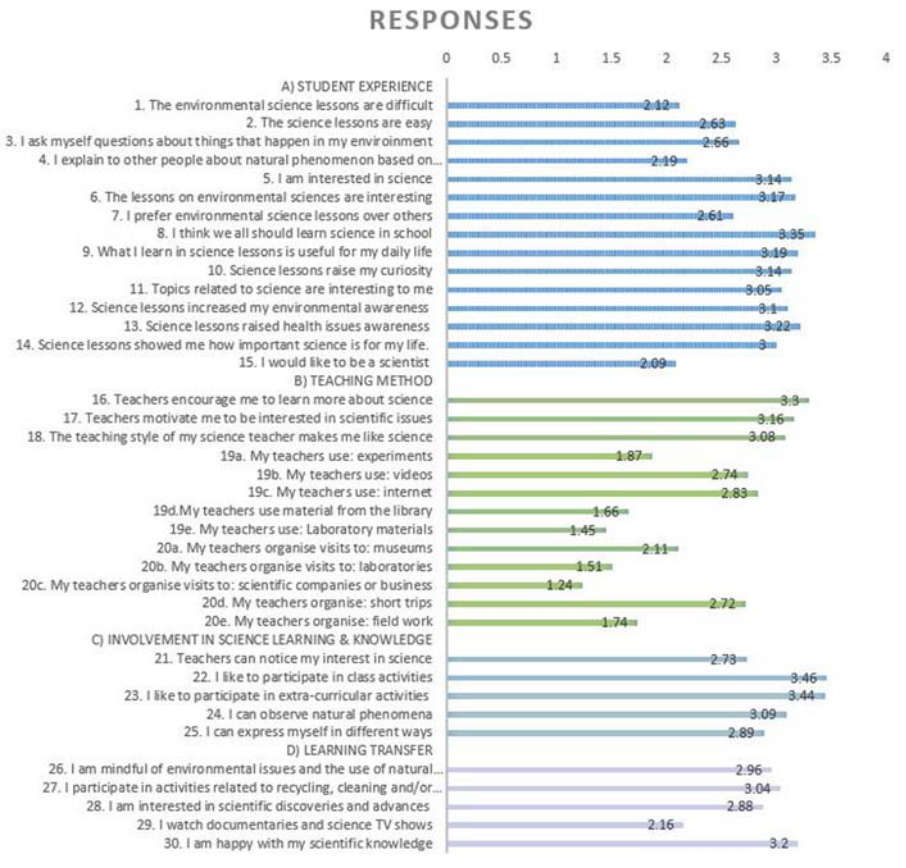

Figure 2. Responses.

experience and teaching method variables) emphasises the idea that students think everybody should learn science in school (Item 8). We can see that students perceive their teachers motivate them to learn about science (Item 16), that science lessons raise their awareness of health issues (Item 13), that what they learn in science lessons is useful for their daily life (Item 9), that they find science lessons interesting (Item 6) and that teachers encourage students to be interested in scientific issues (Item 17). The items with lower scores are those associated with the teaching method variable. We can see from these scores that students do not visit companies or businesses engaged in scientific activities very frequently (Item 20c), that teachers do not regularly use laboratory materials during lessons (Item 19e), that teachers do not organise many visits to laboratories (Item 20b) and that it is unlikely teachers will use materials from the library (Item 19d).

Involvement in scientific learning

The data show that the items with higher scores belong to the involvement in scientific learning variable. As illustrated in Table 2, 61.5% of the students participating in this study chose the option *often* as their main response, followed by 26% who chose *always*.

Figure 3 provides a more detailed insight into the students' perceptions of their involvement in scientific learning. Activities that take place in and outside of the classroom (Item 22 *I like to participate in class activities* with an average score of 3.46 and Item 23 *I like to participate in extra-curricular activities* with an average score of 3.44) are those participants value the most, not only within this group of items but among all the groups. Moreover, even the items that have lower scores within

Table 2. Involvement in science learning: overall responses.

		Frequency	Percentage	Valid Percentage	Cumulative percentage
Scale	Never	1	,1	,1	,1
	Rarely	88	**12,4**	12,4	12,6
	Often	436	**61,5**	61,5	74,0
	Always	184	**26,0**	26,0	100,0
	TOTAL	709	100,0	100,0	

the involvement in scientific learning variable (Item 25 *I can express my ideas about science confidently* with an average score of 2.89 and Item 21 *Teachers notice my interest in science* with an average score of 2.73) are close to a score of 3, showing that within this category the average responses are far from *rarely* and very close to *often*. This indicates that students have a very positive perception of the opportunities available for getting involved in scientific learning.

When looking at gender differences in relation to involvement in scientific learning, our data do not show significant differences. Table 3 exposes this in more detail, showing that the difference between the genders when choosing the response *always* is 6.4%, with males obtaining the highest percentage. On the other hand, the difference between the genders when choosing the response *never* is extremely low.

To summarise, we understand that the sixth-grade students participating in this study are very enthusiastic about getting involved in scientific learning. Specifically, they are very interested in participating in activities in and outside of school that allow them to expand their scientific learning, and they are confident about expressing their knowledge of science. Students are also able to appreciate the natural environment and they feel that teachers value their interest in science. Finally, there are no significant differences in relation to gender, but the students in semi-private schools have a slightly better perception of scientific learning.

Transfer of learning

Transfer of learning refers to the students' perception of the applicability of the scientific knowledge acquired in class to daily life. Table 4 shows that 6 out of 10 participants consider transfer of learning happens often, whereas 2 out of 10 participants think it happens only rarely. We can also see that 13.4% of the students said they always apply their scientific knowledge to their daily lives, although a very small group (2.3%) said they never apply their knowledge outside of school.

From the data presented in Figure 4, we can observe that the average of responses is between 2.16 and 3.20, therefore close to the third type of response (*often*). The highest average score expresses students' satisfaction with their scientific knowledge (3.20). This is followed by their participation in activities related to recycling, cleaning and/or caring about animals and plants (3.04),

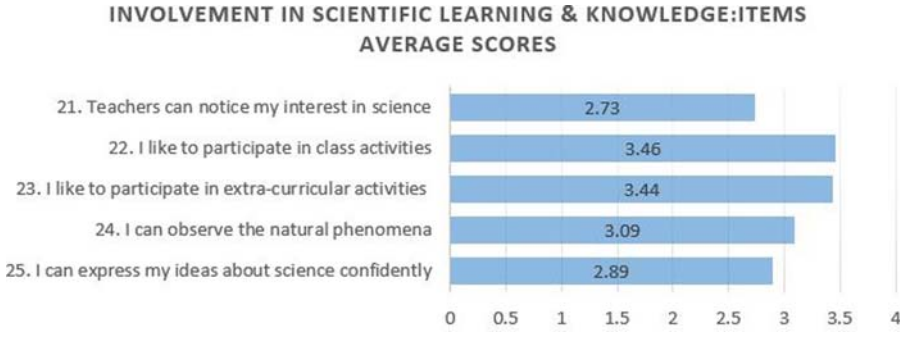

Figure 3. Involvement in scientific learning: Item average score.

Table 3. Involvement in Science learning & Knowledge: gender and type of School.

Involvement in science learning & knowledge: gender and type of school						
				Type of school		
				State	Semi-private	Total
Never	Gender	Male	Count	1		1
			% of total	100,0%		100,0%
	Total		Count	1		1
			% of total	100,0%		100,0%
Rarely	Gender	Male	Count	21	21	42
			% of total	23,9%	23,9%	47,7%
		Female	Count	16	30	46
			% of total	18,2%	34,1%	52,3%
	Total		Count	37	51	88
			% of total	42,0%	58,0%	100,0%
Often	Gender	Male	Count	106	126	232
			% of total	24,3%	28,9%	53,2%
		Female	Count	87	117	204
			% of total	20,0%	26,8%	46,8%
	Total		Count	193	243	436
			% of total	44,3%	55,7%	100,0%
Always	Gender	Male	Count	29	56	85
			% of total	15,8%	30,4%	46,2%
		Female	Count	32	67	99
			% of total	17,4%	36,4%	53,8%
	Total		Count	61	123	184
			% of total	33,2%	66,8%	100,0%
Total	Gender	Male	Count	157	203	360
			% of total	22,1%	28,6%	50,8%
		Female	Count	135	214	349
			% of total	19,0%	30,2%	49,2%
	Total		Count	292	417	709
			% of total	41,2%	58,8%	100,0%

Table 4. Transfer of learning: overall response.

		Frequency	Percentage	Valid percentage	Cumulative percentage
Scale	Never	16	2,3	2,3	2,3
	Rarely	161	**22,7**	22,7	25,0
	Often	437	**61,6**	61,6	86,6
	Always	95	**13,4**	13,4	100,0
	TOTAL	709	100,0	100,0	

their awareness of environmental issues and the use of natural resources (2.96), their interest in scientific discoveries and advances (2.88) and, finally, the frequency with which they watch TV programmes about science (2.16).

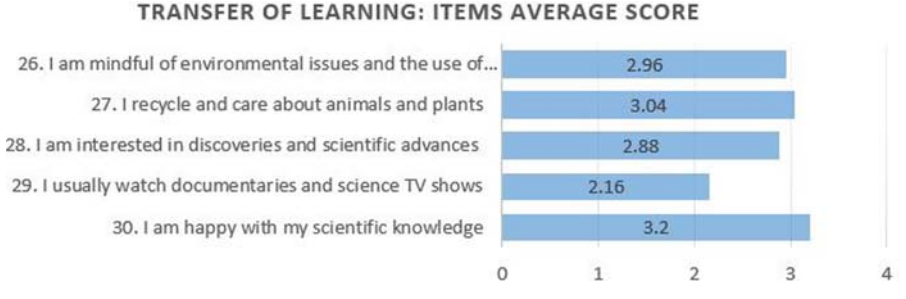

Figure 4. Transfer of learning: Item average scores.

Although female students chose *always* (228) more times than males (209), in general terms, there are no significant differences between the genders when looking at the students' perceptions of the transfer of scientific learning.

We can observe differences between type of school in all the categories of responses, but particularly for the main options (*rarely* and *often*), to which most of the responses are allocated. Students from state schools gave the response *rarely* (55.9%) more often than those from semi-private schools (44.1%). There is a more significant difference if we look at the response *often*, with 60.4% of students from semi-private schools and 39.6% from state schools giving this answer. Finally, 56.6% of the students from semi-private schools gave the response *always*, as opposed to 43.2% of the students from state schools. The data suggest that the students from semi-private schools have a better perception of their capacity for transferring scientific learning than students from state schools.

Looking at the relationship between gender and type of school with regard to the transfer of learning as illustrated in Table 5, we found that girls (31.6%) and boys (28.8%) from semi-private schools give the response *often* more than girls (19%) and boys (20.6%) from state schools. The more negative response of *rarely* was given more by girls (26.7%) and boys (29.2%) from state schools than girls (18.1%) and boys (26.1%) from semi-private schools, and we can also observe some small differences between the genders. There are no significant differences between the genders within the same type of school but some differences can be observed when the responses across different types of school are compared. Our data suggest that girls from semi-private schools have a better perception of their ability to transfer their scientific learning to contexts outside of school.

Table 5. Transfer of scientific learning: Gender and type of school.

Transfer of scientific learning: Gender and type of school						
				Type of school		
				State	Semi-private	Total
Never	Gender	Male	Count	4	6	10
			% of total	25,0%	37,5%	62,5%
		Female	Count	3	3	6
			% of total	18,8%	18,8%	37,5%
	Total		Count	7	9	16
			% of total	43,8%	56,2%	100,0%
Rarely	Gender	Male	Count	42	47	89
			% of total	26,1%	29,2%	55,3%
		Female	Count	29	43	72
			% of total	18,0%	26,7%	44,7%
	Total		Count	71	90	161
			% of total	44,1%	55,9%	100,0%
Often	Gender	Male	Count	83	126	209
			% of total	19,0%	28,8%	47,8%
		Female	Count	90	138	228
			% of total	20,6%	31,6%	52,2%
	Total		Count	173	264	437
			% of total	39,6%	60,4%	100,0%
Always	Gender	Male	Count	28	24	52
			% of total	29,5%	25,3%	54,7%
		Female	Count	13	30	43
			% of total	13,7%	31,6%	45,3%
	Total		Count	41	54	95
			% of total	43,2%	56,8%	100,0%
Total	Gender	Male	Count	157	203	360
			% of total	22,1%	28,6%	50,8%
		Female	Count	135	214	349
			% of total	19,0%	30,2%	49,2%
	Total		Count	292	417	709
			% of total	41,2%	58,8%	100,0%

We found that when asked about their transfer of scientific learning, the more positive options of *often* and a*lways* appear more in the responses given by students from semi-private schools (60.4% and 56.8.%, respectively). As far as gender is concerned, the girls from both types of school show a slightly more positive perception than boys.

The results for the two types of school are very similar for the two main variables (involvement in science learning and learning transfer) when they are explored more in depth. There is a very positive response to students' involvement in scientific learning and its transfer, although the latter is more established in semi-private schools. In general, the participants show a very positive attitude towards science, emphasising their awareness of environmental issues and how natural resources are being used, and highlighting their daily involvement in activities such as recycling and caring about animals and plants that help to protect the natural environment. We understand that this is something students have learnt in school and then transferred to their daily lives. Therefore, in school, students develop a sense of responsibility for taking care of the natural environment. Their newfound environmental awareness and increased knowledge then transcend the boundaries of the classroom and the school and translate into usefulness in the wider community, enhancing their knowledge of the applicability of science at the same time.

4. Discussion

Capacity for applying scientific knowledge

First, we found that sixth-grade primary school students who participated in this study are able to identify scientific issues, develop their own appreciation of the natural environment, understand the impact of human activities on the environment and take decisions about they interact with it, and apply scientific knowledge. They understand basic scientific texts and are able to transfer and apply their knowledge to enhance their scientific learning. In general, the participants in our study do show an interest in science. This is something also evidenced in previous results from PISA, which showed that the scientific knowledge of Spanish students had improved year on year since 2006. However, this progression was disrupted in 2018 when Spain received its worst test results for science education since testing began in 2000 (OECD 2018), raising many questions inside and outside of the education community (Torres Menárguez and Silió 2019). In this respect, we need to bear in mind that the results presented in this article are for students aged between 11 and 12, whereas PISA analyses information from children who are 15 years old. Therefore, we cannot make a direct comparison between the latest results from PISA and the results of our study. Nevertheless, drawing on Mellado and Blanco (2013), we understand that the implications of the results of our study are expected to be visible in the longer term. We argue that the latest PISA outcomes should not discourage teachers, school leaders and policy makers from continuing to support the engagement of primary school students in scientific learning that is transferable to daily life. There is a risk that negative results in international assessments will be used to challenge or interrupt existing long-term domestic policies, innovative practices and certain pedagogical initiatives (Niemann, Martens, and Teltemann 2017). As discussed in the introduction of this article, there is evidence of the positive impact on students' learning experiences and the resulting outcomes when a pedagogical strategy aimed at personal involvement of the student is adopted, thereby enabling the transfer of learning to daily life situations (e.g. see: García-Carmona and Acevedo-Díaz 2018; Georghiades 2000; Zembylas 2016).

Gender difference and type of school

The second point is concerned with gender differences. Dapía, Escudero-Cid, and Vidal (2019) argue that in Spain the gender differences between primary school students in relation to scientific learning have been underexplored. Our study contributes to this discussion by showing that

boys and girls aged between 11 and 12 share a positive attitude towards science. For years, women have been underrepresented in the scientific professions (Bamberger 2014; Watts 2014); however, our study provides arguments to indicate the gender gap in science is changing. Our data suggest there is no significant difference between the genders with regard to their perceptions of science and the transfer of scientific knowledge, and this is something that evidences a change in relation to gender differences. This positive tendency is also observed in the latest PISA reports. Although the difference between European countries does not give cause for concern, there is still work to do because, on average, across OECD countries, it has been shown that girls are slightly outperforming boys in science (OECD 2020). With this in mind, we agree with Osborne, Simon, and Collins (2003), who suggest that nurturing a positive attitude towards scientific learning in the early stages of education, paying special attention to transforming stereotypical views, should make a contribution towards ensuring a more balanced presence of the genders in scientific professions.

There are some differences between state schools and semi-private schools. The students from semi-private schools enjoy more opportunities for transferring their scientific learning than do students from state schools. As both types of school follow the same curriculum, the difference lies in the school organisation and the emphasis that semi-private schools put on adding value to the curriculum, for example, through offering extracurricular activities and/or introducing innovative teaching and learning methods. Differences between semi-private schools and state schools have previously been explored, and it has been noted that students from the former tend to have better perceptions of their educational experiences (e.g. Gibson and Davies 2008). We suggest that this issue should be explored in more detail and that policy makers and education authorities should pay attention to it, because there is a risk that differences between types of school may cause an even more unbalanced education system (Ball 2017).

Improve scientific learning through its application

Finally, the participants in our study see themselves as able to apply what they have learnt about science in school to common situations they may experience in daily life. They are interested in participating in different scientific activities and they are pleased with their scientific knowledge, knowledge that they find useful. As explained by Driver (1996), these first steps in primary education are necessary if we want to develop a more scientifically literate society, a process that according to Rosales Sánchez, Rodríguez Ortega, and Romero Ariza (2020) requires the student to have specific knowledge, make a cognitive effort and, as has also been suggested in this study, be able to apply his/her learning. Students' views on the methodology used by their teachers for science instruction show the lowest scores of the questionnaire. We recognise the challenges of teaching science, but our findings suggest that teachers can still do more to provide a learning experience that ensures primary school students acquire scientific understanding and the ability to transfer scientific knowledge to contexts outside of school. In their book, Harlen and Qualter (2018) discuss pedagogies that teachers can adopt for this purpose and we can summarise these into three strategies: teaching through inquiry (using scientific material and information and communication technologies); introducing assessments that support the learning process; and taking advantage of the learning opportunities provided by visits to natural spaces, places of work, science centres and museums. The aim is that with the help of the teachers, students are able to reflect on their perception of science so that later on they can formulate questions related to scientific issues that emerge during their daily lives, creating a reciprocal learning process. Primary students are active learners. This means that the teaching and learning processes must be based on active and interactive methods. These should include activities that stimulate and motivate the development of a critical, but positive attitude towards science that may influence students' future career decisions (Millar and Osborne 1998).

4. Conclusions

If we consider the findings presented in this study, together with the arguments presented in the literature, in a few years we could expect to see an increase in the interest in scientific careers, moreover, an interest that includes more women. To maintain this tendency, it is vital that the education community makes the process of acquiring scientific understanding, knowledge and skills meaningful for daily life.

We can identify two main limitations of this study. The first is its context and scope. This study considers the views of students from Spain and, more specifically, from the area of Castilla y Leon. It is not our intention to claim that this is representative of the situation in the country as a whole or that the results mirror what happens in an international context. We understand that to make this kind of claim we would need to expand our study to include more contextual variables. However, we believe that this study contributes to current debates about the interest young people have in science and scientific careers, showing that changes in how science education is delivered are already having an impact on how primary school students perceive and engage with science. In a more controversial sense, we invite practitioners to use the results of studies, such as the one discussed in this article, to develop pedagogic arguments that can be used to challenge short-term administrative decisions based on the latest international assessment results. The second limitation of the study is the constraints imposed by the methodology. We have presented a simple but accessible statistical analysis that provides the reader with an easy understanding of the data. To some extent, it may have limited the potential of the study if it had presented a more sophisticated analysis, because the one contained herein is more accessible to a greater number of members of the education community.

To conclude, we suggest that more support needs to be put in place to avoid an increase in the gap between the science education delivered at semi-private schools and that offered by state schools, because this could create major socioeconomic divisions in the future. Encouraging teachers to use teaching and scientific resources differently and providing more opportunities for visiting and experiencing the world of science seem to be learning strategies that have not yet been fully exploited. Therefore, we invite teachers to introduce relevant changes that will help students attach new meanings to their school learning and lead to a more positive attitude towards science. It would help them to navigate secondary education more confidently and, perhaps, arouse a strong passion for science.

Note

1. A semi-private school in Spain (*Colegio concertado*) is a private school subsidised by the government. This type of school implies a public–private partnership. Generally, students do not pay fees for attending these schools at compulsory education levels.

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