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Initial and In-Service Teacher Education in Sciences — What Portuguese Kindergarten Teachers Say about Their Teaching Practices

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Abstract: Education in sciences should contribute to everyone's scientific literacy and encourage their democratic participation in informed decisions making.

In a time when we claim the educational relevance of science, promoting its early start among three to six-year-old children is necessary to create appropriate strategies to guide educators towards practices which are consistent with the current national science curriculum guidelines.

The objectives of this study are twofold. Firstly it aims to depict the type of training kindergarten teachers of the district of Bragança receive in the field of sciences. Secondly it intends to clarify didactical and pedagogical aspects set out by educators in the context of experimental sciences in their everyday workplace.

The data was gathered through questionnaires, in the universe of the kindergarten teachers in this district. It is based on a case study of descriptive and interpretative nature.

The overall results show that they are satisfied with the experimental sciences training they received in their initial degrees, although a more practical training is needed to implement sciences in their everyday practice, as well as more scientific and pedagogical resources in order to make them feel more confident regarding education in sciences.

Key words: education in sciences, educational practices, in-service teacher training and practical work

1. Introduction

Education in sciences in early life is essential for the development of the child, becoming an important asset to exercise citizenship. The importance of teaching sciences to young children is indisputably argued by Ellis and Kleinberg (2000) who claim that sciences in pre-school education contribute to the children's ideas of the reason why science is carried out, what it involves and that science is something they are able and wanting to perform. This creates a predisposition for a more scholarly science.

In this sense it is essential to invest in the training of practitioners in order to promote the teaching of science. Educators need "opportunities to build knowledge, develop skills, values and attitudes necessary for effective

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innovations, particularly those which are appropriate and coherent with the promotion of literacy and culture" (Pedrosa & Henriques, 2003, p. 278). According to the research carried out by Portugal (2009) it is necessary to work in a "qualitatively higher manner in early childhood education", in order to achieve the adequate promotion of the teaching of science.

Hence, the educator will be able to respond adequately to the diversity of childhood experiences, present in different educational contexts, and will have the know-how of the content areas he/she addresses and use documentation as well as assessment strategies which support the organization of the educational environment, the curriculum development and the teaching/learning processes. In this way, educators can contribute to the quality of education in sciences, which will, in the long term, bring substantial educational, social and economic benefits (Barnett, 2004).

Following the research undertaken by Cachapuz, Praia, Paixão & Martins (2000) we have to develop a demanding training work with teachers, "capable of leading to changes of perspective and eventually to new practices — innovative practices, by the attitude and values they introduce, in order to promote the culture of science education" (p. 122).

According to Martins (2002), it is necessary to involve teachers in the deepening of global issues, of multi and interdisciplinary nature, developing their interest in non-formal learning. The same author states that this may be the path to a new participation by teachers in scientific literacy.

However, we must also take into account what is said by Tenreiro-Vieira (2010). She explains that in order to these and other reforms to take place in education, just as any other changes or reorganizations, they cannot be imposed on teachersfrom above or the outside. This would cause lack of belief in the reforms themselves and subsequently they would not be implemented efficiently. Therefore, to accomplish a reform or innovate in any area it is absolutely necessary to invest in in-service teacher training (Altet, 2000; Tenreiro-Vieira & Vieira, 2004; Saracho & Spodek, 2007; Harlen & Qualter, 2009; Formosinho, Oliveira-Formosinho & Machado, 2010).

In this sense, the training of educators and teachers in general, and the training in the field of sciences in particular, should be carried out with the intervention of the subject in their own training process, since "the way science is taught has to do with the way one conceives the science that is taught, and the way one thinks the other learns what is taught (...), it is pertinent to strengthen aspects bearing in mind the epistemological training of teachers" (Cachapuz, Praia & Jorge, 2002, p. 55).

These principles are consistent with the ideas of Martins Veiga Teixeira, Tenreiro-Vieira, Vieira, Rodrigues & Couceiro (2006) and Martins, Veiga, Teixeira, Tenreiro-Vieira, Vieira, Rodrigues, Couceiro & Pereira (2009), who advocate that in addition to investment in initial training it is necessary to develop measures to provide training for all practitioners about the teaching of sciences. This is clearly justified nowadays, especially because the "Learning Goals" for the pre-school have recently been published in Portugal, and specifically in the domain of the "World Knowledge", which nowadays includes the sciences (Portuguese Ministry of Education, 2010).

Thus, we consider the education in sciences in pre-school education emergent and necessary. This will lead to a change in the actual practice of teachers so that they realize that to educate in sciences is to educate for life. The development of scientific skills is therefore rather relevant and becoming aware of the benefits that this kind of education will have in the building of scientific skills and research will surely aim at a more conscious scientific literacy.

This is the background which frames our decision to obtain a general knowledge about the initial and in-service training of kindergarten teachers in the district of Bragança, because it is crucial to better understand

their practices, their needs and their expectations so that we can answer to the identified situations.

2. Objectives

At this stage of the research, and in this context, we pursue the following objectives:

(1) to describe the training, both initial and in-service, offered to kindergarten teachers in the district of Bragança in the field of sciences;

(2) to clarify aspects of the didactic and pedagogical practices set out by educators in the context of experimental sciences for kindergarten teachers.

3. Theoretical Framework

Organizations like the OECD (2005) and researchers like Elliot (2006) consider the training of educators is critical to professional development and to the creation of environments where all participants feel comfortable and capable of actively intervening in the educational process. According to Ramos & Nunes (2007) the qualification of educators and their training are key factors in order to determine the educational quality and its improvement.

As such, it becomes necessary to provide educators and teachers with adequate and innovative initial and in-service training programs throughout their career (Rebelo, 2004). According to Altet (2000), it is through this kind of training process that teachers build their professional identity, thus becoming agents “capable of thinking in action, to adapt themselves and to dominate any new situation” (p. 27). The same author adds that training consists in “preparing the future teachers to adapt to all kinds of educational situations, and to learn how to continuously adjust its action to a perpetually changing reality, in developing attitudes that make them able to change and adapt” (p. 177).

Supported by statements of the authors who have studied this issue, namely Henderson (1979); Formosinho (1991), Rodrigues & Esteves (1993), Ribeiro (1993), Leite (2005) and Correia & Flores (2009), we can consider in-service teacher training as a process that aims at improving skills, knowledge, techniques and attitudes necessary to pursue the teaching profession. These types of programs must take place throughout the career, following the acquisition of initial certification, thus pursuing the development and improvement of quality in education. It is an instrument to facilitate teachers’ skills, to break their isolation and opening doors to interact with local communities, and, finally, to structure and select the set of competences which should be acquired, regardless of the time they have been teaching.

In-service training should allow teachers to develop skills to deal with situations generated by social changes. Therefore we must consider in-service training in the light of a reflective paradigm of training (Leitão & Alarcão, 2006; Schön, 1987). That is to say, in-service teacher training have to be a continuous processes that regard reflection as the basis of professional performance and knowledge acquisition (Echeverria & Belisario, 2008).

In contrast, Feldman (2000) remarks that the implementation of innovative practices is only possible if the teachers feel uncomfortable with their own practices, if they want to take risks and are open to use different strategies from those they usually apply. It is in this perspective that education in sciences is particularly important. As concluded by Toplis, Golabek & Cleaves (2008), many teachers have spent decades trying to improve the results of education in sciences with a focus on the teaching and learning of knowledge and ideas, without much consideration regarding its practice. They therefore need support to make the transition that allows a dynamic and

transformative learning process which would have a positive impact in early childhood settings.

According to Fensham (2002), it is essential to approach the science that is taught in school to the real needs and interests of students and society. Consequently, education in sciences should stimulate the fascination for science, which is crucial for students to be able to engage in scientific and technological careers and also to contribute to a more global training, therefore becoming more effective in an integrated treatment of the problems and world situations (Galvão & Freire, 2004).

In this respect, we must take into account the research undertaken by Woolnough (1995) and Woolnough, Guo, Leite, Almeida, Ryu, Wang & Young (1997) who show that students are influenced in their choice of careers related to science and technology, not only by their family background and society, but also by school and by the role educators play.

This is why authors such as Martins & Veiga (2001), Osborne (2008) and Roden & Ward (2010) argue that all countries have an obligation to invest in science education in order to gain balanced, informed and scientifically well prepared adults, with skills that enable them to adapt to the demands of the modern society.

Scientific education is therefore a right of all citizens and should start as early as possible. DeBoer (2000) presents nine goals for education in sciences and scientific literacy, namely: (1) to teach and learn about science as a cultural force in the contemporary world, (2) to prepare for the labour market, (3) to teach and learn the science that has direct application to everyday life, (4) to educate informed citizens, (5) to teach science as a specific way of examining the natural world, (6) to learn science with an aesthetic sense, (7) to understand reports and discussions on science which appear in the media and in everyday life, (8) to prepare rightful citizens, and (9) to understand the nature and the importance of technology and of the relationship between science and technology.

Although some educators argue that sciences are difficult to teach and learn at an early age, a growing number of authors claim that education in sciences should start in the early years (Millar & Osborne, 1998). According to studies carried out by the UNESCO (2000) and the OECD (2007), all children should have the opportunity to learn about sciences in the early years in order to raise their level of scientific and technological literacy.

Education projects in sciences in the early years are based on ideas from authors such as Coltaman (1999) and Millar & Osborne (1998) who state: (1) science must be pleasant, (2) research skills should be identified and developed, (3) hands-on experiences are essential for the initiation in science, (4) Games can give an important contribution to scientific learning by providing opportunities for small researches in the classroom, (5) science provides conditions for the development of children's innate curiosity, (6) it promotes habits of careful observation about their world, (7) it encourages the use of precise language for descriptive purposes thus providing context for measurement practices and the use of numbers, and (8) science creates the opportunity to interact with a wide variety of natural phenomena and explore their behaviour.

In the process of reconstruction and development of better ideas, Harlen (2007) highlights that education in sciences should help children to become aware of their own ideas and to have access to the ideas of others in order to compare them. Moreover, or also helps the child to apply ideas (their own or others) when considering a problem or situation, and to prove its utility in particular situations, as well as to help children think critically about how ideas should be used and tested, and seek more effective ways to accomplish these tasks.

Johnston (2005) mentions that, in the first years of life, scientific concepts, skills and capacities of children are developed through exploring the world. In the same perspective, Coltman (1999) adds that children cannot acquire scientific concepts by just hearing about them. Direct exploration using all the senses and hands-on

experiences is the path to children's learning (Bóo, 2004).

That is why authors such as Martins (2002) consider practical research activities as an excellent way for children to develop their scientific skills. These activities always cover two kinds of understanding: concepts and processes. Since they are articulated with each other, they provide the individual with cognitive skills to solve the problems presented (Feasey & Goldsworthy, 1997; Caamaño, 2003; Martins et al., 2006).

In short, education in sciences in the early years of life is fundamental to the development of the child, being a clear asset for the exercise of their citizenship (Harlen, 2006; Johnson & Morris, 2010). Practical work provides not only the manipulation of material and techniques but also the possibility of developing a certain type of thought, which is clearly useful in other fields, for example in decisions-making and problem-solving (Lankin, 2006).

Therefore we consider educational practices essential to education in sciences starting in the early years. If there are educators who develop their didactic and pedagogical practices based on experimental, interactionist and social constructivist activities, which promote autonomous, supportive, active and responsible individuals, there is also the reverse. We all see the setbacks, such as professional instability and the lack of training in some areas, which now emerge from this issue and are reflected on education in sciences and quite clearly constitute obstacles to its application with small children. This situation can only be changed through the promotion of in-service training of kindergarten teachers.

4. Methodology

Following what we outlined in the objectives of the study, namely the description of initial and in-service training provided to kindergarten teachers in the field of science and the clarification of aspects related to the didactical and pedagogical practices of these professionals, we decided on an exploratory descriptive study.

Initially, we used a questionnaire in order to achieve information on the training and on the level of experimental work in sciences, which was offered during the initial degrees and in-service training programs to kindergarten teachers in the district of Bragança. At the same time, we also intended to get information about what they say about their own practices within the area of world knowledge, the manner and frequency with which they work this area.

To design the questionnaire we considered the opinion of Ghiglione & Matalon (2001), when they claim that to construct a questionnaire it is necessary to know precisely what we are looking for, to ensure that all questions are meaningful and that all different aspects are indeed addressed. In turn, Foddy (2002) argues that a survey by questionnaire should be based on three premises: "the researcher clearly defines the information he/she is looking for; the respondents have that information, the respondents can provide this information in the context in which the research is undertaken" (p. 27).

We were especially careful in the formulation of the questions, which in our view, are presented in a clear, brief and objective way.

After designing the questionnaire, we submitted a first version to a pilot group of three educators who were not part of the study universe. As a matter of fact this sample belongs to a nearby context and it had very similar characteristics to the population under study. This test allowed, among others, to check the understanding of the issues and if the language was understandable for the participants. In this process we asked the professionals to answer the questionnaire and submit suggestions to it as a whole and to each of the questions in particular. Despite

these indications, the educators answered without any difficulty and did made any suggestion, so we considered that the questionnaire was appropriate for the intended population, particularly in terms of language. Subsequently, we proceeded to the validation of the questionnaire in order to ensure the credibility of the study and to reduce errors. We sought for the opinion of two experts, one from the field of Methodology in Sciences and the other from the field of Psychology. We got some considerations regarding the sequence and relevance of some questions. In particular, they remarked that we should not include too specific information, such as the nature of the subjects, *workload* and contents that were addressed in their initial training, because they concluded that these issues were of no relevance for the study itself. They made proposals and suggestions to change the graphic design of the questionnaire to make it more appealing to participants. A first version had a rather condensed layout. This is an aspect that also must be taken into account in the design of such tools to gather information. After reviewing the experts' suggestions, we carried out the changes mentioned in order to make the questionnaire clearer and more accessible to the target-group.

In its final version, the questionnaire begins with a text informing the respondents about the main topic and objectives of the study, the purpose and use of the collected data and also a notice regarding anonymity. It also contains some brief comments on how the questions should be answered.

The body of the questionnaire is divided into three sections. The first concerns the personal characteristics of respondents; the second is related to their training and experience and, finally, there is a section with questions about their practices.

It consists mainly of closed questions, with only three open questions. The main advantage of the closed questions lies in the easiness of the data analysis, since they present a limited number of possibilities of response (Foddy, 2002). Besides multiple-choice answers, six questions, give the opportunity to respondents to complete one of the options. Three additional questions use scales to assess attitudes and opinions of the respondents. The open questions were designed so that respondents could give their opinions freely. These questions allowed us to gather more complete information on the matters addressed, such as on the importance and concept of experimental work and about the measures that educators indicate in the direction of improving their practices. This seemed the right option because these questions helped us understanding issues of great importance for other phases of this study: to establish if the educators consider the experimental approach of sciences in the kindergarten important and why; what their concept about experimental teaching is; and finally, to indicate measures that can help them improve their practice in the area of world knowledge by carrying out experimental activities.

The questionnaire was applied to all kindergarten teachers in the district of Bragança in May 2008. In order to treat the data collected through the questionnaire we used statistical analysis, with the help of the SPSS statistical package. In this context we must highlight the Kruskal-Wallisb test as an alternative to the ANOVA test, since the latter requires certain assumptions regarding the homogeneity of the variance along groups under study. The chosen test can be used to analyze either two or more samples from the same population or different populations or, similarly, the samples from populations within the same distribution (Maroco, 2003).

To see whether two variables are related to each other we used the Chi-Square test of Independence. The objective was to verify whether two or more independent samples differ with respect to a particular characteristic; usually in these cases the data is organized in tables of absolute frequencies, known as contingency tables.

In all statistical tests whenever the value obtained was less than 0.05 this allowed us to conclude that there is no dependence of the variables (Pereira, 2006).

Sometimes we had to turn to measures of association or correlation coefficients measuring the association between variables without any implication of cause and effect between them. In our study we used the *Pearson's correlation* coefficient which measures the degree of linear association between two continuous variables with bivariate normal distribution, and the *Spearman's correlation* coefficient which is a nonparametric measure of association between two ordinal variables.

The questionnaire was used with 213 subjects with age range from 24 to 59 years. The range between 31 and 45 years is of more importance, because it includes 40.2% of the respondents. Of the remaining, 18.6% are aged between 46 to 50 years, 9.8% are between 25–30 years and 5.1% are over 50 years.

5. Presentation and Discussion of Results

Of the total of 213 professionals we obtained 194 answers which correspond to 91.5% of the sample of the participants. This value varies for each question according to the number of non-answers. Of the 194 kindergarten teachers who answered to the questionnaire, only one was male and the others female.

The results outlined in Table 1 refer to the degree of satisfaction of educators in relation to the initial training obtained in the field of experimental sciences. To better quantify the satisfaction of the respondents we calculated the average rank for each question and then the overall average rank.

Table 1 Average Rank Relating to the Satisfaction Rate Related to Initial Training in Sciences

	Distribution of responses					
Response scale	1	2	3	4	5	AR
Adequacy of the work wad hours assigned to science subjects	15	51	83	26	2	2.7
Adequacy of the schedule assigned to the subjects of education in sciences /didactics/methodology	13	50	79	31	6	2.8
Presentation of content relevant to their practice	12	63	70	28	3	2.7
Planning and carrying out experimental science activities	20	61	80	13	6	2.6
Approach of appropriate strategies to the teaching of experimental science	18	61	75	19	3	2.6
Preparation acquired at the end of the degree to work with sciences in the Kindergarten	20	57	80	17	8	2.6
1 – Not at all satisfied; 2 – Slightly satisfied, 3 – Moderately satisfied 4 - Very satisfied, 5 - Extremely satisfied, AR - Average Rank						

Teachers reported a satisfaction rate of 2.6, 2.7 or 2.8, which is equivalent to 3 by approximation and corresponds to Moderately satisfied on the scale used. The overall rate also tends towards Satisfaction (2.7).

The satisfaction rate regarding initial training in sciences had an average score of 2.69, with a standard deviation of 0.75 for a sample of 165 educators. The minimum value obtained was 1 and the maximum was 4.5. Globally, we verified that educators believe that their initial training was quite satisfactory.

After this first approach we proceeded in order to find out their opinions regarding some aspects of the in-service training in sciences. To better quantify the opinion of educators surveyed we calculated the average ranks for each question and then the overall average rank (Table 2).

We noticed that the overall average rank is 2.7, which is equivalent to Satisfaction in the scale considered. The most common classification is Moderately satisfied, and there is a question with a 3.5 average rank, i.e., between Moderately satisfied and Very satisfied, thus concerning the importance of training in education in sciences. However, in the first three questions about the number of courses, about the easiness in attending these courses and the compatibility of schedules, the most repetitive classification is Slightly satisfied.

Table 2 Rank on the Average and Overall Satisfaction Rate of Educators with Regard to in-Service Training in Sciences

	Distribution of responses				
Response scale	1	2	3	4	AR
a) Frequency with which training courses are promoted in sciences	\	87	30	0	1.8
b) Easiness in attending such training courses	40	70	60	4	2.2
c) Compatibility between the schedule of the training courses and their own	43	55	62	6	2.2
d) Training courses' contribution to build and deepen their knowledge	13	16	60	79	3.2
e) Promotion of the training in work areas (themes) of their interest	16	46	83	24	2.7
f) Experimental nature of the approach to education in sciences	16	52	67	26	2.6
g) Importance of the training in education in sciences for their practice	3	9	60	103	3.5
h) Willingness to participate in a Training Program on the experimental approach to science in the Kindergarten	5	23	86	62	3.2
1 – Not at all satisfied; 2 – Slightly satisfied, 3 – Moderately satisfied 4 - Very satisfied, 5 - Extremely satisfied, AR - Average Rank					

For the score, with regard to in-service training, we obtained a minimum of 1, a maximum of 3.75, an average of 2.65 with a standard deviation of 0.52. Note that only 139 teachers responded to all questions on this item. Globally, educators quantify as "Moderately satisfied" their satisfaction rate with regard to in-service training.

Regarding the context of their teaching practices and the existence of a specific space and materials suitable for the work related to sciences, we show this data presented Table 3.

Table 3 Existence of A Specific Space and Appropriate Resources to Use Sciences in the Classroom

Existence	N.º of responses	Percentage
Yes	10	5,2
Temporary solution	40	20,6
Yes, but integrated in another area	60	30,9
No	70	36,1
No answer	14	7,2
Total	194	100

We found that 36.1% of educators indicated that there is neither a specific space nor resources to work on sciences. 30.9% said there is some space and resources, although they are part of other areas and 20.6% say that those spaces only exist on a temporary basis.

Then we present the results corresponding to the satisfaction rate of educators on the implementation of experimental activities in sciences, taking into account its practice *per se*. We also calculated the average ranks for each question and then the overall average Rank. Values are shown in Table 4.

Table 4 Rank of the Average and Overall Satisfaction Rate of Educators Regarding the Performance of Experimental Science Activities

	Distribution of responses				
Response Scale	1	2	3	4	AR
Cooperative participation adult/child in the planning of activities	8	34	113	29	2,9
Manipulation of materials by children	0	16	64	104	3,5
Active participation of children in the implementation of the activities	0	4	60	121	3,6
Interaction and cooperation among children	0	6	89	89	3,5
Interaction and cooperation between child/adult	1	13	78	90	3,6
Implementation of the activities in a large group (all the children in the classroom)	5	14	86	75	3,4
Carrying out activities in small groups (4/5 children)	5	25	92	61	3,3
Implementation of activities integrated in different spaces of the kindergarten	19	112	582	569	3,1
1 - None, 2 - Little, 3 – Some, 4 – A lot, AR - Average Rank					

When referring to carrying out experimental activities of sciences, the average ranks obtained are all above 3, with the exception of the cooperative participation adult/child which only presents a value of 2.9. The overall Average Rank obtained was 3.4, i.e., in the category Some. Besides there are still 4 items with values greater or equal to 3.5, in other words, approximately 4, which correspond to the category A Lot in the scale.

Later we proceeded to calculate the average score for each individual depending on the answers given. We obtained a minimum score of 2 and a maximum of 4. The average is 3.37 and the standard deviation is 0.38. As a consequence the satisfaction rate of educators on the implementation of experimental activities in sciences is medium.

Afterwards we questioned practitioners about the difficulty they encounter in relation to some aspects concerning the preparation and execution of experimental activities. We calculated the average ranks for each item and the overall Average Rank. These results can be seen in Table 5.

Table 5 Rank on the Average and Overall Degree of Difficulty of Educators in the Preparation and Implementation of Experimental Activities

	Distribution of responses					
Response Scale	1	2	3	4	5	AR
a) Scientific Domain of the contents approached	4	14	127	32	3	3.1
b) Planning and organizing activities	1	18	108	48	7	3.2
c) Selection of the content to address	2	22	98	48	10	3.2
d) Adaptation of the content to the age of children	8	28	81	54	9	3.2
e) Organization of the children	3	34	72	51	19	3.3
f) List of issues with the other areas	4	26	79	55	12	3.3
g) Acquisition of all necessary materials	16	41	90	30	5	2.8
h) Practical implementation of the activities with the children	5	21	99	44	11	3.2
Total	43	204	754	362	76	3.2
1 - Very high, 2 - High 3 - Medium 4 - Low, 5 - None; AR - Average Rank						

The overall average rank obtained was 3.2 which in the scale corresponds to medium. The lowest value, 2.8, is associated with the completion of materials. All the others are above 3, the highest being 3.3, in items e) and f).

When referring to their educational practices, in particular to the difficulties faced by educators in the preparation and implementation of experimental activities, globally we achieved a minimum of 1.25, maximum of 5, and an average of 3.16 with a 0.6 deviation. Thus, we conclude that the overall rate of difficulty is medium.

When teachers were asked to indicate measures that could contribute to improve practices within the area of world knowledge, namely the implementation of experimental activities, 66% suggested two measures; 7.2% one measure and 26.8% did not reply.

In Table 6 we present the content analysis of responses recorded by educators regarding the measures that can contribute to improving their practice within the area of world knowledge.

From the table above we highlight the great number of times that educators indicated the existence of more material resources and more training in the area, as measures to improve their practice. Although not so persistently, they also reported the need to have a pedagogical area suitable for the development of activities, and their personal need to deepen and develop an understanding of disciplinary content within the sciences.

Related to the number of experimental activities, we wanted to know if there is influence of the existence/absence of a specific space and resources to work on sciences. This is why we conducted a Chi-square Test of Independence. The results are presented in Table 7.

Table 6 Summary by Categories of Educators' Responses Regarding the Measures Which, in Its View, Can Help Improve Their Practice Within the Area of World Knowledge

Category	Subcategories	Indicators	n.º R
Proposed measures for improving practice	Within the professional and personal scope	Providing more disciplinary and teaching training	92
		Enabling practical training in context	6
		Entities responsible for the training	3
		Providing the scientific domain of the content	21
	In the scope of resource availability	Materials	113
		Social and human	11
		Financial/logistical	3
	In the scope of space management	Appropriate pedagogical space in the kindergarten	24
		Linked to non-formal education	7

Table 7 Chi-Square Test for the Existence of A Specific Space for the Sciences Regarding the Number of Experimental Activities Carried Out

	Statistical test	Degrees of Freedom	P-Value
Chi-Square Pearson	16,865	6	0.010
N	168		

In kindergartens with a permanent space for sciences most of the teachers made at least one experiment per week, in the remaining categories they performed from 1 to 3 activities per month.

The Chi-square Test allows us to remark that the existence of the permanent space and appropriate resources influence the frequency of carrying out experimental activities, because the p-value is less than 5%, that is, the educators who claim to possess an area of sciences carry out more experimental activities.

Taking into account the number of in-service training courses held in sciences we proceeded to the grouping of three categories: None, One and More than One course. A number of 81 teachers did not attend any course on sciences, 29 answered one and 12 attended more than one. The remaining 72 did not reply to the question.

Since we cannot apply the parametric ANOVA test due to the fact that the assumptions cannot be verified (normality is not the case), we applied the Kruskal-Wallis Test as the nonparametric alternative. The results are presented in Table 8.

Table 8 Kruskal-Wallis Test on the Satisfaction Rate in the Accomplishment and Carrying out of Experimental Activities Based on the Number of Training Courses in Science

	Score
Chi-Square	7,398
Degrees of Freedom	2
P-value	0.025

This test allows us to compare the average score for each group, having obtained a p-value of 0.025, which is less than 5%, and as such we find that there are differences between the groups. In this particular case we can say

that educators that have undergone training in sciences have a higher average score than the others.

We also intended to investigate if the score was related to the frequency of carrying out experimental activities in sciences. We therefore proceeded similarly to the previous case and so present the box-plot diagrams in Figure 1.

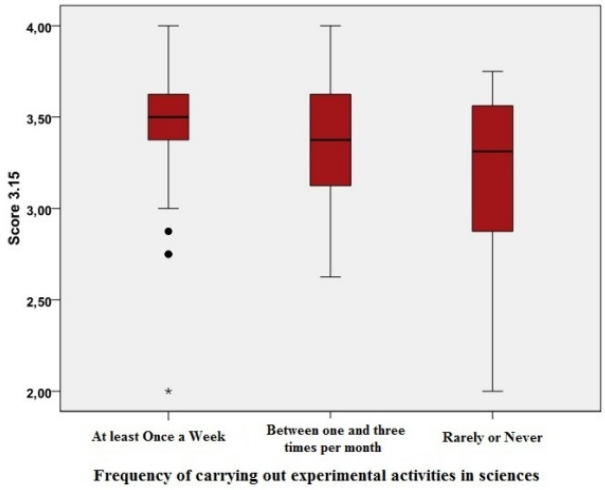

Figure 1 Box-Plot Diagram for the Satisfaction Rate in the Accomplishment and Execution of Experimental Activities Depending on the Frequency of Experimental Activities

We observed a greater dispersion in the group of educators who rarely or never perform experimental activities and less in those who perform these activities at least once a week. It is also for them that the median value is the highest, almost 3.5. For these there are also three outliers (two moderate and one severe), values that are much lower than the others.

Then we applied the Kruskal-Wallis Test to compare the scores in the three groups of educators. The results are presented in the Table 9.

Table 9 Kruskal-Wallis Test on the Satisfaction Rate in the Accomplishment and Execution of Experimental Activities Depending on the Frequency of Implementation

	Score
Chi-Square	8,608
Degrees of Freedom	2
P-value	0,014

We obtained a p-value of 0.014 < 5%, so we must conclude that there are differences between the groups. Concerning their satisfaction rate in the accomplishment and execution of experimental activities, the group of educators who carry out more experimental activities in sciences, at least once a week, has a higher score than the others, especially in comparison to the group who never or rarely performed any experimental activities.

6. Conclusion

In conclusion, the results presented show that we were able to achieve the initially established objectives. Our aim was to depict the type of training kindergarten teachers of the district of Bragança receive in the field of sciences, as well as to clarify didactical and pedagogical aspects set out by educators in the context of experimenting sciences in their everyday workplace.

Thus, regarding the opinion of kindergarten teachers about the training on sciences offered to them in their initial training degrees, the majority considered it satisfactory. However, 32% rated the item corresponding to the "presentation of content relevant to their practice" as "Not at all satisfied" and 31% attributed the same classification to items relating to "planning and carrying out experimental activities in science" and the "approach of appropriate strategies to the experimental teaching of science".

Educators rate their satisfaction, with regard to in-service training in sciences, as "Moderately satisfied". Considering the practices listed by educators, we must highlight that the group of children, in most cases, is heterogeneous with respect to age (3 to 5 years old). 36.1% of educators said that there is no specific space and resources to work on the sciences in their classroom. We also checked that this aspect is related to the frequency of carrying out experimental activities. In other words, practitioners who carry out activities more frequently had a permanent space and appropriate materials to work on sciences in the classroom.

Those who attended training courses in sciences showed a higher score with respect to its practice and with regard to carrying out experimental activities in sciences, being these who carry out experimental activities more frequently.

In terms of the satisfaction rate in carrying out experimental activities in sciences, educators indicated that they had some satisfaction, however, admitted that they have an average degree of difficulty in the preparation and implementation of activities. Here we focus on the items relating to "organization of children" and "acquisition of all necessary materials" due to the large number of responses on the "high" degree of difficulty.

When asked which measures could help to improve their practice within the area of world knowledge, namely the implementation of experimental activities with the children, many mentioned the need for more training in this area and availability of material resources.

We also conclude that kindergarten teachers need more training in sciences to be able to implement the practical work of science in their educational practices on an everyday basis.

In short, the results obtained during this research show that kindergarten teachers in the district of Bragança recognize the potential in education in sciences and the interest of children for matters related to this area. However, their scientific and didactic limitation prevents them from addressing frequently and adequately the sciences in their practices. These aspects have confirmed the importance of in-service training in the professional development of kindergarten teachers. This is the reason why we began this research in the first place.

In this context, the training course we subsequently developed has the main purpose of providing a quality in-service training that allows educators to change their practices. This follows the direction of the guidelines for education in sciences in Europe. According to Osborne & Dillon (2008) the training of science teachers with knowledge and skills are the foundation of any education system in relation to formal education in sciences, so the in-service education of teachers should be a priority policy in Europe.

The same authors mention that education in sciences in the early years should focus on the investigative work and "hands-on" and not only focus on memorizing concepts. This idea is also shared by Martins et al. (2009) when they state that effective implementation of the activities should focus on active, participative and participated methodologies, to encourage the child's enthusiasm.

7. Implications of the Study

At this point it is important to remember that kindergarten teachers indicated to have little training in sciences

to use it on an everyday basis. This is way a further training programme in this area is necessary to enable them to address these issues in the context of its adequate didactic and pedagogical practices. In order to achieve this we believe it is essential to rethink the initial training curricula for kindergarten teachers. As such we suggest the introduction of more content and didactic scientific knowledge which allows these teachers to develop practical and experimental activities in the contexts of their pedagogical activity.

With regard to in-service training, we believe that the proposed actions should meet the needs felt by educators and should also focus on the areas in which they consider themselves to be less prepared. As indicated by the data these are the cases of the world knowledge area, where the sciences are included.

Following the premises of our study, we believe it is important that in-service training must be presented and developed with all its potential, i.e., a training extended in time, with bridging the initial and in-service training. This can trigger a cooperation between educators, favouring the sharing of experience, the upgrading of knowledge and the use of adequate and diversified resources. In short, this change could promote innovative didactic and pedagogical practices, which take into account the full potential of the teacher/child relationship.

Without a qualified education in science the personal growth of a citizen with the ability to make an informed reading of the world and to participate freely and democratically in the development of the societies is not possible. In this sense, we found that in-service teacher training in general, and of the kindergarten teachers in particular, must assume a decisive role and to meet the modern society needs.

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