

Science Education: how some Brazilian and international journals approached the theme in 2010-2014

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Abstract

Quality researches about Scientific Education (SE) can contribute to its real inclusion on citizen formations. Therefore, the aim of this article was investigated the profile of SE researches published on some academic journals, three Brazilian and four international ones, during 2010-2014. We investigated publications that mentioned SE (or Science Literacy) on their titles and keywords. Teaching-Learning was the most frequently approach on SE articles. Teachers training, non-formal spaces of teaching and adult education was also reported, however in lower frequencies. Most of articles discussed the subject Science and not specifically Biology, Chemistry or Physics. The amount of annual publications on the SE was lower on Brazilian journals when compared to international ones.

Keywords: Scientific Education; Scientific Literacy; Academic Researches; Academic journals.

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Introduction

Although it's not easy to define Science, Gilbert (1991) describe it as a process of conceptual predictive model's construction. Ziman (2000) postulated that it's a way to produce knowledge, and its social standards are inseparable from epistemic standards. Chalmers (1999) published an interesting and complete review about Science and its approaches and relate them to different periods and a variety of philosophers.

Actually, Science is over rated and, apparently, it is a widely held belief that there is something special about it and its methods (Chalmers, 1999, p.17). As a consequence, there is strong, and many times uncritical, belief in Science and in its products. However, it is known that Science can be questioned, as well as its benefits are not evenly distributed among countries. Unesco (2000), for example, states that the scientific development of nation becomes something so powerful that actually the distinction between rich and poor people is also based on the capacity to develop (or not) this kind of knowledge. Therefore, it is important to people to be critical about Science and its process and products.

In 1985, Paul Hurd presented the term "Scientific Literacy", that promotes intense discussions and debates at the academy, since definition involved some polemic and controversies (Laugksch, 2000). Since that, other definitions have been presented. We chose, for the present article, the Hurd's (1998) definition, which states that a scientifically literate person is, among other aspects, capable of critically analyzing the Science and its products and also establish relations between them and their own everyday life. We do not differentiate the terms "Scientific Literacy" and "Science Education", although some authors distinguish these expressions.

Unesco (2000) defends that Science Education (SE) is a key requirement for democracy. Therefore, it is believed to be important that the school practice is not focused only on the passing content, but it need to provide the development of more critical students (Hurd, 1998). Based on the importance of Science and SE, we believe that the university help the society to discuss about SE, using it as research subject. Additionally, the promotion and dissemination of this theme researches can contribute positively for the effective presence of SE in citizen's formation. Therefore, we intend to investigate if SE have been focused on academic researches and which approach has been used in these studies.

Objectives

This work aims to contribute to the knowledge about the profile of researches involving SE on academic journals. The specific aims were: 1) identify articles that mentioned SE (or Science Literacy) on their titles and keywords published in 2010-2014 on journals with high impact on

Education area, as well as on the special number of *Procedia – Social and Behavioral Sciences* related to the Symposium of the International Organization for Science and Technology Education (IOSTE) in 2014; 2) calculated the amount of researches published about this subject in those journals; and 3) Identify the main approaches of these researches.

Methodology

The present research can be described as an investigation with mixed approaches (Lankshear and Knobel, 2004). We chose six journals in Education area with high score on the classification of Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) in 2014. This agency coordinates and evaluates under graduation and post-graduation courses in Brazil. The "Qualis" program evaluated journals in each area of knowledge and these publications received grades from A1-highest grade, to C-lowest grade (www.periodicos.capes.gov.br). For this research, we selected only educational journals classified as Qualis A1:

- Brazilian journals - "Ciência e Educação" (Ci&Ed); "Ensaio - Pesquisa em Educação em Ciências" (EPEC); and "Educação e Sociedade" (Ed&Soc);
- Three international journals, "Science & Education" (Sc&Ed); "International journal of Science Education" (IJSE); and "Teaching and Teacher Education" (T&TEd).

As we discussed earlier, we also investigated studies published in *Procedia*, related to IOSTE Symposium (2014), because of the importance of this scientific event, which gather researchers from all around the world.

We investigated articles that mentioned the following expressions related with SE on their titles or keywords: "Educação Científica", "Alfabetização Científica" and "Letramento Científico", for Brazilian journals, and "Science Education" and "Scientific Literacy" for international journals, including *Procedia*. We research these expressions in all article in each one of the journals.

After finding the articles with the SE expressions ("Science Education", "Science Literacy" or "Educação Científica", "Alfabetização Científica" and "Letramento Científico"), we read these selected articles abstracts and the data were analyzed and quantified. We investigated about subject area (Science, Biology, Chemistry, Physics) and by research approaches. The results of this procedure will be detailed in the next topic.

Results and discussion

It has been found a total amount of 228 articles that mentioned SE expressions (2010-2014) on their title or keywords in the six selected journals (Qualis A1). Additionally, we also found 13 articles from the journal *Procedia* in 2014, which results in 241

articles, nearly 11% of all investigated publications (Table 1):

TABLE 1

	Ci&Ed	Sc&Ed	EPEC	IJSE	T&T Ed	Procedia	Total
Published articles	285	354	152	578	709	44	2122
Articles that mentioned SE expressions	23	46	9	134	16	13	241

Table 1. Total number of articles published in the selected journals and number of articles that mentioned SE expressions on their title or keywords.

The Brazilian selected journal has some features: the first volume of Ci&Ed was published in 1998, releasing two publications per year until 2003. Between the years of 2004 and 2010, this journal published three annual volumes and, since 2011, it published four volumes per year with an average of 15 articles per volume. About EPEC, it focused on publishing researches related to SE. Its first publication was in 1999, with five annual volumes. Since 2010, this journal has had a reduction to three annual publications, with an average of 10 article per volume. The third Brazilian researched journal, Ed&Soc, has been published since 1978 and has three annual publications, with some special volumes eventually published. Considering this brief presentation, Figure 1 shows the percentage of work related to Science Education found in the analysed period. We could not find SE articles on Ed&S.

About international journals, the Sc&Ed focus on History, Philosophy, and Sociology of Science. The first release was in 1992 and, until now, the journal published 24 volumes, with a total of 142 articles.

The second international journal, IJSE, focus on Curriculum, Education and Science Education. The first volume was published in 1987 and, to this date, 35 volumes have been made available with an approximate current rate of 18 numbers per year. The third international journal, T&TEd, is multidisciplinary. Around 53 volumes were published until now, with an average number of four volumes per year. Procedia has been published since 2009, and by the year 2016, have been published about 221 volumes. According to this journal information, articles of conferences are included in the journal provided as long as they are original and meet certain quality criteria, which is evaluated by reviewers. Nevertheless, this last journal has no impact factor. From this brief description, the Figure 2 shows the percentage of studies related to SE present in the international journals, between 2010 and 2014, as well as the publication found in Procedia in 2014. Over this period, there is a decrease in the number of articles published on IJSE. However, this is not true to Sc&Ed and T&TEd.

FIGURE 1

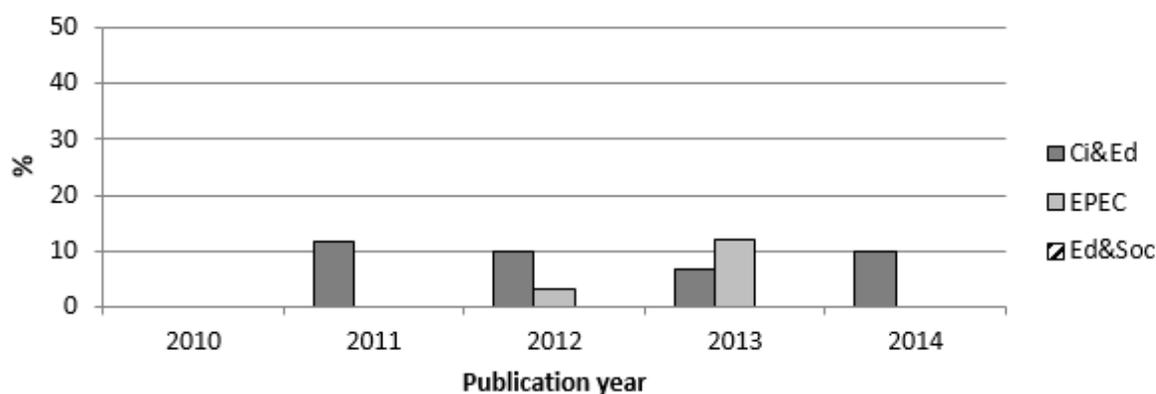


Figure 1. Percentage of articles that mentioned SE expressions on their title or keywords in Brazilian journals between 2010 and 2014.

FIGURE 2

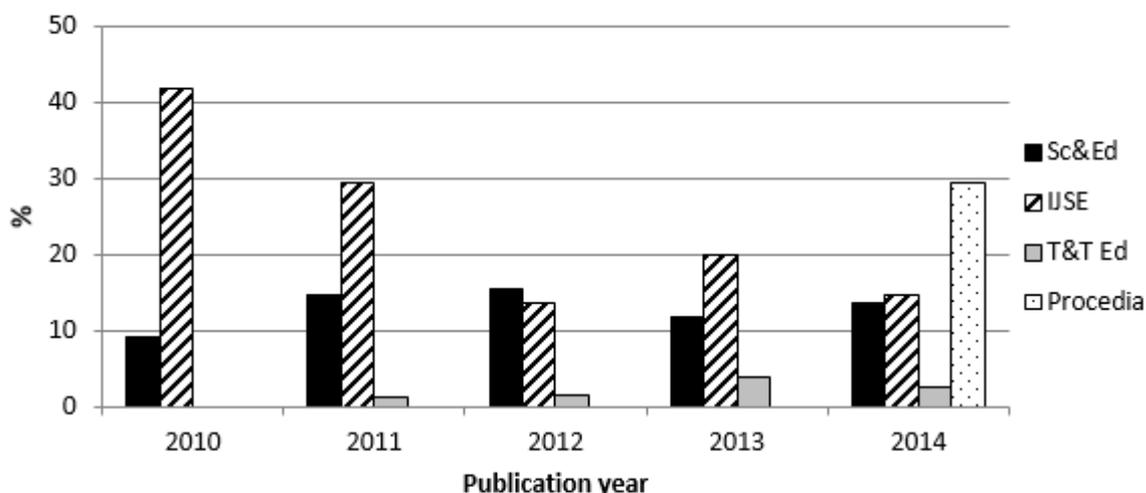


Figure 2. Percentage of articles that mentioned SE expressions on their title or keywords in International journals between 2010 and 2014.

Results shows that most of articles are about Science in general (Table 2, Figure 3), regarding the approaches focused on these articles. "Teaching and Learning in basic education" was predominant (Table 2, Figure 4).

FIGURE 3

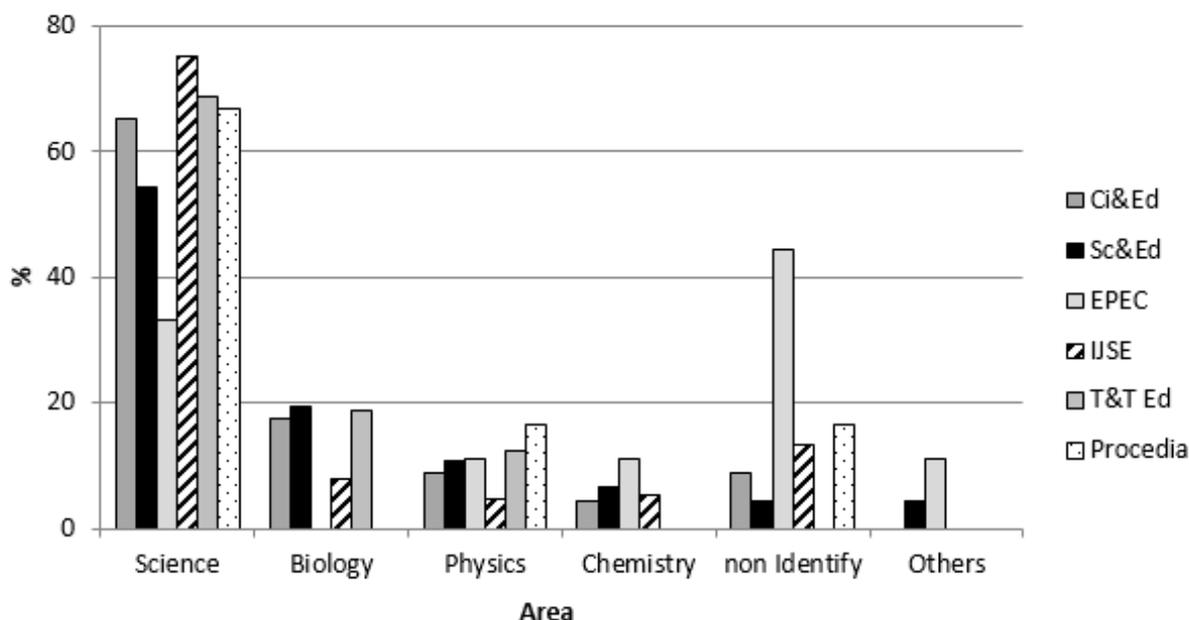


Figure 3. Main subject areas present in articles that mentioned SE expressions on their title or keywords. (percentage per journal).

FIGURE 4

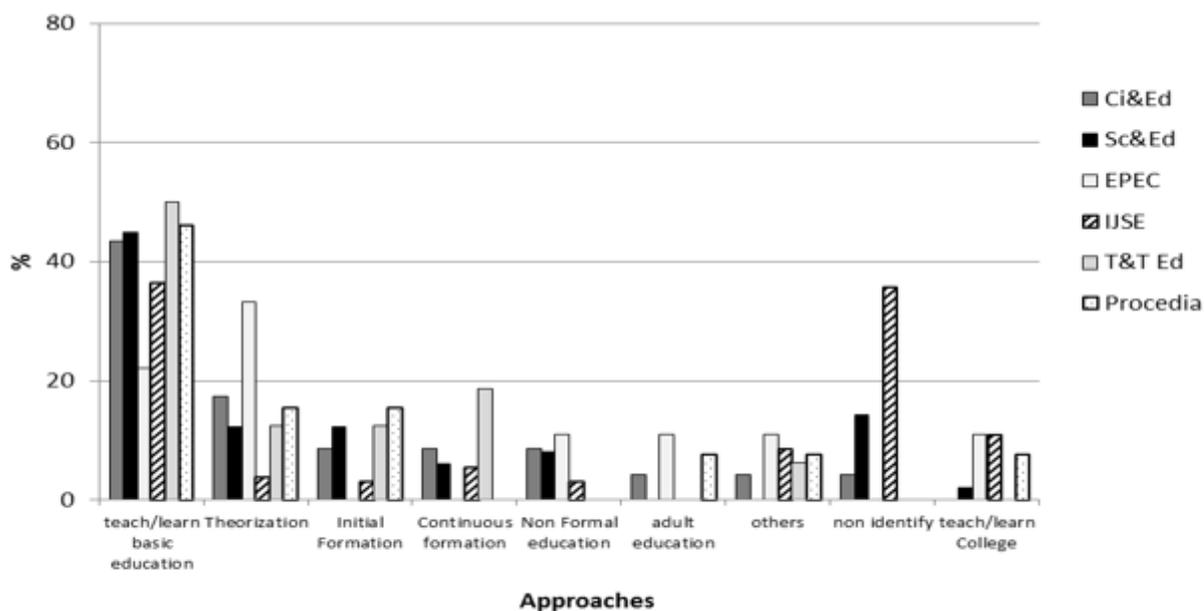


Figure 4. Main research approaches present in articles that mentioned SE expressions on their title or keywords. (percentage per journal).

TABLE 2

	Ci&Ed	Ed&Soc	EPEC	Sci & Ed	IJSE	T&Ted	Procedia
Total of articles that mentioned SE expressions (%)	8,1	0	5,9	13,2	23,1	2,2	29,5
Area (%)							
Science	65,2	0	33,3	54,3	75,1	68,8	66,7
Biology	17,4	0	0	19,6	7,7	18,8	0
Physics	8,7	0	11,1	10,9	4,6	12,5	16,7
Chemistry	4,3	0	11,1	6,5	5,4	0	0
Unidentified	8,7	0	44,4	4,3	13,2	0	16,7
Others	0,0		11,1	4,3	0	0	
Approaches (%)							
Teaching/Learning in basic education	43,5	0	22,2	44,9	36,4	50,0	46,1
Educational theory discussion	17,4	0	33,3	12,2	3,9	12,5	15,4
Initial Formation	8,7	0	0	12,2	3,1	12,5	15,4
Continuous formation	8,7	0	0	6,1	5,4	18,8	0
Non-formal Education	8,7	0	11,1	8,2	3,1	0	0
Youth and Adults Education	4,3	0	11,1	0,0	0	0	7,7
Teaching/Learning in College	0,0	0	11,1	2,0	10,9	0	7,7
Other	4,3	0	11,1	0,0	35,7	6,3	7,7
Unidentified	4,3	0	0	14,3	8,5	0	

Table 2. Results about total number of articles mentioned SE expressions on title or keywords, subject area and approach obtained for each journal (data presented in percentage).

From the results, it can be seen that Brazilian journals show proportionally fewer articles about SE when compared to international journals (Table 1, Figures 1-2). Besides, during the established period, some Brazilian journals did not publish articles about SE. These results can be related to the late incorporation of researches about this theme in Brazil, when compared to other countries, as USA and European ones, for example. Unlike those countries, in Brazil the researches about SE started only in the 1970's, and it was recorded just about a thousand studies (Dissertations and Thesis) between 1972 and 2003, as highlighted by Santos (2007). Strengthening this hypothesis, we can see that the Brazilian journals that look upon SE also had a late creation, from the mid-1990s. This situation is very different from some international journals, like IJSE, which has been published since 1987, for example. Another important result was that the main subject reported on SE articles was "Science" (around 60% of the researched articles, in average), while around 9.07% was about Biology, 9.2% about Physics and only 3.9% about Chemistry. It is not a surprise because "Science" can contemplate the content of the specific areas (Table 2, Figure 3). However, we highlight the importance of research SE related to these specific areas, once each one has their proper epistemology.

About the research approaches (Table 2, Figure 4), "Teaching and learning in basic education" was the most reported approach in the investigated articles (28.3%). We consider this a positive result, since these researches can help improve SE at school, which is quite necessary nowadays. According to Hurd (1998), there are hardly any ideas related to research in science / technology associated with their functional uses for human health and well-being. Instead, most of the curricula of the area found in schools are descriptive, focusing on laws, theories and concepts. This author states that what is expected from these curricula is that education provides individuals the ability to cope with the changes in the Science, Technology and Society, as well as the dimensions of these changes to the social welfare. About the Brazilian reality, Sasseron and Carvalho (2011) stated that the contact of the basic education students with the Scientific Literacy help them to discuss, reflect and position themselves critically about science subjects. However, SE in Brazil is still a challenge. Therefore, although the present study did not make a deeper analysis in order to identify the forms used to promote science education for young people, we emphasize the importance of the employed teaching strategies taking into account the factors highlighted by the authors previously cited.

Teachers training related to SE were reported by 6.5% of journals (on both, initial and continuing formation) and all of them reported studies with this approach. Based on the possible relationship between academic research results and improvements in real education, we expected that

this approach was more frequent. Thus, when we think of the importance of SE be addressed in the classroom, we cannot rule out the relevant (and central) role held by educators, since they are largely responsible for the effective promotion of this in schools. Hurd (1998), without specifying the courses, reported that there were efforts at university to incorporate science culture and contemporary scientific practice on education. However, when we analyze the Brazilian reality of teacher education, some studies indicate many needs and challenges to be faced (Gatti and Barreto, 2008), although there were some advances, e.g. the publication official Curriculum Guidelines for Teacher Training (2002).

Other SE approach found in this work (13.5%) concerns the relationship between SE and some researchers/educator's ideas (as Vygotsky, Piaget, among others). Although the present work does not aim to further investigate how such approaches have been applied in the investigated articles, it should be said that, as Westbly and Torres-Velásquez (2000), we believe in the importance of promoting socio-cultural teaching perspective at school, in which the activities are mediated by the teacher in order to obtain the active scientific learning.

Many authors have described studies highlighting how museums and other non-formal spaces may be good learning alternatives (Cerati and Marandino, 2013; Rennie and Willians, 2002). We emphasize that more researches in this area can contribute to that science becomes actually closer to people's daily lives. On our data, only 4.4% of the articles focus on this approach.

Finally, the Science Education for Youth and Adult Education (EJA) was also one of the themes found in our results (3.3%). However, only two journals reported studies with this approach. Knowing that this type of education is more common in countries less developed, this result does not surprise us, because the EJA is currently a very common type of education in Brazil. According to the Brazilian Institute of Geography and Statistics (IBGE) approximately 8.6% of Brazilian with over 15 years old are illiterate. Although there have been many Brazilian initiatives to reduce these numbers (as the memorable initiative of Paulo Freire, from the 1960s, the Literate Brazil Program in 2003; PROEJA in 2006, among others), illiteracy among young people is still considered high and contributes to many social problems in the country. It is also worth mentioning that the Brazilian public policies for this type of education not been satisfactory and the target of much criticism from researchers (e.g., Rummert and Ventura, 2007). Therefore, we believe in the importance of Brazilian universities to promote actions in partnership with the state and society in order to promote adult literacy, since it is known that the language plays a crucial role in the formation and development of the individual. These actions may also involve SE.

Conclusion

In short, we noted that the main approach of the SE articles was teaching-learning process in basic education, although other ones were found in lower frequencies: teacher training, relationship of the SE with some educational theories, non-formal education, and SE for youth and adults. We consider a positive finding these variety of approaches on research involving SE. However, we highlight the need for further studies involving SE and teacher training, non-formal education and education of youth and adults. This last one is special important in developing countries (such as Brazil) for example. It was also noted a prevalence of SE research on Science discipline. Nevertheless, we encourage SE research to also focus on specific science areas (Biology, Chemistry and Psychics), because of their peculiarities.

Our results showed a low amount of annual publications on SE articles in Brazilian journals compared to international journals. The journal "Education and Society", for example, did not show any article related to SE during the period surveyed. Therefore, we emphasize the need of more publications related to SE on Brazilian journals, which can help the development of a more critical SE in schools and non-formal education actions in the country. Finally, we reinforce the importance of researches in teacher training area, as we believe that educators are key actors to promote effective SE in schools and citizen's daily life.

Finally, we highlight that if we used another methodology (for example, research the expressions in the complete article, and not only at title and keywords) the results could be different. It was not our aim, since we intent to do some similar with researchers usually do in their first effort to investigate a new topic on scientific articles, by checking titles, keywords and abstracts. However, it is a good approach that can be done in future investigations, aiming to complement and improved this one.

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