Teachers' Scientific Culture in Brazil - a panorama of Minas Gerais

Jessica Norberto Rocha

Universidade Estadual de Campinas

jessicanorberto@yahoo.com.br

Maria das Graças Conde Caldas

Universidade Estadual de Campinas

gcaldas@gmail.com

Abstract

Teachers are a great influence on their students' perceptions, attitudes, interest and participation towards the contemporary issues regarding Science, Technology and Innovation (ST&I), and have an important role in the formation of critical citizens who may also become decision-makers. This study, which is a single case study (YIN, 2001), aims to identify and analyze the scientific culture of current and future Primary Education teachers, who were, at the time the research took place, undergraduate students in the Distance Learning Education Course provided by the Open University of Brazil (UAB), in the state of Minas Gerais, Brazil. The results show that there is an interconnectedness and an interdependence between the eight rings of Teachers' Scientific Culture (model created by this research), as follows: sociodemographic characteristics; culture, reading and access to places of science and culture; main issues of interest; informative habits; scientific information; participation in ST&I issues; imaginary on ST&I and on the scientist; and pedagogical practice. They also reveal that there are gaps on cultural offers and on the access to qualified information in the regions where these students live, with significant losses in the teachers' scientific and cultural formation and pedagogical practices.

Introduction

In order to educate anyone in the contemporary world, the notion of what happens in Science, Technology and Innovation (ST&I) is vital, i.e., their main findings, methods, uses, risks and limitations as well as the interests and decisions that govern their processes and applications. Besides formal education and science education, the building of a Scientific Culture in society also depends on several factors from the social environment, which often belong to the universe of non-formal education, such as access to various means of information, to scientific and cultural centers, to places for civic debates, to cultural offerings, such as theater, cinema, fairs, among others.

In Latin America, a number of initiatives are being carried out to promote the popularization of S&T, some of them consisting of joint actions among different countries. A prime example is Red-POP, which in 2013 published the Declaration of Zacatecas, outlining actions and committing to fight and contribute to the social appropriation of science and technology. The Brazilian government has also been promoting a great effort to establish policies for dissemination and popularization of science that can respond to the increasing demands of the population and reduce the gap between science and daily life.

Nevertheless, despite the progress made and the variety of actors investing in the area, the development of the Brazilian Scientific Culture remains fragile and limited, since large portions of the population still have no access to scientific education and to qualified information regarding ST&I. In addition, according to national and international studies, such as the Program for International Student Assessment (PISA - OECD), science education in Brazil – at different levels – has shown alarming shortcomings.

In order to change this scenario, a deeper reflection on teachers' qualification and training is required in association with the aforementioned initiatives in progress. To effectively discuss teachers' perceptions of science, we must consider that they are usually built based on these teachers' socio-historical and ideological formation process. The teachers' perceptions of science, its methods, its types of research, their knowledge regarding scientific policies, the value they give to it, as well as their interest and attitude towards ST&I issues are made explicit in their teaching. Also, it is essential to consider that teachers have great influence on their students' perceptions, attitudes, interest and

participation in ST&I contemporary issues, and have an important role in the formation of critical citizens who may also become decision-makers.

Therefore, this study aimed to identify and analyze the Scientific Culture of Primary Education teachers and future teachers in order to reflect on the formation of this culture and development process, as well as to evaluate their pedagogical practices regarding science teaching and discussions about ST&I.

Methodology

This study, which is a single case study (YIN, 2001), was based on the definitions of Scientific Culture developed by Vogt & Polino (2003), Vogt (2003 & 2012) and Hurtado & Cerezo (2010), and its methodology was divided in three moments. During the first moment – between 2011 and 2012 –, 155 teachers and future teachers from 50 different cities located in Minas Gerais, all undergraduate students in the Distance Learning Course provided by Universidade Aberta do Brasil/UFMG, answered questionnaires based on the Public Understanding of Science research models (ALLUM et al., 2007). Since questionnaires are not enough to explain the Scientific Culture in its complexity and depth, in the second moment, eight (out of 155) science teachers were also interviewed so as to find out more specific aspects of their connections to ST&I issues. Finally, in the third moment, a crossed analysis between the data collected in the first and the second moments was carried out, allowing the design of a panorama of this public's Scientific Culture.

Results

The term "Scientific Culture" is wide and is not limited to scientific information or to the amount of knowledge accumulated by individuals. It is in fact an interaction of the individual in his/her sociocultural context. Thus, there are different experiences regarding ST&I which range from institutionalized practices, such as school, science centers and museums, until everyday relations between citizens and the media, informational habits, social imaginary, access to means of science and culture, social participation in discussions and decisions on matters of ST&I among others.

Therefore, this study presents its results organized in the "Eight Rings of Teachers' Scientific Culture" (model created by this research), that are interconnected and interdependent, as follows: Sociodemographic characteristics; Culture, reading and access to places of science and culture; Main issues of interest; Informative habits; Scientific information; Participation in ST&I issues; Imaginary on ST&I and on the scientist; and Pedagogical practice. The model can be visualized in Figure 1.
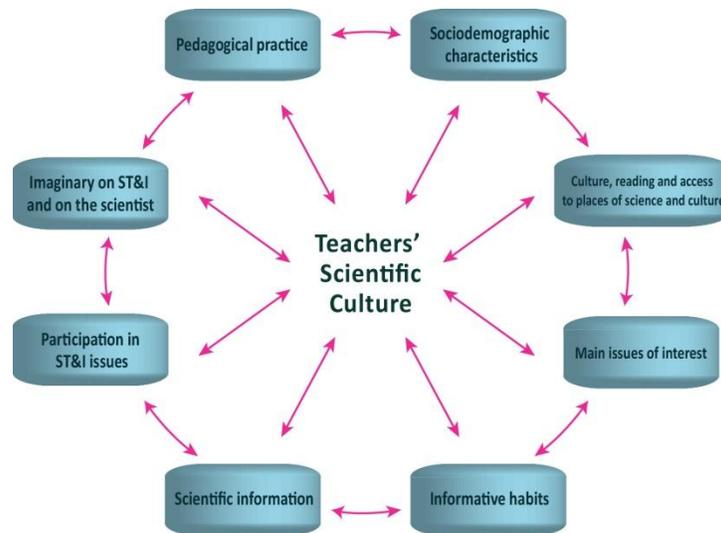
Figure 1 - Eight Rings of Teachers' Scientific Culture

Source: NORBERTO ROCHA, 2013. Based on the concept of the five rings of information (WURMAN, 1991), and on studies regarding Public Understanding of Science.

Based on the collected data, a general profile of the audience studied can be drawn: they consist, mostly, of women (87%), from the countryside of Minas Gerais, aged between 22 and 42, who studied at public schools throughout their school lives and have low monthly personal and family incomes. Concerning the Sociodemographic ring, the factor that most influences the relationship of these people with the ST&I is the issue of low income. The economic situation of this audience has direct implications and effects in their Scientific Culture, such as: little access to quality education; modest consumption of scientific information through magazines, newspapers and cable TV; few opportunities to travel to attend events or venues of science and culture; and poor

perspective of leaving their hometowns to pursue a scientific career or a qualified Higher Education course.

It could be noticed these teachers' attendance at cultural venues such as cinemas, theaters, concerts and / or musical performances, book fairs and bookstores is very small, with the exception of the library, which has a higher frequency. 43.7% said that they never go to the cinema, and 41.2% said that they go at least once a year; 61.2% stated that they never go to the theatre and 23.2% go at least once a year; regarding concerts and/or musical performances, 45.6% declared that they go at least once a year and 27% go at least once a month; 30.9% stated that they never go to book fairs or bookstores, and 32.9% go at least once a year. The attendance at libraries is higher, as 28.3% declared that they go very often/every week, and 34.1% go at least once a month.

Nearly half of the teachers who never go to some of these cultural venues said this happens because of the lack of offering in the city where they live, and a smaller part said that it is due to lack of financial resources. After comparing IBRAM's (2011) information and the data collected in this study, it can be stated that only 15 out of the 50 towns where the studied public lives have any kind of museum institution. Moreover, regarding museums and science centers, specifically, there are only 16 institutions in the entire state of Minas Gerais (ABCMC, 2009). Given this reality, it is not surprising that 83% of the respondents said they have never been to a science museum.

With respect to reading, the questionnaire respondents affirmed they read, between 2010 and 2011, 7.89 books, surpassing the national average of four books a year (INST. PRÓ-LIVRO, 2012). Nevertheless, 29 of them said they did not read any book in that period. The textbook is the most read genre, followed by literature, religious and self-help books – data which resemble theaforementioned national survey. It was also found that their main means of information are the internet and the television (76.8% and 71%, respectively), despite the relatively high reading rates. Books, the radio, newspapers and magazines are used as a source of information at lower frequency or never.

When asked in which subjects the teachers were more interested, they answered that they have a greater interest in Religion (46.5%), Culture (43.9%), Music (37.4%), Arts (32.3%) and ST&I (31%). Among the subjects that most of them reported having no interest are: Sports, Theatre and Politics. When asked in what ST&I-related subjects they

were more interested, they showed greater interest in Public Health, Technology, Informatics and Computing, and no interest in Car Engineering, Nanotechnology and Nuclear Energy.

In addition, on issues related to Health, a large part of the studied population demonstrates what Hurtado & Cerezo (2010, p. 370) called "inclination to make use of scientific knowledge", which can be confirmed by the fact that most teachers declare that they read the instructions on a medicine package as well as the information on food packaging, that they follow the doctors' guidelines when in treatment or diet and that they keep themselves informed when an epidemic or a risky accident occurs. Few, however, check the technical specifications of the household appliances or the manuals of electronics. This demonstrates that there is low social appropriation in matters that are not directly related to health.

The majority of them also stated that the news focused on issues related to ST&I broadcast by the media have a complex language and are difficult to understand. They also affirmed that they do not consider themselves well informed about these matters and that the information about ST&I in the media is not enough to make decisions or choices when it comes to more complex topics. Only 18.7% consider themselves at least informed about ST&I-related matters.

Low levels of education and information on ST&I are illustrated by the high percentages of teachers who cannot cite research institutions in the country and names of Brazilian and foreign scientists. 77% could not cite research institutions, 73% did not know any Brazilian scientist and 65% could not name any foreign scientist.

A positive image appeared when the teachers were asked to think about the scientist. According to the public of this research, scientists are smart people who do useful things to mankind and are genuinely interested in the advancement of knowledge. According to the participants, their motivation is to contribute to the advancement and to the scientific and technological development of the country. Moreover, scientists are considered by them the most reliable source of information on ST&I, whose opinions and guidance are relevant and should be taken into account by governments. However, not only good points build the image of the scientist and his practice, since few teachers

agree completely with the statement that scientists are free to develop any kind of research in both public and private sectors.

The data also show that the majority of respondents can develop a critical and conscious reflection of the image of science and its means and processes. Most of them stated that S&T may bring benefits or harm to society, depending on how they are used. While 6% believe that science brings only benefits, 46% believe it can bring more benefits than harm to humanity, and 43% answered that it brings both benefits and harms.

Despite little training and information about STI, most teachers declared they want to have a say in major decisions about the future of science and technology in the country, but do not know how and do not know the space for it. They also want the public communication of researches' potential risks, their progress, their funding agents and outcomes, but also do not know where that information may be available.

Finally, in the Pedagogical Practice ring, several respondents reported difficulties in Science Teaching. A fairly emblematic phrase of their experienced reality is: "*I really like the area of science, but I have that fear. I wanted to know more*". These teachers feel "fear of science" for several reasons: lack of training, information, depth and updating and didactic difficulties of working with complex issues. The material used in class consists mostly of photocopies and material created by them or by the school, followed by the textbook. Labs, improvised labs and news reports are the least used resources. They recognize the need of classrooms that allow practice, experimentation and interactivity, so that students can participate more actively in the learning process and, hence, feel more motivated and have a better understanding and reflection of the theoretical contents. Nonetheless, it was possible to confirm in the interviews the absence of laboratories and few practical activities in the schools where they work.

These teachers are interested in taking their students to scientific and cultural places and in participating in Science Fairs and Knowledge Competitions. In spite of this, they and their students attend these spaces at a reduced frequency because of the high embedded costs (including production, transportation and participation fees), therefore less than half of the teachers reported having already organized fairs in their schools and none affirms that their students have participated in any Knowledge Competitions.

Final remarks

In view of the data presented, it is necessary to reinforce that there is a great need to fill in the gaps left by the lack of cultural devices in remote regions, by the lack of access to information and by the lack of information on where and how to qualify for improving teaching practices. It is apparent that the pedagogical practice reflects the Scientific Culture of the teacher as a citizen and that the reality of Science Teaching and training of these professionals should be improved, given the importance of science education for the formation of a Scientific Culture in society.

Then, we leave the following questions for reflection and further studies: how can distance learning education overcome the lack of access to scientific and cultural places? How can the courses of teacher training and distance education help to break the geographical and financial barriers and gaps left by restrict access to science, culture and information? How to build channels o enable the public, in particular those from the most remote towns, to participate effectively in decisions and debates about ST&I? How to extinguish the fear of science still widespread among Primary Education teachers?

In conclusion, with the results of this research we expect to pave the way for future research in Science Communication programs and to strengthen the study area in the country. We also expect to influence the improvement of teacher training regarding the approach of ST&I and its relations with society in the contemporary world.

References

ABCMC (2009), Guia de Centros e Museus de Ciências do Brasil 2009, Rio de Janeiro, Associação Brasileira de Centros e Museus de Ciência; UFRJ; FCC; Casa da Ciência: Fiocruz; Museu da Vida.

Allum, N., Bauer, M. W., Miller, S. (2007), "What can we learn from 25-years of PUS research? Liberating and expanding the agenda", Public Understanding of Science, 16, pp. 79-95.

Hurtado, M. C., Cerezo, J. A. L. (2010), "Political dimensions of scientific culture: Highlights from Ibero-American survey on the social perception of science and scientific culture", Public Understanding of Science, 21, 3, pp. 369-384.

IBRAM (2011), Guia dos Museus Brasileiros, Brasília, Instituto Brasileiro de Museus.

Instituto Pró-Livro (2012), Retratos da Leitura na Brasil. Available at: <http://www.prolivro.org.br/ipl/publier4.0/dados/anexos/2834_10.pdf>. [accessed: 15 dec. 2012].

Norberto Rocha, J. (2013), A Cultura Científica de professores da Educação Básica: a experiência de formação a distância na UAB/UFMG. 2013. Dissertation (M. A. in Divulgação Científica e Cultural), Universidade Estadual de Campinas, Campinas.

Vogt, C. (2003), "A espiral da Cultura Científica", Folha de S. Paulo, 24th July. Available at: <http://www.comciencia.br/reportagens/cultura/cultura01.shtml>. [accessed: 05 jul. 2012].

Vogt, C.; Polino, C. (Ed.) (2003), Percepção Pública da Ciência: Resultados da Pesquisa na Argentina, Brasil, Espanha e Uruguai, Campinas, Ed. Unicamp; São Paulo, FAPESP.

Vogt, C. (2012), "The spiral of scientific culture and cultural well-being: Brazil and Ibero-America", Public Understanding of Science, 21, 1, pp. 4-16.

Wurman, R. S. (1991), Ansiedade de informação: como transformar informação em compreensão, São Paulo, Cultura Editores Associados.

Yin, R. K. (2001), Estudo de caso, planejamento e métodos, 2. ed., Porto Alegre, Bookman.