

RETHINKING SCIENCE EDUCATION: BRAZILIAN AND ARGENTINIAN TEACHERS' PERCEPTIONS

Ana Cristina Santos Duarte

Southwest Bahia State University, Bahia, Brazil

E-mail: tinaduarte2@gmail.com

Héctor Santiago Odetti

National University of the Littoral, Santa Fé, Argentina

E-mail: hodetti@fbc.unl.edu.ar

Abstract

This study aims to identify what science teachers from Brazil and Argentina think about science education. This study is based on the viewpoint that science teaching, even today, is so fragmented and decontextualized with the predominance of traditional methods such as lectures and textbooks which in turn favor an abstract approach of the contents, decreasing the students' motivation and interest for science. The research is qualitative, involving 20 teachers of science and biology, 10 from Brazil and 10 from Argentina, who responded to a semi-structured interview. The results show that the interviewed teachers, both in Brazil and Argentina, understand the need to rethink and change the current structure of science education in the intention of renewing curriculum structure, pedagogical practice and encourage the training of teachers towards meeting the training needs of the contemporary world.

Key words: science education, rethinking, scientific knowledge.

Introduction

Science education, over the last decades, has undergone renovation attempts, due to several factors, including: changes of the environment in which modern man lives, the search for new ways for education and obsolescence of science teaching.

Lack of motivation and engagement of the students in the learning process is one of the major issues present in contemporary education. Specifically in science education, which still occurs in a fragmented and decontextualized way with the predominance of traditional methods such as lectures and textbooks favoring an abstract approach of the subject matter (Carvalho, 1989; Chapani and Cavassan, 1997; Tiedermann, 1998). Thus, the subject is transmitted 'ready' and 'complete, without any possibility of questioning by the students as to its origin, relations and applications.

Studies by Scheide (1983), Carraher (1985) and Krasilchik (1987), describe the changes in the conception of science education. They also explain that the attempts to introduce innovations

associated with this conception that would ensure the achievement of the objectives proposed for science education seem to have reached very few classrooms, since the teaching of science is still, in most schools, based on the use of traditional classes.

About the proposed objectives for the teaching of science, Bizzo (2000) states that science education must provide all students the opportunity to develop skills that raise in them the restlessness of the unknown, seeking logical and reasonable explanations, taking students to develop critical positions, make judgments and decisions based on established criteria, based on knowledge shared by an educated community.

Therefore, it is necessary to resignify the teaching of science, both from the point of view of theoretical and methodological foundation, adjusting the teaching-learning process to the new technologies of information and communication, seeking a quality education that is capable of forming critical citizens, motivated and interested in understanding scientific and technological concepts.

The difficulty of access to school conquered, gradually, the concern with the need to improve the quality of teaching and of scientific education gains expressivity in basic education schools. This social demand is today recognized among researchers and educators from all countries, as part of the development of a society depends on the quality of its education and its links with scientific and technological knowledge (Demo, 1997).

There is currently, by various segments of society (companies, civil society organizations, the church, the press, etc.) a demand for the quality of education, a growing feeling, as the developmental delay that characterizes our education is realized, and also the precariousness of the population's basic education, which in many cases approximates the state of "functional illiteracy."

The field of educational research and the proper educational legislation restate scientific education on the agenda of the current discussions, because the school has failed to keep up at the same speed, with the scientific and technological advances in society and is, therefore, not meeting demands imputed for contemporary education.

In this perspective, research conducted in several regions of Brazil has shown that some of the barriers to improve the quality of education is associated with lack of scientific training of the teachers and lack of public policies that invest in science education.

In other Latin American countries, such as Argentina, Natural Sciences are taught very little (much less than expected by the curriculum). However, the problem goes beyond the number of hours that are dedicated to the area. According to Furman (2009) the way how Natural Sciences are taught in Argentinean schools are still very far from contributing to form the basis of students' scientific thinking.

About science teaching in Argentina, Weissmann (1998) states:

The teaching of Natural Sciences in Argentina is also affected by the manner and quality of initial teacher education, the place that it occupies in the school in relation to other learning areas (...), by the short time that it has in the school schedule and its irrelevancy when making decisions regarding the student's approval (Weissmann, 1998, p. 31).

Thus, the design of this project of science education parts from the reflexions of science teachers from Brazil and Argentina, and has also as premise that it is not possible to consider the education of a critical citizen without the inclusion of scientific knowledge.

Indeed, science education is a fundamental requisite for democracy and sustainable development. The importance assumed by science education today, as part of a general education, that is, as a basic component of citizenship's training cannot be denied (Fourez, 1997; Bybee, 1997; Deboer, 2000; UNESCO, 2003; Gil - Pérez & Vilches, 2004; Werthein & Cunha, 2005).

In the current scenario, Scientific and Technological Literacy are configured as a valuable artefact for the development of knowledge and mental constructs that allow the inclusion of the subject in society in an autonomous, responsible, critical and ethical way, establishing itself as one of the fundamental factors for the improvement and quality of life of the population.

However, most of the population has no access to such knowledge or has it in a wrong and fragmented way, so that they cannot apply this knowledge or establish relations with their day-to-day life. It is necessary and urgent to rethink science teaching. In this sense, the school has a fundamental role in the dissemination of such information and the development of scientific skills from elementary school to higher education. It is also necessary that teachers should understand that a new vision of science aims to build an educational model capable of generating a learning environment in which the human being is understood in its multidimensionality, i.e., physical, biological, mental, social and cultural aspects.

In this context, this research aims to identify what science teachers from Brazil and Argentina think about the rethinking science education.

Methodology of Research

It is a descriptive qualitative survey. According to Gil, descriptive research aims to “Describe the characteristics of a given population or phenomenon” (Gil, 1994, p. 45). Minayo (1994) states that qualitative research is concerned with a level of reality that cannot be quantified, i.e., phenomena that cannot be reduced to the operationalization of variables.

The research was conducted with science and biology teachers of basic education from Brazil and Argentina who attended, respectively, the Graduate Courses “Scientific Education and Teacher Education” and “Didactics of Experimental Sciences”. Participants were 10 teachers from Brazil and 10 from Argentina.

The data collection instrument was a semi-structured interview. According to Gil (2008), the interview is a research technique that follows a pre-determined path and seeks to meet the objectives of each stage of the research. In the interview questions were asked about: perceptions on rethinking science teaching; need to rethink science teaching and the possibilities and difficulties for rethinking science education.

To preserve the identity of the subjects, teachers from Brazil were identified as B1, B2, B3 and so on and teachers from Argentina as A1, A2, A3 and so on.

Profile of the Participants

All participants have a degree in Biological Sciences, are science and biology teachers of elementary to high school and are students in graduate programs related to science education. Survey participants are graduated since 02-14 years, have 01-24 years teaching experience and are aged between 26-48 years old.

Results of Research and Discussion

To achieve the research objectives and identify what science teachers from Brazil and Argentina think about the renewal of science education, teachers from the two involved countries were interviewed. After the transcription of the interviews, analysis categories were established.. The results show that all the interviewed teachers were unanimous in stating that it is necessary to rethink science teaching and that they observe that such change should occur through reflection and critical posture of the teacher, but also by changes in curriculum and teacher training. They also indicate difficulties for this to occur.

Rethinking Science Education Practice

We live in a society that changes constantly and rapidly. Logically, these changes interfere in all social sectors and directly on the family and at school, requiring transformations and/or physical, structural, educational, cultural and mindset adjustments. It should be reinforced that these changes go through critical reflections, imbalances, innovations, cooperation, etc., which are fundamental to establish the “newness” within school and in teacher training.

One factor that draws our attention is the slowness with which changes take place within

the school, perhaps because those changes do not depend so much on technological modernization, but on changes of thought and teaching practice/activities. Therefore, it is necessary that the teacher should reflect his practice, his teaching routine, what has worked out and what needs to be changed/adapted or suited to the students' needs and to the social demands. As stated by some of the teachers interviewed when they were asked about what they understood by resignification of science education: *I understand that reflective practice is an analysis of our intervention, tending to overcome dichotomously science education adapted to social and current demands and to the needs and interests of students (A1); I understand that it implies giving a new meaning (...) as an ongoing process, where students are active and reflective protagonists, (A8), I understand that it should take a new meaning from the advances in general pedagogy/didactics, educational psychology and a new interpretation of the teaching-learning process (A2); Resume thinking the class, to think about it, the class from a pedagogical and didactic point of view; regarding teaching strategies, significant approaches (A5).*

It can be verified in the above statements, that the teachers associated rethinking science education to reflective teaching practice, i.e., the teacher's need to reflect his practice, methodological strategies, resources used in the classroom etc.

It is necessary for teachers to reflect on the relationship between the learning process of their students and the methods and resources used. It is necessary to adopt criteria that allow us to obtain information about the suitability of materials and activities to the goals we want to achieve with students (Geli, 2000, apud Castiñeiras, 2007, p.30).

The reflexive teacher, therefore, is the one who is concerned with the learning of the students, with their cognitive, social and emotional development, thus he seeks activities/tasks that actively involve students, that arouse their interest and motivation, that promote the development of autonomy, the ability to work in groups, in short, it is a teacher who thinks and rethinks, who invents and reinvents his pedagogical practice.

Zeichner (cited in Pimenta, 2002, p. 30) highlights its importance: "There must be a reflexive attitude of teachers in relation to their teaching and to the social conditions that influence it".

Rethinking Curriculum Changes

There are many different conceptions of curriculum and several curricular designs are established in the states/provinces. However, we take a concept of Moreira, "Curriculum is a construction and selection of knowledge and practices produced in concrete contexts and in social, political and cultural, intellectual and pedagogical dynamics. Knowledge and practices exposed to the new dynamics and reinterpreted in every historical context" (Moreira, 2007, p. 9)

There seems to be a consensus that the school curriculum should be able to promote the necessary skills for the students to meet the social, cultural and professional challenges of the contemporary world, which requires reading and writing skills, mathematics skills, but also scientific and technological knowledge. Thus, the curriculum must propose the guiding principles for educational practice. As noted in the speech of the teachers: *Situate science in a predominant place in the curriculum at all levels of the education system, to achieve scientific literacy of students (...) (A3) it is to rethink, reevaluate, it is (re) constructing knowledge, learning, curricula focused on research, on experimentation (...) (B2); it involves a restructuring both in the construction of knowledge, the school and the professionals in the teaching and learning process, to the reflection or application of scientific knowledge in the daily routine, in the everyday life of the individual to the social ambit (B1).*

A tendency to rethink the curriculum is observed in the teachers' speech, placing science teaching in a predominant place in the curriculum, aiming at the capacity to arouse scientific curiosity and interest of children and adolescents. Besides the need for an adequate science education to the student's daily life, making it more significant. As some teachers state: *Resigni-*

fiction is to think and rethink the goals, forms, ways of teaching science in school, from a more open paradigm and closer to the everyday life of the people (A7); it is working the issues in the classroom always thriving to contextualization. Leading students to understand the presence of science in their daily lives, i.e., approximate it more (B3).

Bizzo states that “Students have easy access to what we call ‘everyday knowledge’ and will not fail to have it when entering school” (Bizzo, 2002, p. 22). However, it is the school’s function to provide students with the acquisition of scientific knowledge and its relationship with society. In the speech of the teachers, we can perceive an approximation to the STS (Science, Technology and Society) movement, which is gaining adherents worldwide, including both in Brazil and in Argentina, and has been ascertained itself, as an alternative trend for curricular organization of science education. STS approach, by means of its relations with society, imposes itself as a way of living and thinking. *Assign a new meaning to science education in order to meet current needs, training and human formation and the enablement of citizenship (B4); it would be to search for a new importance given to this knowledge using tools that actually show which are the contributions of this knowledge to contemporaneous society (B5).*

Rethinking Teacher Education and Practice

Teacher education has concerned and involved many researchers in recent decades and many point out to the complexity and specificity of the teaching profession. According to Garcia (1999), teacher training is associated with the preparation for the profession; it refers to actions aimed at acquiring knowledge, know-how and knowing how to be.

According to Weissmann, “Regarding the teaching of natural sciences, it is increasingly perceived, that one of the major obstacles when wanting to teach is the lack of control and update the teachers have with regard to classroom content” (Weissmann, 1998, p. 32).

The area of knowledge, research and theoretical and practical proposals that studies the processes by which teachers acquire or enhance their knowledge, skills and dispositions, and allows them to act professionally in the development of their teaching, the school curriculum and the goal of improving the quality of education that students receive. [...] (Garcia, 1999, p. 26).

It is important to recognize that the training is not only for those who are preparing for teaching, but also those already in the profession should pay attention not only to the domain of content, but to the development of didactic and pedagogical principles. Teacher training is also associated with live experiences and new learning. As stated by some teachers. *Resignifying science education would be to review the training of teachers, their way of acquiring science education and encourage their teaching (A6); it would actually include students with special needs in the regular classroom, having equipped labs, multimedia classrooms (...). However, for this to become possible, the teacher should be in permanent training, updating himself (B8).*

In this sense, resignifying science education, taking as its starting point the teacher training, covers not only the conceptual level, but also the procedural and attitudinal ones. It includes change of attitude towards the diversity of students who are in the classroom. Meet the diversity and special needs of students implies a renewal of methods, teaching tools, in order to engage students actively in educational activities. Among these tools we could highlight the didactic sequences, experimental lessons, problems and situations in context, group activities, etc.

Difficulties and Possibilities of Rethinking Science Education

It draws our attention that what is considered necessary to rethink science education is also placed by the interviewed teachers as an obstacle, as difficulties: curriculum design, training and upgrading of teachers. Another difficulty pointed out concerns the working conditions. For example: the environment of the school, the organization of the class time, the teacher’s excessive workload, the high number of students in class, the resistance to changes, the lack of motivation

of students and teachers; formalism, decontextualized science teaching; shortage of natural sciences teaching training proposals by the state; resistance of teachers to incorporate new teaching strategies and the ICT (Information and Communication Technology).

On the other hand, and even in a incoherent way, teachers indicate some resignation possibilities of science education: *The possibility arises from the students' interest and from the development of everyday life problems (...)* (A1); *Curricular changes that are happening in all teacher training institutes, since the focus of teaching by inquiry and bibliographic and digital resources (A3), today we have the technological tools (computers and internet) to help overcome the gap and be more communicated (A4); continuity in teacher education (...), seeking to emphasize the situations day-to-day experiences of the individuals, leading to a critical and reflexive view (B1); it would be through the training courses that currently exist and the media that disseminate innovative approaches in science education (B8).*

The results of the interviews show that teachers recognize the investment by the Governments of Argentina and Brazil in education: implementation of training and qualification programs for teachers; investments in physical and pedagogical infrastructure, curricula are being rethought and modified, etc.

It is noteworthy that universities are privileged places to discuss the renewal of science education. Thus, many teachers of basic/elementary or secondary education, concerned with the quality of science education, have sought and engaged themselves in graduate courses, indicating that they are open and willing to rethink the teaching of science.

On the other hand, we believe that the professional valuation should be part of the countries' public policies and that society should also recognize the work of the teacher. Therefore we must consider the teachers' working conditions and their remuneration in a worthy manner; as a teacher declares: *That allows them access to training and updated bibliography (...). There are a lot of exigencies for today's teachers, but there are many obstacles and the teaching profession is despised"* (A4)

Conclusion

Rethinking science education makes us reflect on the reasons for teaching science in a world increasingly influenced by the accumulation and speed of production and dissemination of information.

Teachers demonstrate a strong interest in change and break away from the traditional, memorizing and decontextualized science teaching, however, they point out practical structural and political difficulties that prevent teachers to exercise their autonomy and try new things. "It is true that the current educational system, still strongly rooted in tradition, imposes itself in an almost intransigent way between the will to renovate and the 'leave it as it is', but gradually, the obstacles will disappear (Martins, 2009, p. 2).

Considering the difficulties and possibilities mentioned by the respondents, we found that the difficulties are pointed at times, as also the possibilities, demonstrating that science education has been questioned, rethought and different possibilities have been glimpsed to teach and learn science, even if it is slow and fearfully.

The results point out that, beyond the difficulties, there are possibilities of renewing science education, to the extent that the teacher assumes his transforming role from judicious choices of objectives and content; efficient pedagogical tools acting in favor of the education and training of citizens; updating constantly and political participation in the sense of contributing to the curricular changes that meet the social scientific and technological demands as well as, claiming more serious public policies for education.

Therefore, rethinking science teaching means to change the teacher's pedagogical practice. However, the research shows that there are knowledge gaps which need to be filled by future surveys and government investments, mainly through public policies, science teaching curriculum restructuring and teacher education.

Acknowledgements

The authors thank CAPES and SPU for their support and funding the project 038/2011.

References

- Bizzo, N. (2000). *Ciências: fácil ou difícil*. São Paulo: Ática.
- Bybee, R. (1997). Towards an Understanding of Scientific Literacy. In: Graber, W. Bolte, C. (Eds.). *Scientific Literacy*. Kiel: IPN.
- Carraher, D. W., Carraher, T. N., & Schlie, A. D. (1985). Caminhos e descaminhos no ensino de ciências. *Ciência e Cultura*, 37 (6), 889-96.
- Carvalho, A. M. P. de, Vannucchi, A. I., Barros, M. A., Gonçalves, M. E. R., & Rey, R. C. de. (1998). *Ciências no ensino fundamental – o conhecimento físico*. São Paulo: Scipione.
- Castiñeiras, J. M. D. (Editor). (2007). *Actividades para la enseñanza en el aula de ciencias: fundamentales y planificación*. Santa Fé, Argentina: Ediciones UNL.
- Chapani, D. T., & Cavassan, O. (1997). O estudo do meio como estratégia para o ensino de ciências e educação ambiental. *Mimesis*, 18 (1), 19-39.
- Deboer, G. B. (2000). Scientific literacy: another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching*, 37 (6), 582-601.
- Demo, P. (1997). *Desafios modernos da educação*. Petrópolis: Vozes.
- Fourez, G. (1997). *Alfabetización científica y tecnológica. Acerca de las finalidades de la enseñanza de las ciencias*. Buenos Aires: Colihue.
- Furman, Melina. (2009). *O ensino de ciências no ensino fundamental: colocando pedras fundacionais do pensamento científico*. São Paulo: Sangari Brasil.
- García, C. M. (1999). *Formação de Professores*. Porto-Portugal: Editora. Porto.
- Gil, A. C. (1994). *Métodos e Técnicas de Pesquisa Social*. São Paulo: Atlas.
- Gil Pérez, D., & Vilches, A. (2004). Importância da Educação Científica na sociedade atual. In: Cachapuz, A. et al. *A emergência da Didática das Ciências como campo específico de conhecimentos*. São Paulo: Cortez, p. 19-34.
- Krasilchik, M. (1987). *O professor e o currículo das ciências*. São Paulo: EDUSP.
- Martins, J. S. (2009). *Situações Práticas de Ensino e Aprendizagem Significativa*. Campinas, São Paulo: Autores Associados.
- Minayo, M. C. S. (1994). *Pesquisa Social: Teoria, Método e Criatividade*. 23ª edição, Petrópolis/RJ, Editora Vozes.
- Moreira, M. A. (2007). A área de Ensino de Ciências e Matemática na CAPES: em busca de qualidade e identidade. In: Nardi, R. (Org.). *A pesquisa em ensino de Ciências no Brasil: alguns recortes*. São Paulo: Escrituras, p. 19-49.
- Pimenta, S. G. (2002). *Professor reflexivo no Brasil: gênese e crítica de um conceito*. 3ª Ed. São Paulo: Cortez.
- Scheide, T. J. F. (1983). Uma experiência sobre a utilização da estratégia de ensino de ciências em estudos de recuperação de alunos da escola de 1º grau. *Mestrado*. Universidade Federal de São Carlos (UFSCar), São Carlos.
- Tiedermann, W. (1998). Conteúdos de química em livros didáticos de ciências. *Ciência e Educação*, 5 (2), 15-22.
- UNESCO (2003). Declaração sobre a Ciência e o uso do conhecimento científico. Brasília: Unesco, Abipti, Fucapi, p. 28-29.
- Weissmann, Hilda. (1998). *Didática das Ciências Naturais: contribuições e reflexões*. Porto Alegre: Artmed.

Werthein, J., & Cunha, C. da. (2005). *Educação científica e desenvolvimento: o que pensam os cientistas*.
Brasília: Unesco, Instituto Sangari.

*Advised by Gunārs Strods,
Rezekne Higher Education Institution, Latvia*

Received: *October 21, 2013*

Accepted: *December 04, 2013*

Ana Cristina Santos Duarte

PhD, Professor, Southwest Bahia State University, Av. José Moreira Sobrinho S/N.
Jequiezinho, Jequié, Bahia, Brazil.
E-mail: tinaduarte2@gmail.com

Héctor Santiago Odetti

PhD, Professor, National University of the Littoral, Bv. Pellegrini 2750 - (3000), Santa Fé,
Argentina.
E-mail: hodetti@fcb.unl.edu.ar
