

Full Length Research Paper

Rousing interest in science among secondary school deaf students

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The present work describes our experience in teaching science to severe-to-profound deaf school students in Brazil, who have Brazilian sign language as their first language. These students lag behind hearing youngsters of their age in terms of academic achievement. They experience isolation resulting from the language/communication barrier that has impeded this group from acquiring general information normally obtained not only via school education, but also informally. This is particularly manifested in regard to scientific knowledge. The format of our course involved deaf students in an active search for knowledge, using an inquiry, collaborative, hands-on oriented teaching. Deaf students learned the importance of questioning, of group work, of performing experiments to answer their own set of questions, of interpreting the information gathered, in a process that resembled the scientific method. In contrast to their normally passive and uninterested attitude during expository classes, the majority of the deaf students demonstrated a high motivation and enthusiasm during the whole experimental course. Deaf students realized that they were learning new strategies that went beyond science and could be used in a number of different situations. During the course, more important than laboratory skills, they were developing a critical mind.

Key words: Science Education, Deaf, Experimental Course, Inquiry Learning.

INTRODUCTION

The importance of science and science education as part of our increasingly technological society has been discussed in different contexts (Osborne, Simon and Collins, 2003), including cross-cultural differences (Pomeroy, 1994). The perception of the importance of science in everyday life, from environmental questions to the production of a new technological advance, is not understood by many segments of the society. This is more so among those, that for some reason, are excluded during the educational process. In Brazil 5 % of the populations is deaf (IBGE 2012). What are the attitudes of deaf children and youngsters towards science? The deaf community is immersed in a culture of their own and experience isolation produced by the Language/communication barrier that has impeded this group from acquiring general information normally obtained not only via school education, but also informally (Schiaffino and Rumjanek, 2012). This is

particularly manifested in regard to scientific knowledge.

In Brazil, the deaf population face difficulties in developing the capacity of reading and writing in Portuguese (the native language of the country), attaining a very low level of literacy. Since 2002, Brazil has established by decree that Brazilian Sign Language (LIBRAS) should be used for educational purposes and should be accepted as the official language of the Brazilian deaf community. Since then, the government has forced integration via inclusion of deaf students in regular schools with the presence of sign language interpreters or resource classrooms with resource provided by an itinerant teacher. The difficulties involved, leading to a greater exclusion of the deaf student, have been discussed Lacerda (2007) and among them are the lack of curricular adaptations or special class strategies.

The deaf community is inserted in our scientific technological society. As citizens, it is important that they should be critical and capable of understanding the implications of the major changes brought about by technological advances, and, in parallel, to appreciate the social value of scientific knowledge (Smith and Gunstone,

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2009). The present article examines our experience in developing a short thematic science course for secondary school deaf students, offered at the Federal University of Rio de Janeiro, Brazil. This course was designed to motivate students towards science.

METHODOLOGY

Participants

One hundred ninety three severe-to-profound deaf students, with diverse etiologies, participated of our study. The participants were in secondary school (attending a specialist school for the deaf Instituto Nacional de Educação de Surdos or government integrated schools in Rio de Janeiro, Brazil), their ages varied between 17-25 years old. All of them have Brazilian Sign Language (LIBRAS) as their first language. Eighty nine percent of our sample consisted of deaf students who became deaf before the age of three. Sixty four percent of the participants learned LIBRAS at the age of six years or more. More than 90% had hearing parents and for 28% of the students nobody in their family could communicate in LIBRAS. Only a few of them had blip-reading skills. None of our students suffered from intellectual disabilities; their short comings resulted from their deafness. Different groups of six postgraduate hearing students, working for their master or PhD in science, participated as tutors in the different courses organized for the deaf students. Their age varied between 20-30 years old. Their participation was voluntary.

The postgraduate students were trained not to answer the questions proposed by the deaf youngsters but to, instead, question them back: "Why do you think so? How could you find an answer to your question?"

Short thematic science course

Full time courses, lasting for one week and based on a specific topic, were offered to deaf students at the Biochemistry Institute - Federal University of Rio de Janeiro (UFRJ). The given topic was announced at their schools and among the deaf community, so that interested students could apply to it. Among the applicants, around 18 students were selected per course by the school(s). They needed to manifest interest and not to suffer from intellectual disabilities.

At arrival, the students were divided into three groups, each group occupying a different bench. The language used in the course was LIBRAS and the help of three interpreters (one for each group) was supplied. There were no theoretical classes. For a summary of the methodology of the course see Table 1. Different topics became the subjects of the ten short thematic courses

organized: inflammation, immune system, blood and clotting, different kinds of cells, insects that feed on blood, aliments and nutrition, DNA, cancer versus medicaments, microorganisms.

RESULTS

Using the strategy outlined in Table 1, deaf students learned the importance of questioning, of group work, of performing experiments to answer their own set of questions, of interpreting the information gathered, in a process that resembled the scientific method. Their tutors were postgraduate life sciences students who were used to scientific thinking, to performing experiments and to face the need of devising different approaches.

Initially, deaf students demonstrated surprise when asked to provide the kind of doubts they might have and what they would like to know about the given topic. But, in the moment the first deaf student asked a question the others joined in with a number of different ones. All questions were listed and this was followed by a debate within the members of the individual groups. The debate ended by each group choosing what they would like to answer first. The next step involved a discussion among the group on how they would like to approach the problem. They received the instruction that the question(s) they wanted to answer needed to be approachable experimentally. They would then suggest an experimental approach, and tutors (hearing postgraduate students) would help them to execute the experiments. The various groups worked independently and at the end of each day there was a presentation of the results obtained separately by each group and the hypothesis raised by them. The groups then realized that some of the information obtained by the others was also useful for their purposes, in this way they also verified the importance of gathering knowledge already available.

The presentation at the end of the day also introduced a degree of competition, each group wanted to be the best, with the most interesting questions of the day, with the better approach, the most interesting experiments etc. During the course, one question led to the next and for four consecutive days they performed different experiments and discussed them all at the end of the day. On the last day, they presented what they learned during the week.

Despite the fact that the proposed research topics of the courses might seem restricted and specialized, they induced a great amount of questioning and led to experiments that went far beyond the original subject. The development of activities based on the students doubts, propositions and experimental approaches demonstrated to them that a same theme can be dealt by the various groups in very different ways mimicking what can be seen in the scientific practice. In contrast to their normally passive and uninterested attitude during

Table 1. Summary of the methodology of the short thematic science courses

Organization of the course
<ul style="list-style-type: none"> • Definition of the research topic. • Teaching the interpreters the subject of the course. • Discussion, among the organizers and the postgraduate students (tutors), on the possible questions that might be raised by the students. • Preparation of the materials and methodologies that might be necessary to answer experiments proposed by students.
Recruitment and selection
<ul style="list-style-type: none"> • Announcements of the course and its topic, at schools and among the deaf community. • Selection performed by teachers at their schools.
Short thematic science course
<ul style="list-style-type: none"> • Deaf students arrive at the university and are taken to a teaching laboratory, where they are divided in three groups, each group occupying a long bench. • The responsible for the course, the postgraduate tutors and the interpreters, present themselves, all in Brazilian sign language (LIBRAS). Two tutors and one interpreter are assigned for each group occupying a bench. Their composition remains the same until the end of the course. • In the first morning it is explained that this is a practical course, that they would provide the questions and would find the answers performing experiments. • The various questions provided by the deaf students are listed in a board and each group decides what question they would like to approach initially. • Each group, composed by six deaf students, two tutors and the interpreter, discuss how they would like to answer the proposed question. The tutors are not allowed to answer theoretical questions nor suggest experiments. In the moment the group decides what they would like to do the tutors teach them how to perform the experiment (that is performed by the deaf students). • At the end of the day each group presents to the other two their original question, the results obtained and what they are going to do the next day and why. • The next day starts by each group discussing among themselves their results confronted to the results obtained by the two other groups that picked up a different question to answer. In many instances they change their originally proposed approach for the day. Once again their results are presented at the end of the day. • The same activities are repeated for the next two days: Performing experiments, discussing with the group, building a hypothesis, performing more experiments and presenting an explanation. • In the morning of the last day the group needs to contextualize everything that had been seen and presented by all the groups in a coherent story. In the afternoon every group makes a final public presentation of their conclusions on the original given topic.

expositive classes, the majority of the deaf students demonstrated a high motivation and enthusiasm during the whole experimental course. Furthermore, their degree of engagement was such that sometimes it was difficult to convince them to stop the experiments they were doing because it was lunch time. Some of the students mentioned that it was the first time they really understood what they were learning. The challenge of this kind of teaching is to develop in the students a critical mind, their inquiring ability, as well as their capacity of collecting data, analyzing it and organizing all the information gathered.

For a number of postgraduate students working as tutors, this was the first time they were in contact with deaf students and were involved in a course with these characteristics. Not being a course organized on content transmission added a degree of unpredictability that was a challenge to the tutors. There was also a certain degree of mistrust in relation to the sign language interpreters. However, at the end of the course the postgraduate students ended by admitting that the course gave them a

new perspective. Some of the questions posed by the deaf had been taken for granted during years by the tutors, without questioning, and they felt that it had been very interesting to see these “truths” being questioned and observing experiments being developed to prove the particular point. One of the postgraduate students also admitted that lately he felt as being trained to perform experiments to answer the questions of his supervisor, not having enough encouragement to propose his own questions. Furthermore, in his own words: “Helping deaf students during the course brought back my original enthusiasm and curiosity towards science”.

In some of the courses the secondary school teachers (none of them was deaf) were also present. They were asked to make their own group in a separate bench and to proceed just like their students. This was not easily accepted in the first day. The school teachers argued that they were there to see how their deaf students were performing. It was explained to them that they could only feel the difficulties involved if they lived the same experience as that of their students. The teachers’

attitude was of insecurity, “they were teachers, and they could not get it wrong”. This changed during the course, and some of them returned a number of times bringing with them different students to follow courses with different topics.

DISCUSSION

The present work describes our experience with severe-to-profound deaf school students in Brazil that have LIBRAS as their first language. Similar to what has been described before (Mitchell and Karchmer, 2005), the profoundly deaf youngsters of our sample tended to have hearing parents and were usually the only deaf member of their family. Furthermore, in more than sixty percent of the families a large proportion of their parents or family members did not know sign language (Martins, 2011).

Therefore, these students lag behind hearing youngsters of their age as this lack of communication within the family not only delayed them from gaining access to a language (Goldin-Meadow and Mylander, 1990) and to an organized form of thinking, but also from gaining factual knowledge of the world normally acquired informally through ordinary interaction at home. Furthermore, many of our students were functionally illiterate and they tended to socialize within the deaf community where they communicated using sign language and shared similar constraints. The reading level of the students that participated in this study was very low and they had a great deal of difficulty in understanding a book or a written text of news. Many different approaches have been used to educate deaf students (Easterbrooks and Stephenson, 2006), most of them focusing literacy practices. Our course involved students in an active search for knowledge, using an inquiry-oriented teaching Bell et al., (2010). This approach has been suggested for teaching science to deaf students Chira, (1990). Our sample attended one week courses given in sign language, based on a specific scientific topic, without theoretical expository classes and involving inquiry, hands-on, minds-on and collaborative team work. This kind of short duration courses (see methodology) has been developed and used for hearing students since 1985 by Prof. de Meis at the Federal University of Rio de Janeiro, Brazil. Our experience with 10 courses and 193 deaf students has shown that this kind of approach is equally effective for deaf students, and that they learn, create and develop experiments exactly like their hearing pairs. This makes it possible to introduce this kind of activity without segregating deaf and hearing students. The courses attempted to reflect science as it is practiced and sometimes involved complex techniques and equipments, similar to those that would be normally utilized during a research project.

This was meant to show students the complexity of the methods and, at the same time, to demystify them demonstrating that it was possible to understand their

functioning. Therefore, this kind of course not only raised the curiosity of the students and gave them enough confidence to question what they wanted to know but also helped them to understand the potentials and limitations of the scientific process.

After the first courses the interest was raised among the deaf community and the number of applicants tended to be 60% higher than the number we could accept. Most of the students wanted to repeat the course in a different occasion with a different topic. This was not possible as we wanted to offer the courses to the largest possible number of deaf students. An additional and unexpected gain resulted from the fact that the courses were offered at the university campus. Most university students and faculty members totally ignored the problems faced by the deaf community and the contact with deaf youngsters made them change a number of their attitudes.

The high acceptance of our short duration courses, based on a single topic, indicated that it was possible to raise motivation and interest in scientific subjects among deaf students. Furthermore, the students realized that they were learning new strategies that went beyond science and could be used in a number of different situations. During the course, more important than laboratory skills they were developing a critical mind.

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