Role-play and the discussion of the controversial issues during teacher training: teaching practices in favor of a Sustainable Development?

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In order to respond to current challenges, typical of a society that is constantly changing and deeply marked by advances in science and technology, in the most recent curricular documents there is a philosophy that emphasises the formative and personal and social development aspects, as well as the interaction Science-Technology-Society-Environment (CTSA). In an open and democratic society, the education in sciences is particularly important in the training of citizens capable of participating actively and responsibly in the discussion or resolution of scientific and technological problems (Cachapuz, Praia, Jorge, 2004). The knowledge and understanding of science and technology and their role in our daily life enable individuals to get involved and understand the discussions about these issues, as well as their social implications. The valuation of a scientific education is evidenced in the PISA – *Programme for International Student Assessment* – study, launched by the organization for Co-operation and Economic Development (OCDE), in 1997, and whose main objective is to access the ability of 15 years old young people to use their skills (defined according to PISA) towards real life challenges. In the PISA report (OECD, 2006) special attention was given to scientific literacy. This focus on various issues related to science comes from the recognition that the individuals face daily with a large number of situations, problems and questions that require, in fact, some understanding of science and technology.

The Education in sciences also refers to the promotion of environmental values. Within the framework of the decade of Education for Sustainable Development (DEDS) (2005-2014), it is possible to affirm that Portugal as a country that has sought to stimulate participatory practices at different age levels, in order to ensure a future that guarantees sustainable development (National Commission of UNESCO-Portugal, 2006). The Sustainable Development requires an adoption of a model that is compatible with the ecosphere, less demanding in relation to natural resources and less harmful to the environment. To this end, it is essential to reduce the effects of human activity about the environment (Fernandes, Gonçalves, Pereira & Azeiteiro, 2007). Currently, the deterioration of the environment is a problem debated in the

most diverse areas, from the media, to political power and the international organizations.

If the seriousness of the environmental problems and the rapid rhythm of today's society call for an intervention and awareness in the environmental area, with a view in terms of continuity of life and sustainable balance, it is essential to reach the population of which young people are part of and, consequently, it is up to the school to intervene in this direction. For Fernandes and his collaborators (2007), the school is an important place to promote the necessary change and clarification, by transmitting the environmental values in order to train more enlightened and responsible young people. The use of diverse environmental themes, whose reflections are felt and have repercussions on the lives of the people and of the planet where they live provides, therefore, diverse opportunities for approach. Due to the rapid transition to the current state of modernization, our country has difficulties in achieving a sustainable situation. The problems are diverse: the disorder of the territory and the disfigurement of the landscape; low energy efficiency and the excessive dependency of fossil fuels (and the associated problems – climate change); the accentuated degradation of natural resources; and the social asymmetries (National Commission of UNESCO-Portugal, 2006).

The discussion of controversial issues and the role-play

In all societies there are controversial issues. The basis for controversy may stem from differences in religious beliefs (such as the abortion issue), cultural beliefs (such as the links between "race" and intelligence) and moral issues (for example, related to genetic engineer) (Oulton, Day, Dillon & Grace, 2004). Controversial issues are, by definition, issues on which there are significant divergences of opinion (Bridges, 1988). Several authors defend the exploration of controversial subjects in science teaching in order to build knowledge about the contents, the history and the processes of science and the comprehension of interactions between science, technology and society (Albe, 2009; Dolan, Nichols & Zeidler, 2009; Legardez & Simonneaux, 2004; Lundström, Ekborg & Ideland, 2012; Oulton et al., 2004; Reis, 2003, 2004). The socio-environmental controversy, explored in the present study, is defined as a conflict that arises from different social interests in relation to the use or management of environmental resources (Lumerman, Psathakis & Ortiz, 2011; Manzochi, 2008).

Empirical studies developed in Portugal show that teachers and students are in favour of inserting the discussion of controversial issues in class. Some of the reasons pointed out by both educational actors are related to: a) the potentialities of this methodology in the understanding of scientific, technological and social dimensions of important issues for citizens' lives; b) the development of thinking and argumentation abilities; c) the motivation of students; d) decision-making; and e) the

formulation of reasoned opinions and criticisms (Hilário, 2009; Reis, 2001, 2004, 2008). This type of educational experience is, therefore, capable of triggering an evolution in the cognitive, communicative, social and democratic processes, paving the way for scientific literacy and participatory and democratic citizenship.

However, there are many obstacles that arise and complicate the practices of teachers related to the discussion. Consequently, not all students have access to this type of educational experience. It is possible to highlight difficulties related to the educative system that, by the extension of the curricula and the use of national exams focused on memorization, make it difficult to carry out discussion activities in different educational contexts. Among teachers, the complexity of the issues in discussion, the difficulties in curriculum management and the lack of familiarity in relation to the theme and methodology in cause may also constitute strong barriers to the integration of the discussion in classes. In the students, there are problems related to their lack of experience in this type of activities and, consequently, the lack of interpersonal skills (Cowie & Rudduck, 1990; Dillon, 1994; Gall, 1985; Reis, 2001, 2004, 2008; Reis & Galvão, 2008). All of these barriers can be overcome but, for that, changes are needed which challenge the entire educational community. It is essential that teachers and their students familiarize themselves with this teaching methodology in order to overcome the difficulties they face. It is by knowing and reflecting about the potentialities and the obstacles detected in the discussion of activities centred on controversial issues that discussion activities can be fully explored and, thus, contribute to the development of diverse competences and social values. It is important to focus on an intervention that allows the promotion of skills in teachers, in the conception, implementation and evaluation of this type of activities, and in the development of skills in students, associated to a greater scientific literacy. Discussion activities can be carried out using role-playing.

In role-playing, the performance of each role gives students to opportunity to engage in discussion of distinct points of view on scientific issues (Cherif & Somervill, 1995) and about various social and environmental issues. The use of role-playing, in addition to placing the participants in certain situations, also identifies their obligations and responsibilities, thus contributing to further reflections about the consequences of their actions. The involvement of students in situations of stimulation exposes us to facts of reality that provide the activation of experiences, meanings and identities, ending up involving them in the problems where moments of sharing, experience and reflection linked to learning take place (Barab & Roth, 2006). As Colucci-Gray (2009) concludes, this whole process of sharing ideas of different characters can make students aware of how society works and of its own ways of acting and living. Osborne, Duschl and Fairbrother (2002) consider it necessary to support teachers in the implementation of this type of activities. According to these authors, the increase of effectiveness and of dynamism of role-playing may require the preparing instructions to students; encourage the adoption

of a role and define appropriate times for its implementation. Depending on the characteristics of the class and objectives of the teacher, it is possible to define different approaches for the presentation of roles. The role-playing organization model proposed by Cherif and Somervill (1995) involves a component of individual work in which, starting from the electronic addresses suggested by the teacher, the elements of each group should research information that allows the construction of arguments to support the position of the character that they represent and, therefore, prepares their report. After this data collection to support the position of each character, the group meets in order to share opinions about the issue under study, according to their character. It follows the final decision of the group that will be presented to class and discussed using various arguments.

Taking into account their characteristics, the effectiveness of role-playing is reduced if there is no previous knowledge about the theme under discussion (Duveen & Solomon, 1994). In order to overcome this limitation, it is expected to explore the theme in previous classes and provide a set of sources of information that students should use to reinforce their knowledge and to produce better arguments during the discussion. The promotion of role-playing in the classroom is justified by the fact that it is possible to measure an increase in student activity and their investigative practice, a retention of the material used in the exercise for a longer time and the evidence of a greater understanding of the issues involved (Duveen & Solomon, 1994; Ments, 1990). This type of activity still produces high levels of motivation and satisfaction in the participants and, consequently, it becomes difficult to interrupt the activity. Thus, the student acquires a deeper understanding of the problem under study and develops social and communication skills (Castano, 2008; Ments, 1990). In this context, the teacher is seen more as a facilitator of the exercise than a source of knowledge (Ments, 1990; Simonneaux, 2001).

Some of the problems that the teachers face in role-playing activities are related to: a) the time and effort that this type of activity requires to succeed; b) the difficulty in creating characteristics in sufficient numbers, perspectives or sources of interest for the topic under study; and c) the use of controversial topics from the ethical, social, political and economic point of view, regarding that many teachers have never been taught to negotiate conflict in the classroom or to teach how to develop conflict resolution skills (Cherif & Somervill, 1995). Regarding the obstacles, Simonneaux (2001, 2002) highlights: a) the lack of familiarity of teachers with this methodology that prevents , most of the times, the teacher to remain neutral during a discussion; b) difficulties in promoting an attitude of respect for contrary opinions; and c) difficulty in asking questions that promote a reflexive thinking, which is responsible for raising students' awareness of the role and limits of scientific knowledge and the values that arise with the subjects under study.

Role-playing can be considered as a teaching tool that can be used to explore and promote learning on an issue or as a means of developing various skills. The skills to

be developed come from a boarder understanding of learning that takes place on an ongoing and shared basis. In the current social context, where the boundaries between science and politics are less clear and where the limitations associated with scientific objectivity are recognized, it is important to think of a form of education that will redefine the power relations between science and the citizen (Colucci-Gray, 2009).

Methodology

This action-research integrates a broader study involving different types of activities to discuss controversial issues in order to provide knowledge about the factors that that may contribute to the quality of these activities. The present study contains a strong formative and reflective component, both for the students and for the teacher-researcher, and is qualitative nature. An investigation of this nature makes it possible to articulate theory and practice and, consequently, makes it possible to transform this practice (GTI, 2002), in order to change and improve a situation (Belton, Gould & Scott, 2006). The action-research is understood as a device where the process of educational action and research are produced simultaneously. The research follows the action in direction of its understanding. The resulting knowledge is reinvested in the action itself, as it aims at its transformation. Therefore, it is a process of research into action, through action and for the action, with active participation of the authors of the action (Caetano, 2004).

It is also a research that is inscribed in the critical paradigm for wanting a transformative action (that characterises this paradigm) and to involve in this action the social and educative authors (Ponte, 2008). This approach is characterised by an intervention of the teacher in his/her own context of action with a view to a change and, simultaneously, an improvement of the approach of the discussion of controversial issues in the formation of future teachers. Regarding the ideological nature of the critical paradigm, it is characterized by a more interventionist nature (Coutinho, 2011) aiming, in this study, to improve a teaching and learning situation.

This study was carried out with 67 students of two classes, working in a different regime, one during daytime and the other in the evening, attending a curricular unit of Environment and Sustainable Development. In order to evaluate the potentialities and the limitations of the discussion of controversial issues using the representation of roles in the environment classes, it was used a content analysis of the data obtained through the application of: a) a questionnaire evaluating the activity; and b) an interview with a member of each working group.

The qualitative analysis involved the classification of the registration units that constitute the texts, according to categories susceptible to introduce order in the apparent disorder of the raw data. The process of construction of categories was influenced by several aspects, such as, for example, the objectives of the study, and

involved the comparison of different units of information in order to detect recurrent categories among the available data (Bardin, 2009). A quantitative analysis was also performed with the purpose of helping to know the importance of each one of the categories considered in the study.

Characterization of the didactic approach of the role-play

As suggested by Tal and Kedmi (2006), the entire didactic proposal was planned to explore a relevant issue/theme of daily life and to enable future teachers to be actively involved in decision-making processes. According to these authors, participating in decision-making processes implies "an active interaction of students with their partners, sharing and communicating identified problems, asking questions, constructing and analysing arguments, deciding on the credibility of sources, interpreting data, raise hypothesis, draw conclusions, make value judgements" (p. 617). The selection of the environment theme was based on its current and social relevance. The problem invites students to become aware of the risks and interests involved and in which different groups of society, such as scientists, environmentalists, politicians and economists, take part. In line with the National Strategy of Sustainable Development (ENDS) (Resolution of the Council of Ministers number 109/2007, 20th of August of 2007) and with regard to the area of integrated management of water from watersheds, it was considered relevant to work the issue related to the construction of dams. Portugal is a country with high water potential in which the government has bet with a view to its better use, namely, through the National Program of Dams of High Hydro-electrical Potential. This bet aims to reduce the high energy dependence of the exterior and increase the percentage of electric energy produced by renewal sources. In this context, the country justifies its commitment to the construction of dams, but does it effectively constitute a sustainable bet? We propose to discuss this controversial issue with the group of students participating in this study, promoting in them the necessary knowledge and reflection to participate in the debate about these issues and to become aware of their role in the decision-making processes of the society they live in. The performed role-playing consisted of a decision-making exercise. The students were confronted with a real situation – The Alqueva Dam – and, through this example; the students had to decide whether or not to agree with the construction of more dams, carrying out or not more of these types of projects. The simulation of certain roles encourages the students to learn a particular way of thinking instead of memorizing facts (Jenkins, Purushotma, Weigel, Clinton & Robison, 2009), which encourages the development of skills.

The elements of each group formed an Evaluation Committee with experts from various sectors of society: agricultural, energetic, touristic, environmental and social sectors. The commission was responsible for analysing the current situation of Alqueva and decide whether it would be feasible to build more projects of this type,

and decide whether they are in favour or against. A favourable decision should indicate some conditions and make some recommendations.

Each member of the group represents one role, with the objective to write an individual report (with a maximum of 2 A4 pages) summarizing their substantiated opinion and their position in relation to the Dam of Alqueva and to other projects of the same nature. After discussing the arguments presented by each character, the group writes a joint reflection that bases their final decision on the feasibility and reasonability of more investments related to the construction of dams in our country and presents their conclusions to the class. The discussion of the group happens in several moments that are summarized in figure 1. In a similar way to the study developed by Simonneaux (2001), at the end of the activity each group should express their opinion on the subject under discussion – whether they are for or against the construction of more dams and the construction of more projects in this area. In case of agreement with the construction of dams, the groups specify in what circumstance they should be performed. This is, therefore, a moment of sharing with the class. This activity integrates an individual and group work component. The evaluation of this activity focuses on: a) group work; b) individual reflections; c) the quality of reflections built by the group; and d) in communicating the results to the whole class.

Figure 1 : *Organizational scheme of the didactic approach performed in the role-play*

	1st Phase	2nd Phase	3rd Phase
Organization	Individual work	Group work and small group discussion	Discussion in class
Task	Preparation of a report on the analysed sector	Discussion of ideas about the various studied sectors and Preparation of group reflection	Presentation and discussion of conclusions in each group

Presentation of results and discussion

Potentialities attributed to role-playing

Regarding the most relevant positive aspects pointed out by the students, they are the ones that coincide with the development of skills. The role of the teacher in the discussion was also often referred, as it can be seen in figure 2.

In the opinion of the respondents, the role-play on the problem of dam construction promoted the development: a) of substantive knowledge; b) of didactic

knowledge; c) of reasoning; and d) of attitudes. A high percentage of answers pointed to scientific knowledge as the most developed aspect through role-play (98, 4%). In the opinion of the students, this activity allowed the knowledge of the operation of a dam and the advantages and disadvantages associated with its construction and operation. The fact that they have to simulate different groups of citizens involved in this issue, made the students aware of the possible impact of this type of enterprise in several areas of our society. The contact with these types of groups was decisive for a deeper understanding of the theme.

Some students report that this discussion contributed to the knowledge of a current theme and the Portuguese reality:

> *I learned that the construction of dams has many positive aspects, in what refers to the evolution of tourism and of energies, because it is important to focus on the economic development and on alternative energies. However, at the social and environmental level, it presents serious problems, as the ecosystems and, villages and lives already built, will be destroyed. (Q, D13)*

> *The theme of the dams was not totally unknown, as it is a current theme in society and in Portugal. Despite this, there are aspects that I had never really thought about, especially the negative ones, because I thought that the construction of dams did not bring so many negative factors as they actually do. Having said that, after having done the work and after having had the opportunity to confront different opinions regarding the construction of dams, I had the opportunity to reflect on my opinion about the subject (…). (Q, PL11).*

Figure 2 : The knowledge that students consider to have taken place as a consequence of the activity of discussion about the construction of dams and the case of Alqueva

Category	Subcategory	N	%
Development of Skills	Scientific knowledge	63	98,4
	Communication	15	24,2
	Reasoning	9	14,1
	Attitudes	5	7,8
	Didactic knowledge	2	3,6
Teacher	Conception, management and evaluation of discussion	43	69,4
	Total students	**62**	

Subtitle: N – number of students who mentioned a certain aspect; % - according to the total number of students who answered the question.

The planning of the activity predicted the necessary research of information by the students in an autonomous way, in order to substantiate their role and, therefore, form a reasoned opinion about the issue under study, contributing to the

development of their reasoning (14,1%) and communication (24,2%). The reasoning of the opinion itself develops in students the argumentative capacity. This context of discussion promotes the expression of ideas by the sharing of opinions, both at the level of the group and of the class:

> *Once again, this activity served to deepen and improve the argumentative capacity of all members of the class. (Q, D24)*

> *It helped me to be in a situation of debate and manage the will to confront ideas with the defended ones. It has helped me to strengthen my power to defend something that does not represent my real opinion. (Q, PL12)*

> *Being able to listen to other opinions and build a more informed idea, about this subject. (Q, D13)*

The students also considered that this activity had an impact on the attitudes (7,8%) resulting in an improvement in interpersonal relationships. Greater familiarity with this type of activity may have led to an increase in respect for the opinions of the others:

> *In this activity, as in the previous one, I learned to respect both my classmates and the class in general. (Q, D41)*

> *This activity reinforced the dynamics practiced in the last group discussion and helped me to better understand certain opinions, as well as to accept them more easily, I feel that with the passage of time I am more receptive to different opinions. (Q, D39)*

Behavioural improvements were referred, mainly, by the students in the daytime class. This fact may be indicative of the occurrence of interpersonal problems during discussion in class. Through the analysis presented by the students, it can be seen that the acquired knowledge, in terms of skills, correspond to those that are mostly identified and discussed in the literature in the use of role-playing (Castano, 2008; Colucci-Gray, 2009; Cudworth, 1995; Duveen and Solomon, 1994; Hilário, 2009; Ments, 1990): a greater understanding of the issues under study and an improvement in the ability to argue, together with the development of social and communication skills. Two answers showed the development of the didactic knowledge (3,6%). These participants valued the opportunity to develop knowledge related to the accomplishment of discussions involving role-playing, emphasising the importance of this knowledge for their future professional practice. These data indicate the recognition of this type of activities and suggest their use in the teaching practices of these future teachers /educators:

> *This activity was an added value, for my future professional practice. (Q, D17)*

> *I acquired knowledge (a lot!) related to this specific theme, and also at the level of research in role-playing. This knowledge enables students to feel more integrated in the community and to be aware of the development. This activity enables us to learn to*

research in order to ground our statements and to develop the capacity for argumentation, as we defend a perspective. It is a very important tool for life because in any subject we always have to defend our opinion. It's learning to research in order to ground our statements. (Q, D37)

According to several participating students, the conception, management and evaluation of the discussion by the teacher constitutes a strong point of the activity of role-playing (69,4%, Q). From a set of focused points, the division of the theme by sectors (different roles) helped to deepen the subject and, as all elements of the group has a sector to work, everyone had to work hard and be involved in the task. In role playing, the discussion in group is essential so all group members get to know the sectors under study and form a deeper global view of the theme. Then, the group can be prepared to discuss their ideas with the class. The orientation of this activity followed some of the suggestions presented by Cherif and Somerville (1995) and Duveen and Solomon (1994), in order to provide accountability for all elements of the group, which seemed to really have happened.

During the interviews, among a set of references favourable to the planning of activity, the most valued aspect consisted in a set of guiding questions for each character that the teacher made available to the students. According to the interviewees, those questions enabled the guidance of the research process and gathering information, helping to select the meaningful information for each sector. This procedure seems to be most appropriate for groups of students with little experience in the discussion (Cherif & Somerville, 1995) as it ensures the research of the essential aspects to the discussion. Ensuring that everyone has prior knowledge of the theme is essential so that the discussion with role-playing is effective (Duveen & Solomon, 1994).

On the other hand, the fact that all groups have the same characters to represent and, therefore, the same questions of orientation, enabled a richer and more concordant exchange of ideas between the groups, since all worked from the same points of analysis. The attribution of different sectors to each group is considered positive because it allowed initially the development of an individual and more exhaustive research on each of the sectors involved in the theme. This individual exploration of a sector gave each element of the group a deeper knowledge about the dimension studied. Posteriorly, all groups had to meet in order to discuss the information related to each sector and all elements of the group were informed of the overall theme.

ENT – (…) What is your opinion about providing some guiding questions to the representative of each sector? (…)

D30 – I think it is good because it gives us clues about the path we have to follow, it does not mean that we have to limit ourselves to those points but it gives us an orientation of the essential points that we should study and work. (Ent, D30, p. 5)

Some students refer, for instance:

> *The whole process of accomplishment of this activity was very positive, as it enabled us to form and ground our knowledge, which is not always verified with the performance of exams, because the information provided by the teachers is memorized in order to be used later. (Q, PL13)*

At the same time, it was proved that the theme was also a favourable factor for the discussion, due to its social relevance and because it is a current theme with future repercussions, functioning as a precondition for the success of the activity:

> *I really enjoyed doing this activity, I think the discussion in class was very enlightening; many important aspects were focused and developed, in all aspects. In all themes, it was verified that each one complemented the idea of the other (…). These are themes that we do not think about every day, and after this kind of work we become more attentive. (Q2, PL17)*

In summary, the participants recognised that the role-play allowed the performance of many skills, mainly, the substantive knowledge.

Negative aspects of role-playing activity

As it can be seen in figure 3, in the questionnaire answers the students also identified weaknesses in the way the teacher managed the discussion (45,8%). It is interesting to notice that, if for some students the division of the theme by sectors was positive, for others it was a negative aspect of this activity. According to these respondents, the fact that they worked individually one sector enabled them to dominate it better than the others, compromising the global understanding of the theme. This situation is surprising, as the meeting in group work in order to discuss the ideas and information about each sector aimed to overcome this eventual limitation. It was intended that this group meeting would provide clarification and information sharing among the various elements so that all would take the different perspectives under study. Probably, this situation was related to the fact that the students were overly focused on their role and on their arguments and, consequently, did not pay enough attention to their classmates:

> *The fact that each element only develops one sector, I think that it could have been a group work because, there will be some gaps to fill in other sectors. (Q, D24)*

Figure 3 : Negative aspects attributed by the students to the discussion activity using in the role-play

Category	Subcategory	N	%
Students	Communication skills and group wok skills	13	22
	Reasoning	2	3,4
Teacher	Conception, management and evaluation of discussion	27	45,8
There are no negative aspects		26	44,1
	Total students	59	

Subtitle: N – number of students the referred a certain aspect; % - according to the total number of students that answered the question.

The intervention of each group in the discussion was organized so that the discussion process occurs after the presentation of the work of all groups and it was not possible to intervene individually before that. In the opinion of some students, this process has resulted positively as it allows everyone to present the group's opinion but, for others it would have been detrimental to the rhythm of the discussion:

> *In my opinion, (…) the negative aspects of these activities are final discussions. This is because we cannot intervene as soon as the speech of the classmates happens. And I think that only opposing all opinions when everybody has exposed their points of view; loses a bit of the impact. (Q, D33)*

Time management proved to be an inherent peculiarity of the nyght class. For some of the respondents of this class, the available time for the performance of the activity was not enough, namely, the period of time that happened between the delivery of the individual report and the subsequent positioning of the group. The explanation presented by the students relates to the lack of time for a better preparation of each moment of the activity. The reason why this factor is referred only by the class of after labour regime may be due to the fact that the students are mostly student-workers (TE) and have a family life (married and with children) that fills their availability. This situation conditions the working group meetings for the performance of tasks:

> *The negative aspects were lack of time and of availability for group work. (Q, PL27)*

According to the questionnaire answers of some students, the communication and group work skills (22%) and reasoning skills (3,4%) were the most negative aspects of this activity. In the opinion of some of them, the problems of disrespect towards the opinions of others seem to remain during the discussion in class. They also suggest

the lack of "knowing how to be" in group and the non-compliance with the rules established by certain elements. The negative cases identified in the study of Colucci-Gray (2009) also point to problems related to the ways of working in group and between groups, when the opinions of the others are not respected and valued. The author also focuses on leadership situations whose focus is on individual performance without appreciation of the contributions of all.

According to a small number of students, the reasoning was the skill where they face greater obstacles because they had difficulties in summarizing the researched information and in reaching conclusions about the subject in questions. These data demonstrate how decision-making about controversial issues can be difficult:

> *In this activity, I think there was a not good aspect, which consisted in the great concentration of information, in relation to this theme. This large information that was available, mostly on the internet, made the process of information selection difficult, as there was a great controversy regarding this theme. (Q, D17)*

During the interviews, the weaknesses associated with role-playing also focused problems related to the teacher's and student's action. In addition to mentioning as weak point the division of the theme by sectors, they allude to an insufficient introduction made by the teacher in this activity. They confess that the difficulties involved focused on the contextualization of the theme and on the points to be addressed, possibly due to the reduced knowledge about the theme under study – the dams. Thus, they present some suggestions to overcome this problem, such as the teacher making news or articles available for analysis at an initial moment and, later, start an activity.

Conclusion

The activity of role-playing allowed the development of great learning, namely, skills related to scientific knowledge, the communication, the reasoning and the attitudes. The references related to the development of didactic skills are highlighted. The participation in the role-playing activity gave the students the opportunity to contact with this type of discussion. From this contact, the students considered the use of this activity in their future professional practise. The simulation of different sectors seems to have enabled the students to understand the impact that the construction of dams can have on society. Therefore, they became aware of the mutual differences between science and technology and their impact on society and on the environment.

The learning carried out by the students during the role-play was notorious. Similar to what was verified in other studies (Barolli, Farias, & Levi, 2006; Freitas, Villani, Zuin, Reis & Oliveira, 2006; Galvão & Reis, 2008) the knowledge of the students about the theme under study was little or none at the beginning of the activity, ignoring in general some of the implications of the construction of dams. Due to the

lack of knowledge about the theme, some students lacked a more consistent and deep theoretical approach to facilitate the initial understanding of the theme, even suggesting the provision of articles /texts about the subject in order to overcome this problem. This suggestion was pertinent as the contact with newspaper articles from the media promote a better understanding of the parties and interests involved in this issue. However, this prior exploration was planned immediately after the introduction of the theme, through the researches and analysis of several documents, among them the *Bioquest* resource. At the end of the activity, it was found that the students were able to consider the involvement of various interests and relationships at the CTSA level and develop an environmental awareness for the sustainable development of the society in which they live.

Due to the specificity of this activity represented by several sectors, the students considered to be important the discussion that happened within the group so that everyone becomes aware of the other sectors worked by the different elements of the group. On the other hand, this division by sectors allowed a deeper study of the subject and everyone had to get involved in the work. The division of tasks seems to create a cooperation and accountability of all. The selected theme was considered pertinent because it has social relevance and is controversial. Still in relation to the planning of the activity, the supply of guiding questions for each role to be represented was received positively by the participants. This procedure seems to have been more suitable regarding the reduced experience of the students in the discussion and to think that, in this way, they would be more easily oriented in the information selection process. The fact that the guiding questions are the same among the groups; ensured that all groups explored the aspects that are considered essential in each dimension under analysis, allowing later a richer and more common exchange of ideas.

For students in the evening class regime, the time available for the activity was not enough for a better preparation and development of the theme. They recognize that this problem only arises because they are student worker and they have little availability to invest in research or to meet with group colleagues. Regarding this limitation, more classroom sessions may be introduced and during them the groups may, effectively, meet to carry out their work.

According to the conclusions of Lewis and Leach (2006), it is considered that a school curriculum that integrates the understanding of scientific concepts, of ideas about the nature of science, promotes ethical reasoning and the abilities of argumentation, will give more opportunities to be applied in the daily life of the students. Consequently, the students become better prepared to deal with social issues arising from the application of science and technology. Giving students the skills to solve the problems they face in their daily life in an autonomous and responsible way is, one of the possible implications that are expected to be achieved with this study.

It is known how difficult it is to develop an environment conducive to the teaching and learning process, but this is where the challenge of each education professional is centred, the constant search for improvement of the pedagogical contexts in which it intervenes, in order to provide the development of essential skills in the students to face the constant challenges of their daily life. It seems that, through the study promoted here, discussion (using role-play) is one of the promising methodologies in the formation of citizens capable of dealing with the diverse demands and changes of the current society, since it allows the aggregation of several favourable factors for the development of skills, as presented and discussed in the results.

However, it is known how it is not easy to implement despite the recommendations that may exist regarding its conduction in educational context. As Hughes (2000) and Martins (2002) mention, it is not enough to introduce references to an approach to content through controversial issues in the curriculum or programs so that this one is carried out. Thus, the recommendations that are left can be a contribution to a path to be adopted by professionals who want the introduction of other approaches and the innovation of their practices.

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