STUDENTS’ OPINIONS ABOUT A SSI: PERSPECTIVES REFERED IN THEIR ARGUMENTS ABOUT BEARS’ REINTRODUCTION

Ana Mª Domènech¹ and Conxita Márquez²
¹, ² Department of Science and Mathematics Education, University Autonoma of Barcelona, Bellaterra, Barcelona, Spain

Abstract: The use of Socio-scientific Issues in Science classes is proposed to define the curriculum’s organization and design activities with the aim of encouraging students to develop scientific literacy. In this research, an activity of bears reintroduction in the Pyrenees has been designed and developed in order to analyze from which perspectives do 125 students from two secondary schools (aged 13-14) placed in Barcelona make their arguments to base their decisions about the reintroduction. Data was collected with an open-ended questionnaire included in the activity designed and the results show that students justify their opinions with different kind of arguments from different perspectives as social-oriented, ecological-oriented and moral-oriented. However, they used to use only one argument in their justifications so they show difficulties to consider the different perspectives that are related to a socio-scientific issue when they have to make a decision.

Keywords: Socio-scientific Issue, Decision making, Nature of Science, Secondary school, Bear reintroduction

INTRODUCTION

Background and rationale

Scientific literacy has become an internationally well-recognized contemporary educational goal (Nuangchalerm, 2010). Although the definition of scientific literacy is controversial, students’ ability to deal with Socio-scientific Issues thoughtfully has been recognized as one of the important components of scientific literacy (Sadler, 2004). During the recent past, Socio-scientific Issues have been introduced in science classrooms and have been investigated by science education researchers (Albe, 2007).

The notion “Socio-scientific Issue” (SSI) has been proposed as a way of describing social dilemmas impinging on scientific fields (Kolsto, 2001; Sadler, 2004; Zeidler et al, 2002). In general, dealing with a SSI often involves argumentation and decision making on this issue as these are typically open-ended and ill-structured problems which citizens will find in their lives. This type of decision-making process needs to be studied in science education (Albe, 2007) and it becomes important to know how students take decisions in these contexts and how do they evaluate contradictory scientific information. Some authors considered that students are led to emphasize personal experiences or values (Sadler et al, 2004), others underlined that the overriding considerations are social or epistemological (Ryder, 2002) and some authors have questioned the importance of using scientific knowledge when SSI have to be settled.
Objective of the research

Giving the theoretical framework just presented, the specific objective this research addressed was analyze from which perspectives do students make their arguments to base their decisions about the bear reintroduction. In this study, in using the term “perspectives”, we are referring to the type of information (for example, as preference for either scientific or social information) participants used in the arguments generated in a decision-making process.

METHODOLOGY

Data collection

Research population

In order to achieve the objective just presented, an activity related to a SSI was designed and carried out in two secondary schools in Catalonia (Spain) in a science class in the context of formal education. Both schools are situated in towns near Barcelona but students from school 1 come from a low social and economic bracket, with 65% of them being immigrants mainly from South America and The Maghreb while students from school 2 come from a medium to high and cultural bracket, with 10% of them being immigrants. A total of 125 students (66 male and 59 female, aged 13 to 14) took part in this study.

SSI classroom activity design

The first phase of the research consisted of designing the classroom activity and the open-ended questionnaire we would develop and use to collect research data. After knowing which students would participate, we select with their science teachers which SSI would be the most suitable, positing the premise that incorporating these issues in science classrooms has to be related to scientific knowledge studied (Barab et al, 2006). As a consequence, it has to be an issue related to what students had studied in previous lessons and to scientific contents and competences defined by Spanish curricula. Considering these requirements, ecology bloc was selected as one of the most suitable subject for carrying out our activity and, as the United Nations declared 2010 to be the International Year of Biodiversity, bears’ reintroduction in the Pyrenees was considered the most adequate subject for carrying out our activity.

In 1996 bear reintroduction in French Pyrenees began with the support of Live Program of the European Union and Catalanian Government although there were different groups against this initiative. Since then, it became a local controversial. As with all SSI, politics, economics and cultural aspects play an important role in decision making about bear’s reintroduction in the Pyrenees. This issue is a social dilemma impinging scientific fields because people have to decide if this initiative continues and more bears are reintroduced in this territory where bear disappeared as a result of hunting. Since this initiative was proposed, there have been different stakeholders that have opposed to and it is an issue that usually appears in the media. Although the students who participate in this study did not live in Pyrenees, researchers thought that it was important talk with them about this reintroduction because they probably will have to face with species reintroductions in the future and make decisions about them as citizens.

Once the classroom activity and the open-ended questionnaire have been designed, they were presented to an expert group composed by teachers and science education researchers who analyzed them and made suggestions which were then incorporated. In the second phase these instruments were applied.
The activity designed lasted 2h and was carried out on February 2009. It was divided in two sessions. At the first one, students read news about bears’ reintroduction and the controversy related to it in order to being introduced to it. When students already knew this information, they discussed in pairs about the different viewpoints supported by all the stakeholders implied in this issue (as politicians, scientists, hunters, farmers or environment organizations for example). After discussing this information with the whole class, students read and discussed scientific information about bears’ and its ecological requirements taking into account students should use these concepts in their decision making. Then, students were asked to respond individually to the following open-ended questions and wrote down their answers:

- Do you think that bear reintroduction should be done in other place where people would not be hurt by bears? (Justify your opinion).
- Do you think that now we can’t know what consequences will have bear reintroduction so we need do more researches in the field? (Justify your opinion).
- How do you explain that scientists have not achieved an agreement about the bear reintroduction? Justify your opinion and explain how do you think it could be reached

In the second session students had to write an argumentative text presenting their personal opinion about bears’ reintroduction after following a guide and discussing it in groups before explaining what they have learned in this lesson and which changes would propose in order to improve the classroom activity development.

**Data analysis**

According to other similar studies and to our research aims, qualitative methods combined with quantitative parameters of analyses were employed. The first phase of the analysis consisted of categories definition following an inductive-deductive method. As a first step of inductive analysis of the data (Lincoln & Guba, 1985), questionnaires responses were read in order to make preliminary notes regarding patterns emerging from data. As a second step, the emergent categories were compared with the categories obtained in other studies and then they were used to classify the arguments given by the students in their responses. The second phase of the analysis was analyzing the frequency of the categories considering qualitative indicators and quantitative measures described in Wu and Tsai (2007) as will be explain in the next point. All this process was made by an independent examination of data done by investigators and the support of Atlas.Ti.

**RESULTS AND DISCUSSION**

In answer to the question “Do you think that bear reintroduction should be done in other place where people would not be hurt by bears? Justify your opinions”, students justify their opinions generating arguments from different perspectives. After categories definition following an inductive-deductive method, in this study, as is shown in table 1, learners generated their arguments from different perspectives such as “social-oriented”, “ecological-oriented”, and “moral-oriented” perspectives.
<table>
<thead>
<tr>
<th>Category</th>
<th>Key words</th>
<th>Exemplar</th>
<th>% students refer to</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Social-oriented” arguments</td>
<td>Welfare or safety</td>
<td>“In my opinion bears should be out of the Pyrenees to prevent the bears will eat sheeps”</td>
<td>67%</td>
</tr>
<tr>
<td>Focus on human</td>
<td>Human’s welfare or safety, economic aspects</td>
<td>“Bears should be in another place because if they are in the Pyrenees, people will be afraid of them”</td>
<td>36,8%</td>
</tr>
<tr>
<td>Focus on bears</td>
<td>Bears’ anthropomorphism, bears’ welfare or safety</td>
<td>“Bears should be in another place because if they continue in the Pyrenees, they will be afraid of people”</td>
<td>30,2%</td>
</tr>
<tr>
<td>“Ecological-oriented” arguments</td>
<td>Habitats, extinction, ecosystems, food chains,</td>
<td>“I think bears should continue in the Pyrenees because it’s their habitat”</td>
<td>12,3%</td>
</tr>
<tr>
<td>“Moral-oriented” arguments</td>
<td>Right to live, behaviors or beliefs considered to be good or bad</td>
<td>“I think that bears should be in other zone because if they hurt people they have to be punished”</td>
<td>20,7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Politicians should take into account that all species have rights and Earth is our planet”</td>
<td></td>
</tr>
</tbody>
</table>

“Table 1. Categories and frequency of perspectives from which students make their arguments to base their decisions about bears’ reintroduction”

Social-oriented arguments were based on the welfare of society or human sympathy and an example is “In my opinion bears should be out of the Pyrenees to prevent the bears will eat sheeps”. It is important to note that, in the analysis, authors considered that it was important to point out that there were students who referred to anthropomorphisms talking about bears as if they were people and, in their arguments, refer to bears’ welfare. An example of these kinds of arguments was “Bears should be in a territory where they can’t be afraid and live safety”. On the other hand, there were students who justified their opinions with the same arguments but pointing their point of view on humans: “I think bears should be in a territory where people can’t be afraid by them”. As a result of this fact, authors distinguished two
subcategories in the “social-oriented” category depending on whether students focused on talking about humans’ or bears’ welfare.

In contrast, ecological-oriented arguments referred to the interactions established between species and the environment where they live as it can be seen in this example “I think bears should continue in the Pyrenees because it’s their habitat”. It has to be considered that successful biological conservation management programmes like reintroductions also depend on an understanding of the biology of the organisms concerned, and how they interact with their surrounding environment (Grace & Ratcliffe, 2002).

Finally, moral-oriented arguments were related to attitudes, facts, behaviors or thoughts that were considered good or bad, for example “I think that bears should be in other zone because if they hurt people they have to be punished”.

These results were consistent with Wu and Tsai (2007) analysis because in their framework they determine that in a SSI, learners may generate their arguments from different perspectives such as social, ecological, scientific or technological. Nevertheless, there were some differences that we would explain. In our study, economic-oriented arguments were included in social-oriented perspective because authors considered that economic safety is part of society welfare’s. On the other hand, science-oriented arguments were represented by ecological-oriented while technology-oriented arguments were not represented because students didn’t identify a technological component in this SSI. It is important to note that, although moral-oriented arguments were not distinguished in Wu & Tsai study, moral perspective is recognized in other studies like Fensham (2002) and Albe (2007). As SSI are of a contentious nature, they may be analyzed according to different perspectives, they do not lead to simple conclusions and often they involve a moral or ethical dimension (Sadler, Chambers, & Zeidler, 2004).

Another interesting aspect is to analyze how many arguments are provided by learners. In this research, students utilized, on average, only one argument to justify their opinion (mean = 1.27) although there are different perspectives related to this SSI. These results do not concur with results obtained in Sadler, Chambers, and Zeidler (2004) and Yang and Anderson (2003) where learners were oriented to reason from multiple perspectives. Despite this difference, in this research, students who justify with more than one argument use to base them on different kind of perspectives and ecological-oriented considerations where the less proposed as occurred in the studies cited above. This trend might be due to their insufficient abilities to make the connections between what they had learned in science classrooms and the SSI they encountered in daily life (Wu & Tsai, 2007). Contrary, Kolsto (2001) argued that students’ knowledge acquired in science classroom can serve as tools for their informal reasoning and decision-making on controversial issues.

CONCLUSIONS AND IMPLICATIONS

In the present research, students generate their arguments on bears’ reintroduction from different perspectives as social-oriented, ecological-oriented and moral-oriented. Despite this fact, the results of this study suggest that students have difficulties to consider all these different perspectives related to a SSI when they have to make a decision, so, it is suggested that they are not able to reason from multiple perspectives. Moreover, ecological-oriented arguments were the less use although students have studied ecology before doing this activity. As a result, this study shows that students also have difficulties to use scientific knowledge when they make a SSI decision.
Taking this into account, it would be important to carry out activities to promote the analysis of the controversy from different viewpoints and to facilitate the scientific knowledge transfer to SSI decisions. To example this idea, in our classroom activity development we would design a set of new exercises in order to emphasize the science and values that each stakeholder implied in bears’ reintroduction draw upon to justify their ideas while students understand they will need to know these information to be able to justify their opinions. On the other hand, the instructor could also explain the relationship between the SSI and the concepts covered in class or share their viewpoints as long as they explain how they use facts to come up with their view or resolution.

In conclusion, further research will be needed in order to improve our understanding of decision-making related to SSI. In particular, some studies can be conducted to examine deeply how students make decisions in these contexts and describing which teaching strategies could be used to enhance students’ learnings transfer and engaging them in scientific practices in order to help them understand the nature of scientific knowledge.

**Acknowledgments**

Based on work supported by Spanish MCYT grant EDU-2009-13890-C02-02) and Catalan PRI 2009SGR1543.

**REFERENCES**


Grace, M., & Ratcliffe, M. (2002). The science and values that young people draw upon to make decisions about biological conservation issues. *International Journal of Science Education, (915530145).*


MIMICKING AUTHENTIC SOCIETAL PRACTICES FOR LEARNING ABOUT THE USE OF SCIENCE-RELATED INFORMATION

Ingo Eilks¹, Ralf Marks¹ and Mareike Burmeister¹
¹University of Bremen, Germany

Abstract: Modern standards for science education ask for promoting scientific literacy for all students. One of the central objectives is that all students should develop skills to be able to actively participate in societal debate on applications from science and technology. One of the central prerequisites for participating in societal debates is the competence of doing evaluations. But, evaluation competence covers several different dimensions: evaluations in science, evaluation about science, or reflecting evaluations done by others. This essay discusses using the socio-critical and problem-oriented approach to science teaching as a basis for learning about evaluation processes with regard to societal questions of science and technology. The idea of filtered information will be introduced for better understanding the process of evaluations done by different groups of persons in society. Learning about filtered information is operated by mimicking authentic societal practices in which science-related information is filtered and used. Examples and experiences from lower secondary science classrooms are reported.

Keywords: science education, curriculum development, scientific literacy, socio-scientific issues, filtered information

LEARNING ABOUT EVALUATIONS IN SOCIETAL-ORIENTED SCIENCE EDUCATION

A central objective of developed scientific literacy (Bybee, 1997) is to become able to understand and to participate in societal debate concerning questions of science and technology (Roth & Lee, 2004). Although the goal is not new and respective standards are now available for quite a long time (e.g. AAAS, 1993; NRC, 1996) the practice of science teaching in many countries is still neglecting the societal dimension of science education and the promotion of respective skills for active participation in society (Hofstein, Eilks & Bybee., 2011).

In the core of the skills to take up own interests in society and to participate in societal debate is the competence of doing evaluations (KMK, 2004). In contrast to other areas of science education, the competency of doing evaluations has typically not been taken into account very seriously in many traditional science curricula (Marks & Eilks, 2009). This observation becomes even truer when we understand the area of evaluation not just as evaluating in science (in other words, evaluating the processes of knowledge discovery, measurements and learning results), but rather as communication and evaluation about science (an evaluation of the role of science in technical, economical or societal developments).

Need for change towards more societal-oriented science education and a more through focus on learning to do evaluations gains growing support from different theoretical resources. In the German-speaking realm, this view coincides with the concept of Allgemeinbildung (e.g. Elmose & Roth, 2005), defined as the educational upbringing of pupils to be responsible