This is the published version:


Available from Deakin Research Online:

http://hdl.handle.net/10536/DRO/DU:30044969

Reproduced with the kind permission of the copyright owner.

Copyright : 2011, European Science Education Research Association
A FRAMEWORK FOR CONSIDERING CROSS-CULTURAL EXCHANGES AS A WAY TO DEVELOP REASONING ABOUT ENVIRONMENTAL SOCIOscientific ISSUES

Olivier Morin12, Laurence Simonneaux2, Russell Tytler3, Jean Simonneaux2
1Université Lyon 1 (France)
2Ecole nationale de Formation Agronomique, Toulouse Auzeville, UniversitéToulouse 2 (France), UMR
Éducation Formation Travail Savoirs
3Deakin University (Australia)

Abstract: This study analyses the evolution of socioscientific reasoning on sustainability, of French and Australian tertiary students exchanging ideas on a digital platform, concerning local (Australian, French) environmental SSIs, and global environmental SSIs. We explore how the exchange of arguments from various disciplinary and cultural perspectives, can promote reasoning about complex problem-situations in the environment. We develop a framework of reasoning, and show how it enables a productive analysis of the nature of the exchanges, and the quality of reasoning. We argue that such a strategy may improve epistemological training on the nature of science, and citizenship.

Keywords: Socioscientific issues, Reasoning, Sustainability, Cross-cultural, Digital environment

Teaching Socioscientific Issues (SSIs), at a time when scientific expertise is the subject of controversy and debate in society, places risk and uncertainty at the heart of the teaching / learning process. The very nature of SSIs implies argument about them from different domains of reference (in experimental science, humanities and social science) and from social and professional knowledge. We are interested in this study to explore the evolution of students’ reasoning about Environmental SSIs (ESSIs), that is to say problem-situations involving tension between the functioning of ecosystems and human interventions related to the management of these ecosystems' products and services.

1. RATIONALE

Awareness of environmental issues in discussions on the appropriate development model for our society is integrated in educational settings linked to sustainable development. Too often, the educational goal is limited to development of good practice (sort waste, carpool ...). We believe that Education for Sustainability (EfS) can also effect change in students’ relationship with scientific knowledge, with the assessment of expertise and with the social relations that are involved. EfS thus implies a scientific literacy questioning the relationship between techno-scientific progress and society.

To address ESSIs from different perspectives, through the prism of various and sometime conflicting interests, seems a good way to understand their complex nature. By
bringing together students from different scientific disciplines, and from different continents, we explore how the exchange of arguments from various perspectives promotes the perception of complex problem-situations in the environment. We explore how such a strategy may improve epistemological training on the nature of science, and on citizenship.

To reflect the interactive nature of the exchanges, we chose to use categorizations developed by Mercer (1995) from an analysis of linguistic interactions between students. One of the functions of language, according to Vygostski (1985), is to enable learners to organize their own thoughts and give meaning to words. Indeed, Mercer (2002) states that we use language to transform our thinking through individual thought and collective action. Postmodern thought states that any discourse can only be relative because our era has shown that we cannot establish universal standards. With the Theory of Communicative Action (1987) Habermas shows instead that the communicative function can break this deadlock and produce a democratic agreement. Construction of reason passes in effect through intersubjectivity, with communicative action based on mutual understanding, designed for justice more than truth, to coordinate planned actions.

2. METHODS AND RESEARCH QUESTION

We have posed three ESSIs to Australian and French students who were able to meet virtually through a digital platform. We are looking at the possibilities of on-line community interactions contributing to learning and at the aspects of cross cultural interactions which act to broaden students’ perspectives on SSIs. The three ESSIs fit into the general theme of "Feeding humanity." We have chosen this theme for its potential to promote individual and collective reflection on the role of expertise in developing a position. Everyone can feel concerned: as a consumer embedded in his social group, as a scientific expert holding more or less current knowledge, or as a "world citizen" involved in a debate on the future.

Our research question is: How do socio-cognitive disturbances, made possible by this cross-cultural approach, contribute to the evolution of socio scientific reasoning in the perspective of sustainability?

2.1 Design of the intervention

The intervention took place during the months of March to June 2011, with thirteen French students from ENFA of Toulouse in their fourth year of a teacher education degree in different disciplines (animal or vegetal production, economy, sociocultural education) and five Australian students which were undertaking their third year of a teacher education degree and specialized in science and environmental education. The two student groups were each divided into three subgroups, each of which took responsibility for discussion and construction of a wiki on one of three socio-scientific sustainability issues. These three issues were designed such that one issue was particularly pertinent to France (4 French & 1 Australian students), one to Australia (4 French & 2 Australian students), and the third was global in nature (5 French & 2 Australian students). The issues involved:

- A green algae outbreak along the coast of Brittany, linked to release of fertilizer by agronomists. The issue thus involved, ostensibly, a conflict of interest between the enjoyment by citizens of the coastal environment, and the needs of the farming community. The issue had a strong ‘local’ French context but for the Australian students was ‘remote’.
• The construction of desalination plants to produce fresh water. This issue was particularly pertinent, and ‘local’ for the Australian students since following years of drought the Victorian government had commissioned such a plant, against widespread opposition by rural and environmental groups, and taxpayer interests.

• The consumption of meat, which was held to be an issue of global scale, and similar in exposure to the French and Australian students.

The sequence of events was as follows: A media file was prepared for each of the three issues, and uploaded onto the project website. “Forum A” involved discussion separately for the French and Australians. This took place in the groups’ first language and led to the construction of a first Wiki by each group, in English. Then the wikis of the French and Australian groups were opened to each other, and a “Forum B” was opened for international exchanges in which each group questioned the other and attempted to come to a common understanding. The last step was the reconstruction of the wikis following this international exchange.

2.2 Analysis framework

Several researchers have developed and modified a grid to analyse socioscientific reasoning (Sadler, Barab & Scott, 2007; Simonneaux & Simonneaux, 2009, Morin & Simonneaux, 2010) to identify the inclusion of uncertainty and complexity in reasoning about problem-situations. The latest version of this grid from the perspective of sustainability (Socioscientific Reasoning and Sustainability: SSR and S) consists of 6 dimensions (Problematisation, Scales, Knowledge, Uncertainty, Values, and Regulation). On each dimension 4 levels of depth are defined, through which the level of reasoning can be assessed.

Mercer (1995, 2002) defined three types of discourse: Disputational talk, where the relationship is competitive, differences of opinion are stressed rather than resolved, and the general orientation is defensive. Cumulative talk, where ideas and information are shared rather than discussed in the process of constructing knowledge. Exploratory talk, during which speakers engage in critical but constructive discussion about each other's ideas and alternative viewpoints are suggested. Most studies show by analyzing the language of students during classroom debates that there are mainly disputational and cumulative talks. A number of limitations have been attributed to Mercer’s approach, in particular because it doesn’t take into account the content of speech. This is why we have added another criterion of analysis, concerning the domain of validity of arguments.

Habermas distinguished between for types of social-interactions according to the domains of validity of arguments in reference to the three dimensions of what he called “real life”. We have used this reference to the three worlds to characterize on-line community interactions. In the Objective world, statements or questions are based on logic, empirical efficiency, and scientific truth. In the Social world, interventions enable the speaker to show he is a member of a group by following social norms of behavior, or to question the interactions and regulatory procedures between social actors. In the Subjective world, the speaker expresses his/her personal experiences, his/her affect, his/her own perception of the situation, and considers the views and the subjectivity of his/her interlocutors.

Thus, we have drawn up a tool combining these two theoretical dimensions. According to our research question, the analysis is focused on the differences between the type of contributions before and after the opening of international exchanges.
3. RESULTS

On our design work, we observe a lot of cumulative talks, in which reasoning was supposed pre-existing and individual positions already determined. Two other types of talk have been observed. In both, the participant’s position is not predetermined: i) in the third type, participation is directed towards the development of individual reasoning, just as in the exploratory talk of Mercer, ii) in the last type, that we have called “Integrative talk”, participation aims at integrating new features into the collective reasoning.

<table>
<thead>
<tr>
<th>Reference to the objective world</th>
<th>Cumulative talk</th>
<th>Exploratory talk</th>
<th>Integrative talk</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPOSURE</td>
<td>The response is affirmative and is based on logic, empirical efficiency, scientific truth. Knowledge is presented as certain. Rationality is technical, instrumental.</td>
<td>REFLECTION</td>
<td>The contributions point to differences in statements, doubts, judgments on consistency with the positions of the speaker. The search for new knowledge may be considered.</td>
</tr>
<tr>
<td>IDENTIFICATION</td>
<td>The procedure allows the speaker to show membership in a group. The statements are based on the values of this social group.</td>
<td>RECOGNITION</td>
<td>The contribution considers the views of other participants or the views of several categories of social actors. The speaker can ask questions of other participants.</td>
</tr>
<tr>
<td>TESTIMONY</td>
<td>The response expresses the opinion of the speaker, which refers to personal experience. He expresses his emotion, his own perception of risk, or the values underlying personal commitment.</td>
<td>ASSESSMENT</td>
<td>The contribution considers views different from those of the speaker, which identifies the values taken by others. The speaker can make judgments, but changes of opinion are possible.</td>
</tr>
</tbody>
</table>

Table 1: Analysis framework

3.1 Impact of contextualizing ESSI

With the GREEN ALGAE issue, it seems that the significance of individual experience is decisive. The introduction of the French wiki gives a sense of the tone: “I remember swimming and fishing near the river, this was a very important place where every child went after school. I remember when on Sundays we went with my family to the sea smelling the good air and seeing the beautiful landscape. It was few years ago... “. It is possible for personal commitments to overshadow a more dispassionate consideration of the
different interests at stake and the wider social policy ramifications. During the exchanges about this issue, the participations often remained as testimony. Table 2 gives the analysis of these first phase exchanges:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Exploratory</th>
<th>Integrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Green algae, French discussions in the first phase, March 14 to May 19 (16 entries)

In the second phase, we collected only a few international exchanges. Most of the discussions are of the cumulative type:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Exploratory</th>
<th>Integrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3: Green algae, international exchanges, May 29 to June 15 (9 entries)

With the SEAWATER DESALINATION issue, one can compare the contributions of the 'local' and 'remote' participants. It seemed that little is known by the "remote" participants and this naturally leads to a search for objective information (9 out of 10 exchanges in the first phase of treatment came from French participants):

<table>
<thead>
<tr>
<th>Objective</th>
<th>Exploratory</th>
<th>Integrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4: Seawater desalination, discussions in the first phase, Mars 14 to May 15 (22 entries)

The first French wiki talked about the problem with a reserved attitude. They took the position of distanced commentators and their group did not feel compelled to commit to a position. They did not enter into the topics proposed for the wiki and only one of the four participants gave the only contribution to finding a possible action. They considered the issues on a global scale but did not engage with local contextual interests and alternative approaches. On the other hand, the Australian students positioned themselves as activists in their consideration of the issues. Their wiki was much more focused on social and technical aspects of local controversy. While one of the two participants reported extensively on the views of stakeholders, the other listed possible solutions implemented locally such as the use of "rainwater tanks". This situated approach seems to have led them to tackle more political issues.

3.2 International interaction and growth in understanding of other perspectives

To what extent did our design work engage students in genuine debate? The discussion about the desalination issue of the first phase was very cumulative, then became exploratory in the second phase during Franco-Australian exchanges (period from May the fifteenth to June the seventeenth). Each highlighted aspects of the controversy he or she considered important, and brought them to the debate. For instance: (French student) "You
bring a substitute solution which we French students had not thought about “Using rainwater tanks on all houses to supply water”. This idea does not seem to me to answer the need for water in Australia. [...] Rainwater tanks are ineffective in this use.” (Answer of an Australian student) “I too agree that rainwater tanks are not the solution. However, in saying that, they can be a great way to save a lot of water. My family live in country Victoria [...] and are completely self sufficient in their water use through installing two large rainwater tanks. [...] Therefore, I believe by most houses being able to supply even a small portion of their daily water use from rainwater tanks, it can help alleviate the water shortage we have here.”

The complexity of the controversy is explored further in that second phase, especially in the second column (13 entries out of 27) that identifies the stakes for participants:

<table>
<thead>
<tr>
<th></th>
<th>Cumulative</th>
<th>Exploratory</th>
<th>Integrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Social</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Subjective</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 5: Seawater desalination, international exchanges, May 15 to June 17 (27 entries)

The attitude of the international group became proactive and each participant through investigation built their critical thinking. It seems here that international exchanges have contributed to more than the juxtaposition of elements. They have led everyone to be clearer with his or her own position.

The MEAT CONSUMPTION issue is also one in which personal context is very apparent. Very quickly in the forum, exchanges moved to declaration of each individual’s consumption of meat which placed the problem in a personal context and displayed identity commitments: “I come from the southwest, a part of France where food is very important. At my grandmother’s for dinner ....” “We Aussies like our barbies”... Different aspects of the debate were opened up, as different positions were dealt with: “Looking at it from an individual perspective, I believe that it would be impossible logistically to outright stop meat production. Too much is reliant on its continuation (people’s livelihoods, demand within the market, obvious health benefits etc)”.

But the construction of the wiki tended to be organized around a division of labor (no action on the French wiki involved the removal or modification of what others had written), with a propensity to neutralize the discussion.

<table>
<thead>
<tr>
<th></th>
<th>Cumulative</th>
<th>Exploratory</th>
<th>Integrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>14</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Social</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Subjective</td>
<td>6</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6: Meat consumption, discussions in the first phase, Mars 12 to May 15 ( 41 entries)

Note that in the first phase, entries are mainly references to the objective world (first row, 24 of 41) and result in a juxtaposition of individual claims (first column 22 of 41). The attitude of the group is retroactive, the communication mode is the "strategic action" of Habermas and the activity is considered as a presentation. The partners are building a common knowledge accumulation, but the decision for action is vested in the reader.

In contrast, the second phase of exchanges is distributed more evenly between the three lines, and three columns.
As with the desalination issue, the activity of the group became proactive and generated more "communicative action", referring to the three "worlds" of Habermas. The discussion became more exploratory. The wiki was seen as a rational presentation of views, which may be different.

**Conclusion**

The interactional socio-scientific reasoning framework proved fruitful for analysing these online community interactions, in particular because it opened up new ways of looking at these exchanges and it helped to understand that reasoning collectively at a high level require arguments across the three worlds in integrative exchanges. We can argue that features of the digital environment both support and constrain students’ reasoning on SSIs, with a lack of dispute in forums and wikis, and the problem of distribution of responsibility on the one hand, and with the value of the international forum in creating the requisite disturbance on the positive side. We conclude that cross cultural exchanges add to the richness of student reasoning both through local vs remote perspectives, and different cultural standpoints. Our team is now developing a new research aiming at a better balance between face to face and online position development. We propose a hybrid system in which students will debate in class, in groups, prior to the use of the digital platform to develop the wiki. We will maintain a commitment to an international forum in which the wiki of each group is opened to scrutiny by the other.

**References**


