SYMPOSIUM: Reflective inquiry as a framework for designing teaching and learning sequences on socio-scientific issues

Abstract

In the past decade, there has been mounting evidence that the problem has become more acute. Studies, such as those performed under the ROSE project, (Sjøberg & Schreiner, 2006), have indicated that most youth surveyed expressed positive attitudes on the importance of scientific and technological issues to society. However, the students show a diminishing interest.

There are four different papers being presented in this symposium. They are from ongoing large-scale projects on Socio-Scientific Issues (SSI). The three first are part of a European project, *CoReflect* (www.coreflect.org). The forth is from a national project in Sweden *SISC* (www.sisc.se). The two projects take different perspectives on scaffolding, inquiry and collaboration in SSI. One project is focusing on data-driven inquiry, where collaboration and scaffolding are important aspects. The other has a more pronounced humanistic perspective and focus interest, knowledge and self-efficacy of the students. One project has a designed-based approach with teachers taking part in the developmental phase, while in the other a large group of teachers have implement pre-designed materials. A digital learning environment is used in a collaborative setting in one project, whereas teachers in the other project are using the materials in different ways.

Introduction and relation of papers

According to many studies (e.g. Osborne & Dillon, 2008, Tytler, 2008) there is a strong need to renew science education. Arguments for change are that young people's interest in choosing a scientific career is declining and scientific ignorance in the general populace is extensive. In the past decade, there has been mounting evidence that the problem has become more acute. Studies, such as those performed under the ROSE project, (Sjøberg & Schreiner, 2006), have indicated that most youth surveyed expressed positive attitudes on the importance of scientific and technological issues to society. However, the students show a diminishing interest.

We believe that one of the reasons that students, especially during the critical period of 11-14 years old, lose interest in science is the lack of appropriate curriculum materials that help them connect the scientific enterprise to human activity, and the role of the accumulated scientifically-based knowledge and technological development in their everyday life.

In addition, the ability to make informed decisions on socio-scientific issues, grounded on scientific evidence, appears a fundamental attribute not only for scientific literate people but also for democratic citizens. However, the development of this skill is not straightforward (Lee, 2007). Engagement in group discussions with some teacher intervention has proved not to be an adequate condition for promoting advanced decision making skills (Ratcliffe, 1997).

Definition of problem for the symposium discussion

There are four different papers being presented in this symposium. They are all from ongoing large-scale project on Socio-Scientific Issues (SSI) that are running over several years. The three first are part of a European project, *CoReflect* (www.coreflect.org). The forth is from a national project in Sweden *SISC* (www.sisc.se). The two projects take different perspectives on scaffolding, inquiry and teaching of socio-scientific issues. This will be problematised and discussed during the symposium. One project is focusing on data-driven inquiry, where collaboration and scaffolding are important aspects. The other has a more pronounced humanistic perspective (Aikenhead, 2006) and focus interest, knowledge and self-efficacy of the students. One project has a designed-based approach with teachers taking part in the developmental phase, while the other has had a large group of teachers implement pre-designed materials. A digital learning environment is used in a collaborative setting in one project, whereas teachers in the other project are using the materials in different ways.

1-3. Digital support for Inquiry, Collaboration, and Reflection on Socio-Scientific Debates – CoReflect.

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Kalypso Iordanou and Constantinos P Constantinou, University of Cyprus

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4. Socio-scientific issues – a way to improve students' interest and learning?

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Background, Framework, and Purpose

One way to increase students' interest and learning could be to bring in a humanistic perspective (Aikenhead, 2006) and to focus more on *scientific literacy* than *science literacy*. In this project we have designed an evidence-based research project to see what happens with interest, knowledge and self-efficacy when students in lower secondary school work with socio-scientific issues (SSI) but also how teachers response to this teaching. Ratcliffe and Grace (2003) describe general characteristics of such issues as; important for society and have a basis in science, involve forming opinions, are frequently media-reported, involve values and ethical reasoning, and there are no "right" answers.

Rationale

Our research questions are

- What knowledge do the pupils develop when working with socio-scientific issues?
- How do interest, engagement and self-efficacy develop in the work? What importance do the tasks have?
- How does the pupil's argumentation develop?
- What knowledge do teachers develop and how does their view of teaching develop?

Methods

The project started in 2006, will end in 2010 and consists of three parts. First we developed a conceptual framework to use as an analytical tool for understanding and constructing socio-scientific cases. The framework is adapted from Levinson (2006) and consists of six components starting point, school science subject, nature of scientific knowledge base, social content, use of scientific knowledge, and type of conflict. From the framework we constructed a teacher guide with six socio-scientific cases which are different regarding the components above. The cases are 1) You are what you eat? 2) Laser treatment and near sightedness 3) To hear or not to hear? 4) Me, my family and global warming 5) Are mobile telephones hazardous? and 6) Climate-friendly food in school? (Ekborg et al. in press). Two pupil questionnaires were developed, the first aimed at describing the work forms that the pupils were accustomed to in science class and pupils personal characteristics from several aspects; learning goals, attitudes toward science in school and society, self-efficacy and beliefs about learning. The second aimed to measure the situational characteristics of the SSI work and its cognitive/behavioural and affective outcomes (Winberg & Lindahl, 2008). A teacher questionnaire with 61 questions about working forms, assessment, learning and personal experiences was also developed together with an interview guide. The items in all questionnaires were collected from extant questionnaires or constructed based on theory within the field.

In next step we invited teachers from lower secondary school to participate and 70 teachers volunteered. They were free to organize their work in their own way but had to use our starting points and allow their pupils to discuss at least once. The data collection was mostly quantitative. Nearly 1500 pupils answered the first questionnaire, worked with the cases and then answered the second questionnaire and 55 teachers answered their questionnaire and 7 of them were interviewed. For the analysis we have used SPSS and Simca P11.0 for descriptive statistics and multivariable analysis.

The third step is an ongoing qualitative study in six classes to learn more about teachers' and students' development in detail. For this part we have developed our questionnaires to have a stronger focus on what we found important in the quantitative part. Besides questionnaires, all lessons will be observed and/or video recorded, all discussions tape recorded and both pupils and teachers will be interviewed.

Results

The data collection and analysis is still going on but so far we have reported some results from the first part of the study.

In the first questionnaire the pupils were asked how interested they are to learn more and how good they think they are in different school subject. The result shows that boys have more self-efficacy than girls in all subjects except in their mother tongue. In grade 9 girls' self-efficacy for science is much lower than for other subjects. We can also observe a decline in interest to learn more science for both girls and boys but also that the difference between girls and boys increase from grade 7 to grade 9. Furthermore, less than half of the pupils agree on statements like "science and technology is important for society" and "the benefits of research are greater than the harmful effects it could have". (Rosberg & Lindahl, 2008)

All cases were considered interesting and relevant, especially according to the girls. The students thought they had learned to argue for their standpoints and to scrutinize information. Irrespective of how interesting the student found the case, they claimed they had learned new facts. (Ottander & Ekborg, 2008)

Pupils from multicultural schools express that they have learned more and think that science is more interesting when working with SSI compared with their normal science class. These pupils do not relate SSI to the public debate as much as pupils from monocultural schools neither do they use internet as much in their work with SSI. (Ideland & Malmberg, 2008)

The items from the pupil questionnaires were distributed on five categories which are 1) Attitudes, 2) Beliefs about learning and knowledge, 3) Self-efficacy/locus of control, 4) Common work forms and 5) SSI work forms and then subjected to Principal Component Analysis (PCA) and hierarchical Partial Least Squares analysis (PLS). In this analysis it seems as work forms, (i.e., issues are up to date, frequent discussions, equally shared work load, and autonomy), are most important to explain positive affective and cognitive outcomes. Pupils' achievement goals also seem important for predicting these types of outcomes. Unfortunately, only one item measured this and therefore no far going conclusions should be drawn on this result. For the last part of the study, items that focus on these goals have been added (Winberg & Lindahl, 2008).

Conclusions and Implications

So far we can see that students in lower secondary school appreciate working with SSI. Further analysis and data from the qualitative study will give us more information about what is crucial and how we can improve this way of working. We also have results indicating the importance of the teachers' way of introducing and structuring the work.

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