



Digital Support for Inquiry, Collaboration, and Reflection on Socio-scientific Debates

PUBLISHABLE SUMMARY

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CoReflect: Digital Support for Inquiry, Collaboration, and Reflection on Socio-scientific Debates

Motivation

Citizens of modern societies are increasingly being asked to deal with socio-scientific issues and make informed decisions on the basis of scientific data. However, research suggests that European students show a declining interest in science education creating an urgent need to reform science education in Europe. The task to reform science education is formidable, as there are many complex variables at play. Some of the difficulties can be identified at the local, within-country level: among others, these include established instructional practices that are resistant to change, old-fashioned textbooks which were first shaped in the industrial era, challenges in reaching a consensus as to what the goals of science education ought to be today, and challenges in supporting student and teacher learning of the reformed ideas. Even though work about the local challenges has been accruing in both sides of the Atlantic, there is little work that discusses the challenges in transferring best practices in science education. These challenges span across countries and can become barriers in successfully transferring best practices from one context to the other; their research is crucial at European level, as they may be related to cultural and national differences between European states.

Project CoReflect

Project ***“Digital Support for Inquiry, Collaboration, and Reflection on Socio-scientific Debates”*** (CoReflect, www.coreflect.org) main objectives were to explore mechanisms for addressing some of the local problems in science education today, and to examine the transfer of empirically-validated successful practices to other contexts. CoReflect, a three year research and development project (2008-2011), was funded by the FP7 Science in Society program, activity 5.2.2 Young People and Science.

Three main assumptions guided the CoReflect work: First, there is little availability of innovative, research-based inquiry environments, at European level, that can support students’ development of scientific literacy; second, science education researchers and teachers often develop pedagogical materials irrespective of the conversations occurring in each other’s community; and, third, little research has been conducted at European or even global level, of the factors that may foster or hinder the adaptation of best practices from one context to another. The CoReflect work was organized around these assumptions, as the project focused on developing:

- An empirically-tested, web-based library of interactive, inquiry environments, which can be modified at the teacher level. The development of these learning environments were guided by science education research findings and each team’s design-based research. The final digital library, which is hosted on the STOCHASMOS learning and teaching platform (Kyza & Constantinou, 2007), is available in English and two other European languages and incorporates digital and printed materials for students and teachers.
- A model for interdisciplinary teams working together to develop, implement, and validate innovative learning environments in science education. Each CoReflect partner organized a Local Working Group

(LWG), consisting of researchers, teachers and scientists; through frequent meetings over the period of three years, each Local Working Group member contributed their respective expertise, as the LWG developed an inquiry-based learning environment on a socio-scientific topic. The idea behind Local Working Groups was to help create learning environments that are research based, scientifically sound, and take into account pedagogy, as well as cultural, operational, and functional constraints.

- Collaboration between countries and contexts, at the Local Working Group level. Three collaborating Local Working Groups (cLWGs) were created and worked together to translate and adapt each other's learning environment. Both environments were implemented in the collaborating countries, thus providing an indication for the success of the adaptation process. This work led to the identification of factors that influence the transfer of successful innovative curricula from one context to another.

Summary of the work conducted during the CoReflect project

Four main objectives were outlined at the outset of the CoReflect project:

1. Develop and empirically test a multi-lingual and multimodal web-based library of inquiry learning environments, integrating reflection as part of the learning process.
2. Contribute to fostering participating students' interest in, and understanding of, socio-scientific issues that preoccupy modern societies.
3. Develop a mechanism for spreading the crucial attributes that make the design of interactive learning environments about socio-scientific topics *and* their classroom implementation effective in existing isolated pockets of practice, taking enough care to overcome the systemic, cultural, organizational and language barriers that impede transfer of educational programs from one educational system to another.
4. Engage a network of university-school-educational authority Local Working Groups in a series of research studies on specific aspects of the classroom implementation of web-based inquiry-oriented science teaching and learning environments, such as the role of student reflection in facilitating inquiry processes and the importance of collaboration in investigating hypotheses using actual scientific data.

The above goals were addressed successfully by the work conducted by the CoReflect Consortium. The work of the project was organized around eight WorkPackages (WP), with WP1 being the Project Management WorkPackage. WP2 supported the project members in building common ground on the important concepts that unify the work conducted by each partner separately: learning in science, inquiry, scaffolding, motivation, understanding, reflection, socio-scientific issues, and collaboration. In the context of the work conducted in this WorkPackage, the Local Working Groups came together, exchanged ideas, and received peer feedback on their work. Three such Knowledge-Sharing occasions were planned and executed, one during each year of the project. These Knowledge Sharing Workshops provided the forum for exploring relationships between teachers and researchers.

WP3 supported the development of the web-based, inquiry learning environments. The STOCHASMOS platform was used to support the development and hosting of these pedagogical content modules for inquiry-based teaching and learning. STOCHASMOS was localized to support the authoring of web-based learning environments in the local languages of the partners; the platform is now fully available in seven languages (Arabic, Dutch, English, German, Greek, Hebrew, and Swedish). With the exception of one partner, who assumed a dissemination coordination role, linking practicing teachers outside of the Local

Working Groups with the project, each partner engaged in design-based research to support learning by inquiry.

Seven Local Working Groups involving university researchers, practicing teachers, and scientists have been formed. Each LWG engaged in the development of digital, web-based reflective inquiry learning environments to facilitate students' engagement with project- and inquiry-based investigations in science. The existing learning environments address socio-scientific issues and seek to support the development of students' understanding of scientific practices, while motivating them to engage in science learning in a meaningful way. Seven learning environments were developed in English and two other national languages on the following topics:

Topic	Target age	Languages	Partner
Biotechnology/ GMOs	15-17	Greek, Hebrew, English	Cyprus University of Technology
Global warming	16	German, Greek, English	University of Cyprus
Nicotine addiction	15-17	Greek, Hebrew, English	Ben Gurion University
Synthetic Ecosystems	10-12	Dutch, English, Greek,	Twente University
Astrobiology	15-19	English, Greek, Swedish	Kristianstad University
River pollution	15-16	English, German, Swedish	Leibniz University of Hannover
Impact of fog on human life	10-12	Dutch, English, Greek	University of Thessaly

A driving question guided students' inquiry of the socio-scientific learning environments developed by each LWG. Suggested activity sequences and teacher guides were also developed by each LWG to accompany the web-based learning environments. The classroom implementation of the CoReflect learning environments was guided and documented at the project level by the procedures established through WP4. Each learning environment was piloted locally in authentic classroom environments. Following design-based research, data were collected during the pilot implementations and each Local Working Group revised their learning environment based on the data collected during the implementation. Following this revision, each environment was implemented for a second time in the local country, and subsequently a third time in a collaborating country to explore issues of transfer and adaptation. Attention was given to carefully documenting the enactment and adaptation phases. Students' motivation to learn and their conceptual understanding are important criteria of success for the CoReflect learning environments. As such, WP5 monitored and guided the process of collecting research data that contributed to improving and examining the potential impact of the learning environments on student learning. At the same time, WP6 supported the examination of the adaptation process, which took place during the second half of the project.

A project website was developed and has been regularly updated. At the same time, numerous dissemination efforts took place during the three years of the project, targeting teachers (both at the local and international level), educational authorities (such as the Ministry of Education or state representatives and school-administration liaison people), and researchers. Several other dissemination activities have been scheduled beyond the completion date of the project, representing CoReflect at international conferences based in Europe (e.g. EARLI 2011, ESERA 2011) and elsewhere (e.g. CSCL2011, Asia).

Results and impact

Based on data collected during the project, CoReflect had an impact on participating teachers, students, and researchers. For **participating teachers** the project served as an informal professional development mechanism, introducing them to inquiry-based learning and new technologies. Teachers also had the opportunity to participate in the process of designing learning environments based on pedagogical design principles. The learning environments developed offered **students** a new perspective on learning, by allowing them to undertake a problem-oriented approach to learning and providing a motivating context in which learning can take place. **Researchers benefitted** by the close collaboration with practicing teachers, especially by gaining better insights about: teacher-researcher collaboration and participatory design issues; the processes of adapting innovative, web-based materials originally developed by others; and the use of web-based platforms to develop inquiry-based materials to promote students' appreciation of science. The CoReflect results were also disseminated to school administrators and education policy makers. In the long term, the project seeks to contribute to informing research, practice and policy making, as these aspects relate to science learning. The CoReflect consortium through its participatory, design-based research and development efforts, created motivating scaffolded learning environments for students and supporting materials for teachers, thus presenting an important perspective on how to engage key players in reforming science education through inquiry in Europe.

Project consortium

CoReflect brought together eight partners:

Partner	Country	Local coordinator
Cyprus University of Technology (Coordinator)	Cyprus	Dr. Eleni A. Kyza
University of Cyprus	Cyprus	Dr. Costas P. Constantinou
Ben Gurion University	Israel	Dr. Iris Tabak
Twente University	The Netherlands	Dr. Hans van der Meij
Kristianstad University	Sweden	Dr. Andreas Redfors
Leibniz University of Hannover	Germany	Dr. Sascha Schanze
University of Thessaly	Greece	Dr. Vassilis Kollias
The Association for Science Education	United Kingdom	Ms. Marianne Cutler



For more up-to-date information on the project's progress please visit the CoReflect website at www.coreflect.org.