PROFILES* – PROFESSIONAL REFLECTION-ORIENTED FOCUS ON INQUIRY-BASED LEARNING AND EDUCATION THROUGH SCIENCE

Claus Bolte[1], Sabine Streller[1], Jack Holbrook[2], Miia Rannikmae[3], Rachel Mamlok Naaman[4], Avi Hofstein[4], Franz Rauch[5]

[1]Freie Universität Berlin (GERMANY)
[2]International Council of Associations for Science Education (ICASE: UNITED KINGDOM)
[4]University of Tartu (ESTONIA)
[4]Weizmann Institute of Science (ISRAEL)
[5]Universität Klagenfurt (AUSTRIA)

Abstract: PROFILES (Professional Reflection-Oriented Focus on Inquiry-based Learning and Education through Science) promotes Inquiry-Based Science Education (IBSE) by supporting science teachers to develop more effective ways to teach students, aided by science education actors (stakeholders). The project is based on "teacher partnerships" aiming to implement existing, exemplary, context-led, IBSE-focused, science teaching materials. Long-term teacher training courses, based on challenges of implementing student relevance is set to improve skills in developing creative, scientific problem-solving and socio-scientific related learning environments. A crucial aim is the strong dissemination of evaluated approaches, reactions from different actors (stakeholders) and insights of the PROFILES Project, making use of the Internet, the PROFILES Newsletter and other media.

Keywords: IBSE, continuous professional development (CPD), stakeholder networking, best practice, scientific competencies, life skills, 21st century science, evaluation.

INTRODUCTION: PROFILES BACKGROUND AND PURPOSE

A student motivational, socio-scientific approach to science teaching is promoted by PROFILES currently one of several European FP7 funded projects in the field of "Science in Society" (PROFILES Consortium, 2010; Bolte, et al. 2012; Bolte & the PROFILES Consortium Members, in progress). The PROFILES Consortium, consists of 21 partners from 19 different countries (status quo: May 2011), is promoting IBSE through raising the self-efficacy of science teachers to take ownership of more student-relevant ways of teaching, supported by stakeholders views. The project is grounded on 'teacher partnerships' implementing existing, exemplary, context-led, IBSE-focussed, science teaching materials, guided by long-term teacher training, reflecting on challenges identified by participating teachers to raising their skills in developing creative, scientific problem-solving and socio-scientific related learning environments; learning environments which embrace students' intrinsic motivation to learn science and enhance competencies in undertaking scientific inquiry and socio-scientific decision-making. Measures of success are through determining

(a) the self-efficacy of science teachers in the PROFILES approach and

(b) the attitudinal gains by students towards science and their science education.

The dissemination of PROFILES approaches, reactions from a range of stakeholders and insights from associated research and evaluation form a further key project target. The intended outcome of PROFILES is science education become more meaningful to students, more strongly related to 21st century science, more associated with generic education and especially promoting and enhancing IBSE in school science. In short, the ultimate PROFILES target is to raise teacher's continuous professional development (CPD) and students' scientific literacy.

FRAMEWORK AND CONCEPTION OF THE PROFILES PROJECT

The PROFILES project aims at ensuring the improvement of science education by offering innovative scientific learning opportunities for pre- and in-service teachers, teacher educators, as well as students within school and in non-formal education centres. The PROFILES consortium members are confident to reach this aim by:

- **Establishing close cooperation and networking of the consortium with stakeholders** (see table on WP2 'Support and Co-operation' and WP3 'Stakeholder Views') which provides strong teacher guidance to assist in removing possible obstacles and to build up confidence that the disseminated materials, conceptions and programmes are being enacted, bearing in mind stakeholder views and evaluated, in terms of approval, by stakeholders.
- **Providing teacher training and innovative inquiry-based teaching approaches** to introduce methods of, and teaching modules for, learning and teaching IBSE inspired science, which feature specifically relevance-identified modules (see WP4 'Learning Environments'), and training programmes linked to classroom intervention support. The introduction of PROFILES ideas into pre-service student teacher programmes, by enhancing science educator awareness and interest, is also intended (see WP5 'Teacher Training').
- **Developing strong(er) teacher professionalization and enhancing teacher self-efficacy** through building on an intervention, guiding teacher reflective processes and teacher initiating use-inspired research accomplishments. Additionally professionalization is enhanced through teacher ownership (see WP6 'Teacher Ownership') enacted through adaptation of state-of-the-art teaching modules related to cultural pre-conditions and gender factors, as well as reflective portfolios and action research projects.
- **Evaluating the outcomes of the intervention linked training regarding student gains** (see WP7) **and the promotion of teachers take ownership of more innovative practices**, concerning the students in terms of both attitudes towards the teaching approaches, and their perception of, and interest in science-related learning and careers in the sciences.
- **Disseminating the PROFILES ideas, materials and outcomes** and its potential for greater adoption through establishing teacher networks and interacting with other regional and national networks, as well as networking with other innovative IBSE science teaching projects (see WP8).

The PROFILES educational philosophy is introduced to central stakeholders within the education system of each consortium country via eight inter-dependent work packages (rf. Table 1 and Figure 1). An intended outcome, through continuous professional development (CPD) of science teachers, is to create interactive local, regional, national and Europe-wide

teacher networks which positively influence teachers' competence and confidence to promote IBSE-related science teaching and hence raise their self-efficacy to teach in an innovative – more student centered, context-led IBSE – manner, as well as in valuing use-inspired research ideas. This will be evaluated by means of systematic, statistically-based methods, as well as with the help of action research activities.

Work Package	Short title	Coverage
WP 1	Management and evaluation	Project management and external evaluation.
WP 2	Partner co-operation and professional support	Partner professional support to guide PROFILES as per the intended philosophy, goals, outcomes and stakeholder views.
WP 3	Stakeholder involvement and interaction	Bridging the gap between science education researchers, educators, and local actors (stakeholder network and co-operation).
WP 4	Learning Environment	Preparing focus of teacher training materials and identification of IBSE related teaching modules plus their modification and enhancement, based on evaluative feedback and involvement of additional teachers in PROFILES.
WP 5	Teacher Training and Intervention	Planning and Implementation of the (longitudinal) teacher training programme and inter-related teacher interventions.
WP 6	Teacher Ownership	Building on WP5 and reflecting and evaluating the effectiveness and impact of the (longitudinal) teacher training programme with special emphasis on teacher ownership and reflective practices.
WP 7	Student Gains	Evaluating the effectiveness and impact of the teacher training programme/intervention and development of teacher ownership by focusing on student outcomes.
WP 8	Dissemination and Networking	Dissemination at a national, international and worldwide level and establishment of a PROFILES teacher network interrelated to other teacher networks operating at a local, regional, national or Europe-wide scale.

Table 1. Work packages of the PROFILES Project.

Within this intended outcome, and by means of a (long term) teacher continuous professional development (linked and supported by stakeholders) a further key target of PROFILES is to convince teachers that the methods they have studied within the PROFILES programme and tried out during the PROFILES classroom interventions in their science classes will, and can, strongly improve the quality of their own science teaching.

Furthermore, teachers - especially those who participate in the PROFILES longitudinal CPD programme – will become convinced of the need for change in conventional practice. The new viewpoints they have learned in the PROFILES teacher meetings they will discuss with their colleagues; especially the need to interact and to seek for further support by networking with other colleagues (e.g. colleagues of other subjects in their schools, or from 'nearby schools' etc.). Beside this, the PROFILES Consortium expects that the teachers, participating in the PROFILES programme, will be motivated to disseminate their new experiences and the PROFILES IBSE teaching and learning materials through informal and/or formal teacher forums. This will be encouraged both through activities organized by the Consortium partners (e.g. via the PROFILES websites and dissemination network) and by follow-up training courses and informal teacher meetings after the longitudinal teacher CPD programmes at a regional, national and Europe-wide level.

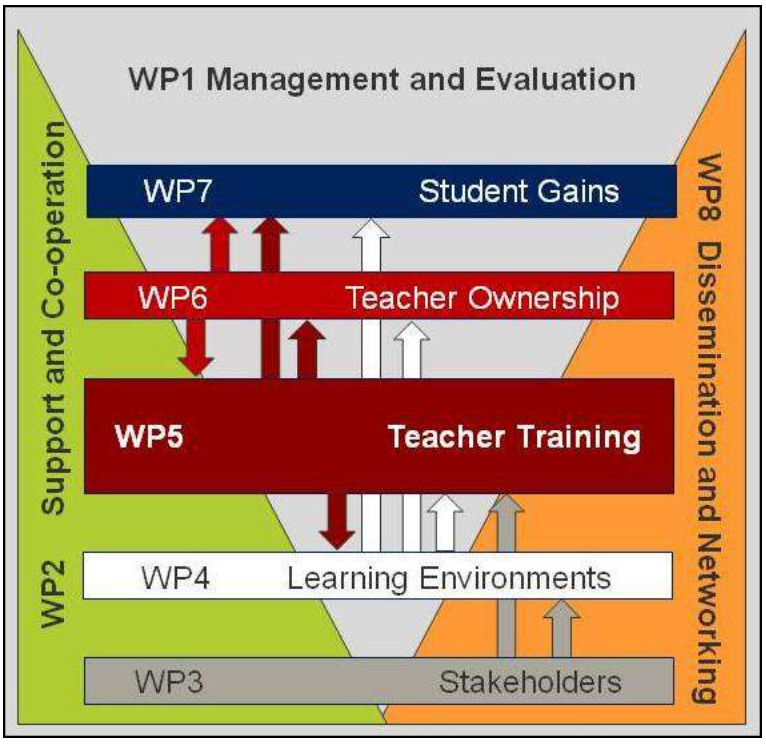

Figure 1. Interdependencies of the PROFILES Project's Work packages

A reflective impact component, first guided by the consortium partners, but later by specific teachers (referred to as 'lead teachers'), is designed to follow-on from the initial training and intervention to raise teachers estimation of responsibility for self-evaluating approaches to analyse students' enhancement of scientific literacy in the participants' schools and/or classes of teachers' special interest groups. These aspects, linked to teachers' self-efficacy, will motivate PROFILES teachers to evaluate their own professional developments as well as guide other colleagues in investigating the success of their teaching; for example by means of action research methods. Professional attitudes like these, we term "teacher ownership".

Confidence that the objectives of the PROFILES Project - the effective and sustainable improvement of teaching through the promotion of self efficacy and teacher ownership - will be reached, is strengthened through evaluation, by both formal and summative assessment. Our evaluation will focus on students' cognitive and affective learning and also on the teaching methods, approaches and materials used within the PROFILES intervention lessons. By means of the PROFILES evaluation it is intended to indicate where improvement is justified and where additional efforts are necessary to improve IBSE to meet stakeholder wishes, as well as teachers and students needs.

From the initiation of the project in December 2010, the PROFILES Consortium emphasises the dissemination of products, experiences and evidence-based outcomes of the project; starting with specific national PROFILES websites in each consortium partner's language and by encompassing the international PROFILES platform (www.profiles-project.eu). But realising that dissemination by partners alone is insufficient, further efforts are included by the PROFILES Consortium to support teachers and stakeholders in general, to appreciate the project and its developments (e.g. by means of strengthened teacher networks and their networking). Through these efforts and interacting with other teacher networks, links are widened, ideas of IBSE are disseminated and teacher-teacher interaction enhanced across borders (insofar as language aspects permit).

Our first steps in dissemination have been taken by presenting the PROFILES Project and its coordinating and supporting actions at international conferences (e.g. Scientix 2011 in Brussels, ESERA 2011 in Lyon, and GDCP 2011 in Oldenburg). A key future event through which it is possible to interact with the PROFILES project and its consortium members, teachers and stakeholders, will take place in Berlin 2012 from the 24th to 26th September, 2012. Those interested to meet PROFILES and the PROFILES actors are invited to participate in this, the 1st International PROFILES Conference on Stakeholders Views and the Enhancement of Inquiry Based Science Education. For more information, please, visit the PROFILES website: www.profiles-project.eu.

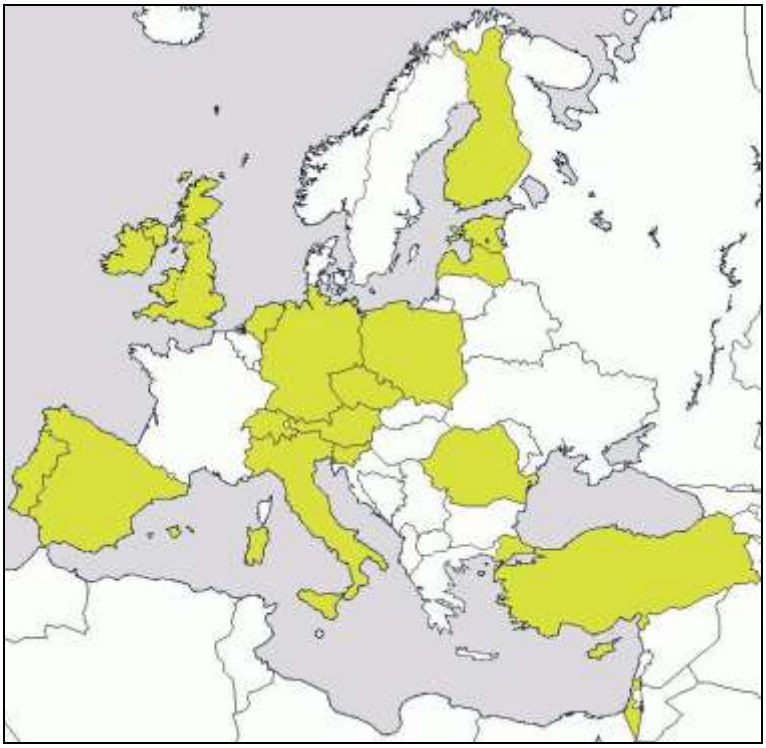

Figure 2. Overview of the countries involved in the PROFILES Project's Consortium*

* The PROFILES Consortium consists of: Freie Universität Berlin (Coordinator, Germany); University of Tartu (Estonia); Weizmann Institute of Science (Israel); Universität Klagenfurt (Austria); Cyprus University of Technology (Cyprus); Masaryk University Brno (Czech Republic); University of Eastern Finland (Finland); University College Cork (Ireland); Universita Politecnica delle Marche (Italy); University of Latvia (Latvia); Utrecht University (Netherlands); University of Maria Curie-Sklodowska (Poland); University of Porto (Portugal); Valahia University Targoviste (Romania); University of Ljubljana (Slovenia); University of Vallalodid (Spain); University of Applied Sciences Northwestern Switzerland (Switzerland); Dokuz Eylul University (Turkey); University of Dundee (UK); University of Bremen (Germany); International Council of Associations for Science Education (ICASE, UK).

REFERENCES

Bolte, C., S. Streller, M. Rannikmae, J. Holbrook, A. Hofstein, R. Mamlok Naaman, F. Rauch (2012; in print). PROFILES Projekt erfolgreich gestartet. Erscheint in: S. Bernholt (Hg.): *Konzepte fachdidaktischer Strukturierung für den Unterricht*. Zur Didaktik der Physik und Chemie. Probleme und Perspektiven. Münster: Lit- Verlag.

PROFILES Consortium (2010): www.profiles-project.eu (Status: 11-01-15)

Acknowledgements

This project is funded within the SEVENTH FRAMEWORK PROGRAMME (5.2.2.1 – SiS-2010-2.2.1) of the European Commission: Supporting and coordinating actions on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe (Grant agreement no.: 266589).