

Deliverable Report

**Grant Agreement Number 612367**



Including Responsible Research and innovation in cutting Edge Science and Inquiry-based Science education to improve Teacher's Ability of Bridging Learning Environments

**Deliverable reference number:** D5.1

**Deliverable title:** Framework paper for teacher professional development programme evaluation

**Dissemination level:** Public (PU)

**Due date of deliverable:** April, 2014 (project month 6)

**Actual submission date:** 31th April, 2014

**Status:** Final

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*This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 612367. The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the Commission. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.*

## Executive Summary

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Innovative topics or structures like teaching about RRI by combining school and out-of-school learning can be implemented into the educational system as top-down, bottom-up or symbiotic approaches (Gräsel & Parchmann, 2004). The IRRESISTIBLE project chose the symbiotic approach, applying the concept of Communities of Learners, CoL (Resnick, 1991; Hord, 1997; Parchmann et al., 2006).

The evaluation in the IRRESISTIBLE project consists of three components: (1) Evaluation of the teacher professional development programme, 2) evaluation of the modules, and 3) final project evaluation. This framework paper (D5.1) describes the methodological framework for the first component.

The evaluation of the teacher professional development programme, based on the structure of CoLs, again contains three foci:

- the goals, tasks and co-operation of Communities of Learners;
- commonalities and differences between the different members of the CoL and
- development of CoL members' perception of RRI and related educational issues and concerns

In the first phase of the project, existing instruments for evaluations of innovations has been analysed. The standardized questionnaire "Stages of Concern, SoC", based on the concern-based adoption model, has finally been chosen and adapted in two steps for the use in the project: (1) the items have been related to an RRI innovation, and (2) the items have been connected to the different roles of the CoL participants, like teachers or museum staff. This instrument is now ready to be used pre, during and post to the work of the CoL.

In addition, items asking for the expectations towards inquiry-based teaching and learning (the 6E-phases) and the development of exhibitions by the students have been newly developed and discussed.

The third instrument, investigating the participants' understanding of RRI, is still under construction. The six dimensions of RRI are represented in the questionnaire and now the questionnaire is in the process of expert validation.

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## Glossary

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<b>Acronym/Abbreviation</b>	<b>Description</b>
EC	European Commission
IRRESISTIBLE	Including Responsible Research and innovation in cutting Edge Science and Inquiry-based Science education to improve Teacher's Ability of Bridging Learning Environments
FP7	Seventh Framework Programme
DoW	Description of Work
PC	Project Coordinator
PSC	Project Steering Committee
WPL	Work Package Leader
WP	Work Package
IBSE	Inquiry Based Science Education
RRI	Responsible Research and Innovation
CoL	Community of Learners
UH	University of Helsinki
IPN	Leibniz Institute for Science and Mathematics Education

## 1. MAIN PART

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### 1.1 Introduction

Evaluation in the IRRESISTIBLE project consists of three components (IRRESISTIBLE Description of Work, 2013): 1) Evaluation of the teacher professional development programme, 2) evaluation of the modules, and 3) final project evaluation (including also an evaluation of exhibitions). This framework paper (D5.1) describes the methodological framework for the first component. However, in order to give an overall picture to the partners about IRRESISTIBLE evaluation, the instruments concerning other components of evaluation are briefly presented as well (Table 1).

The goals of the teacher professional development programme are twofold: to promote teachers' understanding of and engagement in Responsible Research and Innovation (RRI), and to develop modules for students. The former goal is crucial regarding the long-term impact of the IRRESISTIBLE project. Research has shown that if teachers are not involved, any educational reform is unlikely to succeed. It is important to engage teachers in educational reforms in an early stage (Anderson & Helms, 2001; van Driel, Beijaard & Verloop, 2001). Taking this demand into consideration, the project IRRESISTIBLE has decided to apply a symbiotic structure of implementation (Gräsel & Parchmann, 2004), forming Communities of Learners, CoL (Resnick, 1991; Hord, 1997; Parchmann et al., 2006). The term "symbiotic" points out that different groups of experts provide their knowledge and experience but also learn from the other groups. Therefore, both groups depend on each other and form a "symbiosis" in the design and implementation of the module. This approach has been successfully implemented in different projects, such as Chemie im Kontext (Parchmann et al., 2006).

Besides the participants' knowledge, attitudes have been identified as an important factor. Teachers' attitudes affect virtually every aspect of their job (Keys, 2001). There are barriers in the way of adopting new methods even if teachers are involved in educational reforms. Some of the biggest barriers are the teachers' concerns and attitudes. Teachers are hesitant and may have anxiety towards new methods. This is problematic whenever a beneficial innovation occurs in an organization. As a consequence, an instrument has to be applied and/or developed that allows insights into the participants' expectations and attitudes towards their engagement in the project, in the CoLs and their foci on RRI aspects.

The latter will also be investigated according to their realization in the modules. A set of guiding questions has been developed and discussed for this analysis. The final scheme for the evaluation of the modules developed for students will be described in a later

deliverable (D5.2).

## 1.2 Structure of the teacher professional development programme

In the IRRESISTIBLE project, the teacher professional development programme is implemented as Communities of Learners (CoL) in all 10 countries. In the CoLs the teachers and/or teacher students acquaint themselves with RRI and search for ways in which to incorporate RRI aspects into their teaching and learning environments both in school and outside of it. In this process the teachers interact with each other and also with the other members of the CoL: research scientists, experts of informal learning, and science education researchers. These members enrich the teacher professional development programme by bringing in their expertise and viewpoints.

To promote students' engagement in RRI, the CoLs employ pedagogical approaches such as the "6E model" (cf. Bybee, 2002) for Inquiry Based Science Education, formal and informal learning environments and Web 2.0 applications.

The CoLs will be implemented in two rounds in order to enhance the impact of IRRESISTIBLE. The teachers of the first round will in turn start another round of CoLs. Each CoL will include 4-5 teachers, so after the second round at least 25 teachers have participated in every country.

## 1.3 Aims of evaluation

The evaluation of the teacher professional development programme, based on the structure of CoLs, is focused on three aspects:

- the goals, tasks and co-operation of Communities of Learners;
- commonalities and differences between the different members of the CoL, and
- development of CoL members' perception of RRI and related educational issues and concerns

The instrument applied should therefore investigate the CoL-participants' expectations, attitudes, conceptions and concerns regarding RRI teaching and inquiry-based science education. As discussed above, these perspectives are crucial for the long-term success of the project. In order to analyze the impact of the professional development programme, a pre-post design is applied. The instrument can also be used in three stages: pre, after developing the module and after using the module in schools.

Teachers' responses will be compared to the views of other CoL members (researchers, informal education experts, science education researchers) who will also be surveyed.

The findings will also show if the novel way of bringing together different experts in CoLs is an approach worth using in other professional development programmes.

Another aim is to survey teachers' views on Inquiry Based Science Education (IBSE) in general, and the impact of the programme on those views.

Evaluation also aims at exploring how the different participants of CoLs perceive the programme in general. For this purpose, the pre-questionnaire includes some open questions. In the post-questionnaire, another set of open questions will be used, asking about the participants' experiences on the collaboration within the CoL.

At the end, the teacher professional development programme will also be evaluated, in collaboration with WP6, by analysing the dissemination of the modules among European teachers, both through pre- and in-service teacher education.

## 1.4 Instruments

In the first phase of the project, existing instruments for evaluations of innovations have been analysed. The "Stages of Concern, SoC"-instrument has been used in many comparable projects and therefore has been chosen as the main background for the instrument. The foundation for this instrument, the "Concern Based Adoption Model, CBAM", has been developed and used in teacher professional development in the US for nearly 30 years (Hall, George, & Rutherford, 1977). The Stages of Concern-questionnaire measures 6 different kind of stages of concern: being aware and having information about the innovation, being capable of internalizing the goals of the innovation, managing the innovative teaching in practice, being concerned about consequences, being concerned about collaboration, and finally being concerned about the improvement of practice for students. There is plenty of research using SoC-questionnaires (Dass, 2001; Liu, 2005), and this research will allow us to compare the IRRESISTIBLE results with other outcomes, based on adapted version of the standard questionnaire.

The standardized questionnaire has been adapted in two steps for the use in the project: (1) the items have been related to an RRI innovation, and (2) the items have been connected to the different fields of the participants, like teachers or museum staff. This instrument is now ready to be used in three stages: pre, after developing the module and after using the module in schools. It has been set up as an on-line questionnaire with different versions for the different groups of participants.

The introduction part asks each respondent about her/his role in the CoL (see Figure 1).

**BACKGROUND INFORMATION**

Dear member of Community of Learners (CoL)!

Thank you very much for working with us in the project IRRESISTIBLE! This project developing and testing new approaches of teaching, learning and communicating about responsible research and innovation around the world.

To be able to do this in a sufficient way we would like to consider your expectations, experiences and concerns. Therefore we would be grateful if you could answer the following questions. Thank you very much indeed!

We use a specific code to guarantee your anonymity and for linking individuals' answers.

	First letter of your mother's first name	The number of the month of your birthday	Second letter of your first name
Please fill in your individual code:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Gender	<input type="text" value="(select...)"/>		
Country	<input type="text" value="(select...)"/>		
How many months has your Irresistible CoL been in operation?	<input type="text"/>		
How many meetings has there been in your CoL?	<input type="text"/>		
* Role in CoL	<input checked="" type="radio"/> teacher / teacher student		
	<input type="radio"/> research scientist		
	<input type="radio"/> science center / museum representative		
	<input type="radio"/> science education researcher		
	<input type="radio"/> other		
If other, what?	<input type="text"/>		

Figure 1: Choice of role for participants in the introduction of the instrument.

Based on their group, participants get different sets of questions, referring to their role in the CoL, but all asking for the same aspects, according to the Concern Based Adoption Model (Figure 2).

## D5.1 / Framework paper for teacher professional development programme evaluation

### IRRESISTIBLE

The purpose of the following set of questions is to determine various levels of your concerns towards RRI. This means that some of the questions might seem irrelevant to you at the moment in which case choose the neutral "I can not say" option.

1 = agree, 2 = rather agree, 3 = rather don't agree, 4 = don't agree, 5 = I can not say

	1	2	3	4	I can not say
I am concerned about students' attitudes toward RRI.	<input type="radio"/>				
I am more concerned about other important things to teach than about RRI.	<input type="radio"/>				
I am concerned about not having enough time to teach about RRI well.	<input type="radio"/>				
I would like to help my colleagues in their teaching about RRI.	<input type="radio"/>				
I have a limited knowledge of RRI.	<input type="radio"/>				
I am concerned about a possible conflict between my interests and my responsibilities.	<input type="radio"/>				
I am concerned about the need to revise my teaching.	<input type="radio"/>				
I am concerned about how teaching about RRI affects students.	<input type="radio"/>				
I am interested in my students' understanding of RRI.	<input type="radio"/>				
I would like to discuss the possibility of teaching about RRI.	<input type="radio"/>				
I am in favor of including RRI into the curriculum.	<input type="radio"/>				
I would like to know what resources are available to teach about RRI.	<input type="radio"/>				
I am concerned about my ability to manage all that teaching about RRI requires.	<input type="radio"/>				
I would like to know if different methods are required to teach about RRI.	<input type="radio"/>				
I am concerned about evaluating my impact on students.	<input type="radio"/>				
I would like to revise the approach of teaching about RRI.	<input type="radio"/>				
I am preoccupied with things other than teaching about RRI.	<input type="radio"/>				
I would like to modify the use of RRI teaching material based on the experiences of students.	<input type="radio"/>				
I don't spend much time thinking of teaching about RRI.	<input type="radio"/>				
I would like to excite my students about their part in teaching and learning about RRI.	<input type="radio"/>				
I am concerned about time spent working with non-academic problems related to teaching about RRI.	<input type="radio"/>				
I would like to know what teaching about RRI will require in the immediate future.	<input type="radio"/>				
I would like to coordinate my efforts with others to maximize the effects of teaching about RRI.	<input type="radio"/>				
I would like to have more information on time and energy commitments required by teaching about RRI.	<input type="radio"/>				
I would like to determine how to develop the approach of teaching about RRI.	<input type="radio"/>				
I would like to use feedback from students to change the module developed during the project.	<input type="radio"/>				
I would like to know how my role will change when I teach about RRI.	<input type="radio"/>				
I would like to know how teaching about RRI is better than what we have now.	<input type="radio"/>				
I would like to know more about RRI topics myself.	<input type="radio"/>				
I would like to know more about the educational aspects of RRI.	<input type="radio"/>				
I would like to know more about out-of-school learning opportunities for teaching about RRI.	<input type="radio"/>				
I think teaching about RRI is not possible in school.	<input type="radio"/>				
I have learned enough about RRI in my teacher education.	<input type="radio"/>				

Figure 2: Excerpt from the questionnaire on Stages of Concern

The questions ask for the participants' interest in the project: it may be driven by their concern about knowledge on RRI in general, (their) students' attitudes towards RRI, teachers' attitudes and knowledge on RRI etc. It also asks for possible hindering aspects like their own perceived lack of knowledge or time restrictions.

Another part of the instrument for teachers asks about the experiences and expectations towards the 6E-model for IBSE (Figure 3).

What are your experiences and expectations about inquiry-based learning?  
1 = agree, 2 = rather agree, 3 = rather don't agree, 4 = don't agree

	1	2	3	4	I can not say
I have experiences in letting my students carry out investigations.	<input type="radio"/>				
I usually engage my students in the planning of an investigation.	<input type="radio"/>				
I would like to learn more about how to engage my students in the planning of an investigation.	<input type="radio"/>				
I let my students explore topics themselves.	<input type="radio"/>				
I usually prepare material so that my students can explore a new topic area themselves.	<input type="radio"/>				
I would like to learn more about methods and approaches that enable my students to explore a new topic area themselves.	<input type="radio"/>				
I let my students find explanations for a new phenomenon themselves.	<input type="radio"/>				
I would rather give explanations myself.	<input type="radio"/>				
I would like to learn more about methods and explanations that help my students to develop explanations themselves.	<input type="radio"/>				
I usually prepare material to enable my students to get deeper insights to a new content area themselves.	<input type="radio"/>				
I would like to learn more about methods and approaches for elaborating a new topic.	<input type="radio"/>				
I usually include an evaluation of what my students have learned in an inquiry-based activity..	<input type="radio"/>				
I would like to learn more about how to evaluate what we have achieved at the end of a unit.	<input type="radio"/>				
I don't include student presentations of investigated subjects within the classroom.	<input type="radio"/>				
I usually include presentations of what we have done in a unit to people outside the classroom (other classes, parents, ...).	<input type="radio"/>				
I would like to learn more about methods and approaches for exchanging results within the classroom.	<input type="radio"/>				
I would like to learn more about methods and approaches for presenting results to people outside the classroom (other classes, parents, ...).	<input type="radio"/>				

Figure 3: Excerpt from the questionnaire on experiences with the 6E model

The questions ask about inquiry based learning in science education, engagement of students and the magnitude of exploring, explaining and elaboration in the participating teachers' classes. Evaluation of the activities and knowledge exchange between students are also investigated. The development of science exhibits and social aspects of science education are also surveyed (Figure 4).

Students participating in IRRESISTIBLE will design their own scientific exhibits. What are your views on this?  
 1 = agree, 2 = rather agree, 3 = rather don't agree, 4 = don't agree, 5 = I can not say

	1	2	3	4	I can not say
My students are capable of planning and constructing a science exhibit about a current and relevant scientific theme.	<input type="radio"/>				
Planning and constructing a science exhibit is motivating for students.	<input type="radio"/>				
The development of a science exhibit about a given subject allows the participating students to learn more about that subject.	<input type="radio"/>				
The construction of science exhibits improves the relationships amongst students.	<input type="radio"/>				
The construction of science exhibits improves the relationship between students and teacher.	<input type="radio"/>				
ICTs (information and communication technologies) are great tools to support the development of science exhibit.	<input type="radio"/>				
Students can create science exhibits as a way to raise awareness for current and relevant scientific issues in society.	<input type="radio"/>				
Through the development of science exhibits students can influence other citizens' decisions and behaviours related to social issues concerning science, technology and environment.	<input type="radio"/>				
In my science classes students...					
	1	2	3	4	I can not say
Discuss about current problems and how they affect their life.	<input type="radio"/>				
Develop competencies that allow them to have a more active role in society.	<input type="radio"/>				
Are encouraged to ask questions.	<input type="radio"/>				
Carry out projects that they consider important and socially relevant.	<input type="radio"/>				
Learn to act in a socially responsible way.	<input type="radio"/>				
Learn to respect their colleagues' opinions.	<input type="radio"/>				
Learn about ways to influence other people's decisions about social issues related to science, technology and society.	<input type="radio"/>				
Are responsible for initiatives that allow them to influence other people's decisions about social issues related to science, technology and society.	<input type="radio"/>				

Figure 4. Excerpt from the questionnaire on designing science exhibits and social aspects of science education.

The fourth instrument, investigating the participants' perceptions and attitudes towards RRI, is still under construction. The six dimensions of RRI are represented in the questionnaire and now the questionnaire is in the process of expert validation.

In later stages of the project a version of this RRI questionnaire for students and the final project evaluation instrument will be developed. A first version of the checklist for the modules has been developed and reviewed by all partners.

Each partner will collect the questionnaire data from the CoLs and send it to WP leader (UH) and co-leader (IPN). This procedure will be scaffolded by the WP leaders through intermediate reminders and short phases of exchange about the on-going process during project meetings. Participants will also be provided with the complete evaluation scheme (Table 1) to be used as a checklist in every partners' country.

WP leaders will also analyze this quantitative data in line with the framework. Descriptive

results of the first round will be reported. This information about major aims and concerns of the different participants in the different countries will be considered and discussed in the second round at the beginning of their projects.

*Table 1: Overview about evaluation instruments, their target group and when they are implemented. **NB:** In order to deliver an overall picture, the table includes all evaluation instruments used in IRRESISTIBLE (not only the instruments of CoL evaluation discussed in this framework paper). \*) The exact dates of data collection depend on the individual CoL timeframes in each country.*

<b>Instrument</b>	<b>For whom?</b>	<b>When? *</b>	<b>Analysis</b>
Online questionnaire, incl. •States of Concern •IBSE •Exhibit Design •Social aspects of science education	All CoL members: •teachers •scientists •science education experts •museum staff	2-3 times during both rounds of CoLs: * pre: during early CoL meetings * (intermediate: after the initial design of the module) * post: after testing with students	Descriptive results (means) for the first round; statistical analyses (SPSS) for the second round
RRI questionnaire	All CoL members: •teachers •scientists •science education experts •museum staff	2 times during both rounds of CoLs * pre: during early CoL meetings * post: during last meeting	Descriptive results (means) for the first round; statistical analyses (SPSS) for the second round
	School students participating in the module	twice (pre-post) during module implementation in both rounds	Statistical analyses (SPSS)
Criteria for modules checklist	One representative of each partner (country)	At the end of the module development (round 1) and during module implementation (round 2)	Qualitative content analysis
Student questionnaire •Exhibit design • Social aspects of science education	School students participating in the module	twice (pre-post) during module implementation in both rounds	Statistical analyses (SPSS)
Project evaluation questionnaire	One representative of each partner (country)	In 2016	Simple statistical analysis

## 1.5 Ethical issues

The evaluation will be carried out according to the ethical issues and precautions described in the IRRESISTIBLE Description of Work (2013). To ensure anonymous analysis of the research data, each surveyed CoL members will be marked with a personal code which cannot be tracked back to the respondents' identity but can be used to connect an individuals' responses between pre- and post-tests.

According to EU regulations, participating schools, students and parents will return a consent form, also containing information about the research (IRRESISTIBLE Description of Work, 2013).

## 1.6 Analysis

The standardized questionnaires use a Likert scale to allow statistical analyses based on common procedures such as comparisons between groups. However, during the first year, the number of participants might be too small for statistical differences; in that case, descriptive results will be reported as a starting point. In addition, some CoLs had the opportunity to start earlier so these groups can only be tested after their first meeting. Therefore the second round will be the main group for statistical analyses.

The open questions will be coded by every partner, due to the different languages. The coding scheme will be developed based on trial answers and discussed and enlarged, if necessary, during a central project meeting (e.g. in Finland in July 2014).

All partners will report the results of content analysis, local implementation and dissemination to the WP leaders. WP leaders will then sum up the results and report the findings and impact of the programme. The outcomes will be provided as the online database and the report of results; additional evaluation protocols are not intended.

### 3. CONCLUSIONS

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The evaluation in the IRRESISTIBLE project consists of three components: 1) Evaluation of the teacher professional development programme, 2) evaluation of the modules, and 3) final project evaluation. This framework paper (D5.1) describes the methodological framework for the first component.

After the first feedback, the set of instruments seem to be suitable for the partners, even though with worries about the length of the online questionnaire in some countries. An estimation is that completing the longest version of the questionnaire (the teachers' version, including all 3 instruments: SoC, IBSE and exhibit development) takes 10-20 minutes – very much depending on the person. Still, application of a standardized instrument as the core will allow a comparison of IRRESISTIBLE results with those of other projects. It will also allow a differentiated observation of steps of development, not just a “high and low” measure. For the evaluation of CoL members' perception of students' exhibition development, partners from that field of expertise provided questions that have been included in the online instrument. The RRI questionnaire is currently under review. Thereby the complete set of instruments for CoL evaluation will soon be ready for use for the first round of CoLs, and later for the second round in order to make statistical comparisons.

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