engage

Equipping the Next Generation for Active Engagement in Science

SEVENTH FRAMEWORK PROGRAMME

DELIVERABLE D1.2: RRI Guidelines with Exemplars for

Learning Materials & Teaching Training

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EXECUTIVE SUMMARY

This deliverable describes RRI Guidelines with Exemplars for Learning Materials and Teaching Training and its methodology, taking into account the project's objectives, target audiences as well as RRI curriculum framework.

ENGAGE RRI Guidelines includes strategies organised around the three project phases: preparation, deployment and sustainability.

- *Preparation Phase* (January 2014 –August 2014) aims to prototype ENGAGE CPD model in order to develop the clarity of vision (Engage Framework) to be properly disseminated and exploited in the next phases.
- *Deployment Phase* (September 2014 – December 2016) aims to disseminate and implement the ENGAGE Programme including the CPD model in each country, with partner input about teachers and students, for continuous improvement.
- *Sustainability Phase* (September 2014 – December 2016) aims to monitor the effectiveness of our ENGAGE CPD framework and coordinating input from our stakeholder groups and evaluation working package.

In the preparation phase wp1 mainly focused on T1.2-T1.4 in the Dow (p.4) namely –developing a framework for preparing OER materials, and developing exemplar materials, developing guidelines for the face-to-face and on-line courses, as well as a prototype course, and conducting a pilot study for observing and testing the OER materials.

This report was prepared during the first phase (i.e. Preparation). It focuses on the second stage – deployment and presents the next steps for the following phase - Sustainability.   Its aim is to provide principles, strategies and pedagogical design through templates (denominate exemplars) for ENGAGE Teachers´ Continual Professional Development (CPD). These RRI guidelines document will be integrated to WP2 T2.4 MOOC and T3.2 Online Courses. The guidelines document will provide guidance for the "Localised Online Courses and Workshops" by project partners, which will be carried out by each country during the phases of Deployment and Sustainability phases.

As part of our evaluation, WP1 team will monitor how successful our RRI Guidelines are based on the project targets. By way of illustration, we will use indicators such as website analytics (number of users,

page views, material downloads, branding resources downloads, social media hits,), as well as evaluation questionnaires during the pilots and deployment phase.

INTRODUCTION

This document presents the ENGAGE RRI Guidelines with Exemplars for Teaching Training and Learning Materials. It is organised in three main parts. First, an overview of the guidelines based on the project's objectives and its key components. Second, the methodology used to develop these guidelines is presented. Third, and finally, the principles strategies and template are described for teaching training and learning materials.

The RRI Guidelines with Exemplars for Teaching Training and Learning Materials is an integration of several components (Figure 1):

1. Teachers conceptual needs from curriculum analysis and observations presented in D1.1
2. Teachers guidelines and strategies for Teachers´ CPD during "adopt" "adapt" and "transform"
3. Online pedagogical design for online courses, workshops and materials
   Materials:
4. Set of techniques for discussions, debates and arguments techniques (Appendix 4)
5. RRI informal Learning strategies for communities and ENGAGE projects (in development)
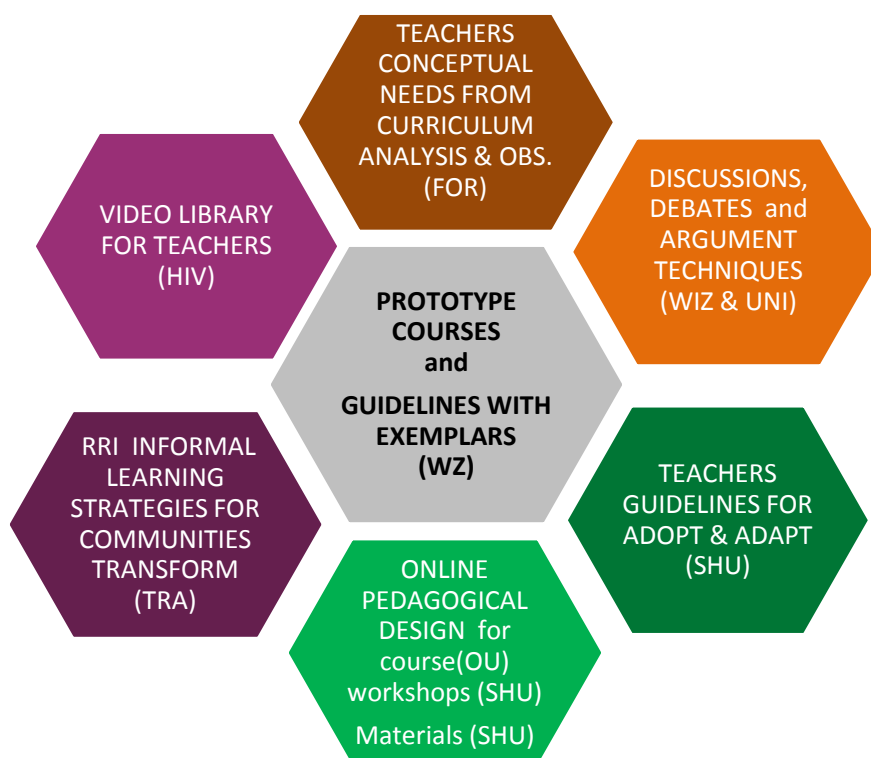6. Video Library with teachers' best practices (in development)

Figure1 – Key components of the prototype courses and guidelines with exemplars

1. AN OVERVIEW OF THE GUIDELINES FOR TEACHING TRAINING

The aim of the ENGAGE workshops and MOOC is to support teachers:

- By providing simulated practice for teachers, in a supported atmosphere of experimentation
- learning directly from 'experts', with an intense focus on successful use of curriculum materials – "feedback will be given by the *Workshop facilitators"*
- Practicing using the strategies, and developing trust by meeting people behind the project representatives of the consortium who will be responsible for the workshop in their countries
- Absorbing the whole programme in a single, time efficient event through simple tasks based on teachers needs and interests

ENGAGE goals focus on more science teachers:

- able to use RRI techniques with the support of our exemplar materials (adopt)
- have begun a transition with significant change in either their beliefs, knowledge or classroom practice (adapt)
- have made substantial changes to their beliefs, knowledge and classroom performance (transform)

Short Sessions (workshops) or short Units (Mooc) aim to cover:

Year 1

- o   Introduction – (sell) Presenting Engage for teachers to adopt
- o   Better Use – (practice) Showing Teachers how to improve the use of Engaging Materials for engaging teachers to adopt and adapt Materials as well as participate in the teachers online community
- o   Highlight Pedagogy – Including guidance for effective use of pedagogies that promotes students' discourse, argumentation and involvement. Specifying, elaborating and unpacking these pedagogies including examples
- o   Hands on – (be expert) Showing Teachers how to deal with some issues for better outcomes: concepts and techniques for students to discuss and debate developing scientific argumentation

Year 2

- o   Making off – Showing teachers the Engage principles for developing curriculum materials, which help them adapt and recreate new materials
- o   Better outcomes – Learning from best practices adopt and adapt Engage Materials
- o   Building confidence – Providing teachers with some up-to-date knowledge and resources regarding RRI & education to make them more confident and deepen their knowledge of the main RRI concepts
- o   Developing Projects – Learning how to use Broker System, develop an ENGAGE PROJECT

Year 3 (Teacher as RRI experts and leaders)

- o   Becoming Expert in RRi inquiry/teaching – Showing teachers the Engage principles which help them transform and innovate!

Workshops and Online Courses focus on addressing discrete goals, such as learning to use a particular strategy (Loucks-Horsley et al 1999). The goals will be based on the need for teachers and their schools to get maximum practical value from time out of school if they are to get permission to attend. Course participants will use a wide range of media and interactive online tools to engage with other colleagues and learn alongside them. These tools include video lectures, online discussion boards, blogs, wikis and social networking sites such as Twitter and Facebook.

Partners have flexibility on scheduling the Workshop, depending on the ease of teachers coming out of school:

- •   Option a) 0.5-1full day interactive workshop format
- •   Option b) twilight sessions

There will be 1 Workshop per year (Adopt, Adapt and Transform), for 3 years, in each country delivering the programme, making 33 in total. Each partner will team up with a science/discovery centre partner to host the event. The events will be held in the first term of each academic year, to get new teachers engaged, with plenty of time to progress towards further stages. Period suggested for partners : Adopt M13 (January/February 2015), Adapt M19 (June/July 2015), Transform M25 (February/March 2016)

Each MOOC will last 3 to 4 weeks, with one topic and task set per week. There will be three open online courses to support Adopt during Year1, Year2, Year3; two online courses for Adapt during Year2, Year3 and one online course for Transform during Year3. In total this gives a total 154 online courses across 11 countries.

The period suggested for partners are

Adopt: Y1 (M14 – February 2015), Y2 (M21- September2015), Y3 (M25 January 2016)

Adapt: Y2(M 22 October 2015), Y3(M26 February 2016)

Transform: (M27 March 2016)

The workshops will be delivered by a combination of 3 different people:

- **teacher education professional,** working with the partner, to facilitate, provide conceptual input and explain the project
- **a local 'expert RRI teacher'**, to explain how to use RRI teaching strategies and project Materials successfully
- **an invited RRI science expert,** from industry who has experience of RRI issues, to explain the collaborative Projects with scientists at the Transform stage (either face to face or online presence)

The choice of online course as a key strategy is based on the need to:

- build in 'conceptual inputs' (a process in the teacher learning cycle)
- enable teachers to learn 'just in time', choosing a module when they are ready
- minimise time out of school
- easily replicate quality across partner countries (a train the trainer model can dilute impact)
- create a community of practice of teachers, bridging geographical boundaries

A massive open online course (MOOC) refers to courses via the web with open access, designed for large-scale participation. MOOC's also:

- connect **distributed experts and teachers as co-learners**
- maximize the opportunity **to connect teachers, who share and critique**
- emphasis content **delivery just in time**

- emphasise **collaborative development** of the MOOC itself

(Fishman & et al., 1997; Johnson & Dyer J, 2005; Lave & Wenger, 1991; Madeira & Slotta 2009; Rubio et al,. 2007)

ENGAGE MOOCs will promote ad encourage participation in each stage of Adopt, Adapt, and Transform, whose objectives matches the learning defined in the workshops. The aim is to provide for both teachers who participate or not in the workshops opportunities to practice and increase their experience.

Module 1 (adopt stage)

This module is an **online version of the F2F Workshop** for Adopters (teachers as learners) with same purpose, but also will include complementary content for teachers to practice what they were introduced to during the workshops. It also provides to other teachers who were not able to participate in the workshops similar opportunities to develop their knowledge and practices. It gives teachers highly valuable 'take-aways': learn RRI strategies through a video library demonstrating how expert RRI teachers make them work.

Module 2: (adapt stage)

This module is an **online version of the F2F Workshop** for Adapters (teachers as practitioners) with same purpose, but also will include additional content for teachers to practice and reflect on what they were presented to during the workshops. It also provides opportunities for any other teachers who have been using ENGAGE as adopters to improve their practices. It also offers teachers highly valuable 'take-aways': a toolkit of anecdotes, analogies, and explanations' to enhance RRI teaching (Bell & Gilbert, 1996)

Module 3: RRI content (transform stage)

This module is an **online version of the F2F Workshop** for Transformers (teachers as RRI experts) with same purpose, but also will include innovative content for teachers to improve their practice on what they were practiced during the workshops. It also provides opportunities for teachers who are practitioners and very active in the online community to become experts. It offers teachers highly valuable 'take-aways': new RRI materials, co-created with other teachers and partners for exciting ENGAGE RRI projects.

Teachers will be assessed by peers, by the *Course facilitator* or by computer marked quizzes for on each assignment. For those teachers who attended 70% of the course and completed the final task will receive a certificate from the ENGAGE consortium with the number of hours, description of the course and participation.

The MOOCs will be delivered by a combination of 3 different people:

- teacher education professional working for the partner, to set tasks, and provide feedback
- moderator, to encourage and facilitate discussion

- '*expert RRI teacher*', to seed discussions and give feedback

Recruiting teachers for Materials, Courses & Community

ENGAGE has set challenging targets for teachers' participation. The key metric is the number of teachers who download the Materials of the Adopt stage, 11,500 teachers. To reach the Adopt target, the recruitment will be focused on each country's localised marketing plan, based on the key benefits:

- Strong appeal for student engagement, curriculum coverage

- Ease of use, coupled with professional development

- Social proof from teachers, through a system for rating and commenting on the Knowledge Hub.

Partners will also use a range of channels:

- National teacher associations and networks, with advertisement /posts

- Publication in science education magazines

- Posts on social networking sites

- Presentations at national or regional science teacher events.

Direct email marketing will be an important mechanism. We will be using partners' existing lists, and to maximise the open and click rates to our Knowledge Hub. Each partners responsible for delivering the course in their countries will monitor the recruitment into Adopt, and progression of teachers to Adapt and Transform, on a monthly basis, both at the national level, and centrally via the Work Package leaders for WP 4,5,6. Early indicators of success will be:

- Materials: monthly trends in new users

- Workshops/Online Courses: course flyer downloads, and early registration numbers

- Community Knowledge Hub: trends in number of website visitors, time on site

We will also regularly collect qualitative feedback and perceptions of teachers using ENGAGE:

- Materials: number of downloads, and positive ratings in online surveys and reviews.

- Workshops/Online Courses: post-course evaluation forms and completion rates

- Community Knowledge Hub: number of forum posts, views and responses, and article downloads

This data will predict likely future success, or indicate changes needed in our processes or products that need to be improved. This feedback is crucial as each year we aim to recruit increasingly large cohorts of teachers into the Adopt stage (see Project targets). Courses will be promoted heavily through our partner training institutions, which have high reputations among teachers, and are well connected with other respected networks/organisations.

Our partners are experienced in crafting marketing messages to attract time-pressed teachers to their courses. We will 'sell' the online Courses as opportunities to

- study high quality short courses with prestigious universities
- learn from *expert RRI teacher*s who will facilitate online modules and co-present Workshops
- the opportunity to watch RRI Pedagogies in action, through our 'Video Library'
- a certificate from the European ENGAGE Consortium with the logo of all universities
- high practical value in the classroom for a small time investment.

We will also use social and word of mouth, encouraging teachers who have been on a course to recommend and invite their colleagues and others' in their networks. Selling F2F Workshops is more challenging as it involves time out of school. ENGAGE will therefore:

- allow partners flexibility to schedule Workshops as 'twilight sessions' after school
- allow the option of building Workshops into existing events which teacher will attending already
- pay schools a small fee in recompense for their expertise i.e. teachers who participate

Once we have sufficient teachers in Adopt, our focus will be on securing the progression of teachers from the Adopt to the Adapt and then to the Transform stages. The model is like a funnel. We expect that a proportion of teachers will move up each step of our model - Adopt to Adapt, and then Adapt to Transform. Each step represents a development in RRI teaching, and teachers in the Adapt and Transform stages are those who have made progress from earlier stages. We expect

- 25% of Adopt teachers to progress to Adapt (partial transformation) – this will mostly take place from Year 2 onwards,
- 10% of Adapt teachers' progress to Transform (complete transformation) – this will mostly take place in Year 3.

Progress from one stage to the next is through self-selection, rather than there being entry requirements. We expect this will occur when teachers have had a combination of positive classroom and online experiences, realizing that the next steps are easy to follow, and see greater benefits of getting more involved and learning more about RRI. We will messages will 'sell' be selling the added benefits of each successive stage, summarised in the table 1 below.

Strategy	Adopt		Benefits of Adapt		Benefits of Transform

Materials	30 min. exercises, apply an already taught idea	→	Teach complete topics	→	Project with student-scientist collaboration
Online courses	Try easy teaching strategies	→	Secrets of greater student understanding	→	Create your own RRI curriculum materials
Online community	Access information about Materials	→	Interact with '*expert RRI teachers*'	→	Take leadership role in community

Table 1: Summary of teachers development stages

We will offer a major incentive to teachers for participating in all stages of ENGAGE: accreditation. It is often essential for teachers to demonstrate their participation in high quality professional development, particularly to achieve promotion. Most or all of our partners provide training that they can accredit, either through the University, or on a national level:

"The UB team and our cluster of partners, including teacher associations and teachers training providers, can guarantee issuing of such certificates" (Spain).

"Teachers can gain 60 credits through the Masters in Education at Sheffield Hallam University" (UK).

We will enhance the mechanism of self-selection through various marketing techniques. For instance, web pages will 'upsell' other ENGAGE components, for instance, encouraging Adopt teachers to go deeper and select the longer 'teaching sequence' Materials or sign up to related online courses (MOOC's). Our Knowledge Hub will keep records of teachers registered, what they download, and their participation so we can promote the other parts of ENGAGE through targeted e-marketing messages.

The online Projects gallery

We will create a showcase for students' and teachers' creativity in the use of ENGAGE's Projects. This area of the Knowledge Hub will display high quality students' outputs, such as videos and presentations arguing their views on scientific issues. The gallery will be promoted to spread the project virally online, showing other teachers what can be accomplished in the ENGAGE programme, and inspiring them to take their first step - Adopt. We will incentivise teachers to upload students' outputs with a competition, linked to the 'RRI Festivals' (see Dissemination Strategy).

Recruitment of 'expert RRI teachers'

Many teachers claim that 'learning from other teachers' is their preferred model of professional development. ENGAGE has built on this principle, by carving out key roles for '*expert RRI teachers*'. They will to support and mentor more novice teachers in the Adopt and Adapt stages, as shown in Table 2 below:

Strategy	Minimum no. of '*expert RRI teachers*' /partner)	Role
Materials	1	Co-creation: to help partners adapt/improve materials

F2F Workshops	1	Modelling use of RRI strategies
Online Courses	1	Seed discussions/provide feedback
Community	2	Guidance and advice through forum Q&A.
Video library of Pedagogies	1	Model RRI teaching strategies

Table 2: *Recruitment of 'expert RRI teachers'*

Each country needs a minimum 5 *expert RRI teacher*s. For at least the first year of the project, these need to come from outside ENGAGE, until enough of our own have progress from Adopt->Transform. All partners have undertaken an analysis of existing RRI-related projects and innovative curricular for recruiting '*expert RRI teacher*s'.

THE METHODOLOGY USED TO DEVELOP THE GUIDELINES

1.1. Developing the format for Teachers training

The development of our teachers' courses had taken the following steps:

1) Setting goals for each stage (adopt-adapt-transform) based on the Dow, the kick-off meeting discussions, in a collaborative way and taking into account partners feedback (see goals in Section 3 of this document).

2) A thorough literature review summarizing the research-based program design and characteristics of effective professional development programs for teachers

3) Specifying possible PD teaching and learning approach and elaborating them. For example: Lecture/talk Workshop, Debate. Role play, Modelling practice, Case discussion, Study group amd more (see Appendix 1)

4) Elaborating on the possibly different Purpose and different foci of CPD activities, including examples (see Appendix 2).

5) Creating a matrix for design the CPD activities: Combining a specific content (for example: "promoting students' discourse" with a possible learning approach will help us to identify better and align the focus of the activity with our goals.

6) We also address a soft version of Research-based design: the development of both CPD framework and the learning materials will be revised continuously based on feedback from different partners and teachers after and during year 1 & 2.

The guidelines we have selected from the literature are:

Continuous Professional Development

There is an enormous amount of evidence that a real and sustained change in teacher's beliefs and practice needs time and is a result of a long learning and reflective process. Therefore, our range of ADOPT-ADAPT-TRANSFORM will

last 3 years for teachers who are willing to, allowing many teaching opportunities and time to implement and reflect on implementation.   Also, this is part of the rationale for integrating the MOOC and not be satisfied only with single one-day face-to-face events (Sharabbani-Furman, 199; Harrison, Hofstein, Eylon& Simon, 2008; Eylon, Berger, & Bagno, 2008; Berger, Eylon, & Bagno, 2008).

Constructivism. Teachers must be active, learn and construct their own knowledge. This way they develop ownership toward the products of their learning. The Adapt and Transform stages are heavily built on this principle.

Teachers should be treated as professionals. The teachers'existing knowledge and teaching experience should be highly regarded, and play a key role in all activities. The use of RRI expert-teachers will emphasize this approach, as well as the fact that the novice RRI teachers will be regarded as capable of analysing pedagogical situations, as well as dealing with new RRI contexts based on their scientific and pedagogical background.

T**he PD should provide opportunities for the development of different types of teachers' knowledge**. These are Content knowledge (i.e. mainly RRI knowledge); Pedagogical knowledge; Pedagogical-Content Knowledge (PCK), and TPACK which defines the interface between teaching approaches and content (Shulman, 1986; Kind, 2009, Mishra & Koehler 2008)

The professional development program should be related to teacher practice in school. Teachers self-experience as learners should be in line with what we expect teachers to do with their students, since this self-experience has a role in shaping teachers beliefs (Pajares, 1992; Borko and Putnam, 1995). Schon (1983) has defined Personal Practical Knowledge as the knowledge resulting from individual professional experiences. We will "localise" teachers activities in our workshops to meet RRI expectations and opportunities in each country as identified by our RRI survey (D1.1)

The program should provide opportunities for collaboration and interactions (Putnam and Borko, 1999)
In order to promote collaboration we will use the technique of fading scaffolding, which means that the level and means of interactions increase over time, whereas the explicit instructions provided decrease (Shwartz et al., 2008, Shwartz & Katchevitch, 2013).

Prividing oppurtunities for development of teachers personally, professionally, and socially.

(Bell & Gilbert 1996). The opportunity to move along the three stages and become an RRI expert-teachers, as well as building an on-line community, and encouraging teachers to become RRI leaders in their schools and districts are in line with this principle.

Evidence-based CPD

In all stages teachers will use evidence from their classes for what worked and what did not, and discuss possible reasons and changes. This approach is a softer version of "teachers investigating their own teaching". This will also increase the link of what they learn in the PD to their practical work in the class.

1.2 Methodology for Developing Learning Materials for Teachers training

Generally, we draw on partners experience and in cases it is possible on existing teaching materials.

The development of our learning materials follows these steps:

1) Defining the goal for the activity + learning performances expected by the teachers
2) Allocating existing resources
3) Choosing an appropriate PD teaching and learning strategy
4) Creating a template for design of the materials:

Engage guidelines for developing activities (aimed for partners) (see follow tables 5-6)

What's the purpose? – Define ta specific goal for the activity, based on the general goals for the stage of the PD

Learning performances: Define what are teachers expected to do by the end of their learning? Based on

Teaching strategy: Choose an appropriate teaching strategy (see appendix 1). How this strategy is addressing your goals?

Allocate resources and ideas – you can use ENGAGE resources including the video library as well as local resources

Develop a 'lesson-plan' including timing

Assessment –define how would you assess teachers' learning?

1.2.   PRINCIPLES STRATEGIES AND TEMPLATE FOR TEACHING TRAINING

The ENGAGE Quality Continuing Professional Development (CPD) programme aims to excite and engage pupils in science through inspiring workshops and online courses for their teachers and support staff. It supports educators in enhancing their professional skills by giving opportunities to learn more about contemporary scientific ideas, experiment with effective teaching approaches and gain experience of modern scientific techniques. The delivery of quality professional development is a collaborative, continuing journey towards ever better practice, positively changing the aspirations, skills and confidence of the participating individuals (adapted from the NSLC Secondary Professional Development Programme) (Bennett, Braund, & Lubben, F. (2010).

The ENGAGE Guidelines document suggests two strategies both for F2F workshops and MOOC. The First strategy aims to offer opportunities for **teachers to become learners** by experiencing RRI lessons and discussion themselves (as it was promoted by the ENGAGE Coordinator with all partners in the kick-off meeting, in which everyone practiced how to create OER and use it in a lesson). It also aims to support **teachers to be practitioners, by** trying out the materials themselves frequently and maybe with some of them even reach the level of **teachers as RRI experts and leaders** in their schools.

The second strategy aims to support teachers as practitioners by encouraging **reflective teaching** and **evidence-based practice** Educator will bring evidence to success, challenges, students' learning products etc in order to become reflective practitioners through reflection in and on action (Schon, 1983).

In summary some features for the teachers' CPD based on the ENGAGE DOW, (pages 45, 58-60) are:

1) Create short interactive online modules,

2) Include input from professionals and expert RRI teachers

3) Provide an **RRI toolkit** which Includes RRI effective teaching strategies (debate, argumentation, card-games, how to deal with diverse opinions, etc.

4) Make use of our video library

5) Establish and support an online community of practice

The adopt stage will present the learning unit: "The ENGAGE project and its resources" , whose aim is to introduce what is the added value of ENGAGE for students and "How to use ENGAGE concepts and materials in classroom teaching". The adapt and transform stage will focus on how to adapt and generate concepts and materials through the units: "THE ENGAGE strategies and its principles"; "The ENGAGE projects for transforming teaching and learning".

Learning objectives for the ADOPT stage

1) Teachers will gain confidence and competence using a variety of pedagogies to encourage student discussion and argumentation.

2) Teachers will get to know the OER materials,

3) Teachers will realize the challenge of integrating RRI domains without neglecting the science content, and the Inquiry-based learning.

4) Teachers will effectively use the OER materials in their classes and realize how they ease the challenge of the teacher.

5) Teachers will acknowledge a positive outcome from their students and reflect on 'why did it work'?

6) Teachers will move to a higher level of participation

7) Optional: Teachers will get to know and understand the ENGAGE 'RRI domains:
Evidence – Sources, Reliability, validity, Technology – probability & risk, cost-benefit analysis, Values – Ethical perspectives, Scope – science, ociety, economy, Argumentation – Argumentation structure, Effective communication

Learning objectives for the ADAPT stage

1) Teachers will learn practical strategies to explain concepts relating to RRI, such as evidence and ethics.

2) Teachers will learn ways to take into account students' ideas: existing conceptions relating to RRI

3) Teachers will be able to PREPARE effective lessons with ENGAGE materials

4) Teacher will identify challenges and SHARE strategies for students to talk and debate with Online Teacher's community

   Teacher will be able to assess and COMPARE students' progress

5) Teachers will move to a higher level of expertise as reflective practitioners.

Learning objectives for the Transform stage

1) Teachers will get a deeper understanding of how current science works, and realize that school science often presents an inaccurate image of science

2) Teachers will learn how to present current research more realistically

3) Teachers will get a deeper understanding of how decision making regarding new technologies is made

4) Teachers will be able to borrow successful RRI-engagement techniques from informal education

5) Teachers will be able to sustain RRI teaching in their school (one way would be adapting high-quality Science in Society curriculum materials)

6) Teachers will be able to run RRI projects and establish partnerships with RRI experts with their students.

7) Teachers will identify how to collect evidence of positive outcome from their students' projects and reflect on innovative RRI teaching and learning.

8) Teachers will move to a higher level of expertise as reflective experts

The Adopt stage

The purpose of Adopt, paraphrasing what it says in the DoW (page X) is: Learning the "how" and "why" of classroom strategies for teaching socio-scientific issues.

"Teachers will learn classroom strategies for teaching socio-scientific issues by downloading topical issue-based materials for classroom experimentation. They take an online module to learn the rationale behind the strategies, which focuses on our Video Library, showing each pedagogical approach in use."

In this stage teachers learn classroom strategies for teaching socio-scientific issues, mainly by downloading topical issue-based materials for classroom experimentation. They take an online module to learn the rationale behind the strategies, which focuses on our Video Library, showing each pedagogical approach in use.

Table 6 and Table 7 aim to provide a more concrete outline of the f2f and mooc courses. The guidelines document suggests a 6-7 hours long face to face meeting, as an introduction to ENGAGE approach and curriculum, which can be split in two or three sessions or deliver in a full long session. (see table 3)

Table 3: ADOPT STAGE - Outcomes and Course Descriptor - EXEMPLAR 1

Section	Notes
Session title	**ADOPT**
Engage Priorities (for ADOPT)	Teachers will get to know and use the OER materials Pedagogy – what teaching strategies are best to get students involved in effective learning of RRI topics?
Duration	To be decided by local partners
Curriculum Stage	Develop, implement and share their own RRI materials
Audience	Science teachers (biology, physics and chemistry)
Summary (to support marketing and recruitment)	Promote our website (see marketing plan) Establish a community of RRI expert teachers, to identify 'persuadable in service teachers
Teacher Intended Learning Outcomes (Face to Face)	Teachers will: - develop an awareness of the ENGAGE 'RRI domains (in particular tools discussion and argumentation) - have an opportunity to explore the OER materials - consider a range of teaching and learning strategies that support the teaching and learning of socio-scientific issues - consider how to integrate the RRI and inquiry based learning into their classroom
Teacher Intended Learning Outcomes (Online/MOOC)	**Teachers as 'learners' will:** - be provided with further support, guidance and exemplar curriculum materials to pilot the OER materials in their classroom (ADOPT RRI toolkit) - evaluate the impact of the ENGAGE ADOPT stage on their own knowledge and skills **Teachers as 'practioners' will:** - have the opportunity to share and disseminate the ENGAGE strategies - have the opportunity to assess and compare student progress **Teacher as 'expert RRI practioners' will:** - have the opportunity to support novice engage teachers - disseminate and share good practice beyond their own classroom/school

Table 4: ADAPT STAGE - Outcomes and Course Descriptor EXEMPLAR 2

Section	Notes
Session title	ADAPT
Engage Priorities (for ADAPT)	Teachers will be able to PREPARE effective lessons with ENGAGE materials Teachers will learn practical strategies to explain concepts relating to RRI, such as evidence and ethics.
Duration	To be decided by local partners
Curriculum Stage	Make changes to ready-made materials, be able to design their own activities
Audience	Teachers that have used our OER materials, and are willing to move to a higher level of participation
Summary (to support marketing and recruitment)	Enhance the mechanism of self-selection through various marketing techniques. For instance, web pages will 'upsell' other ENGAGE components, for instance, encouraging Adopt teachers to go deeper and select the longer 'teaching sequence' Materials or sign up to related online courses (MOOC's).
Teacher Intended Learning Outcomes (Face to Face)	Teachers will: • be able to prepare effective lessons using ENGAGE materials • have the opportunity to work collaboratively to develop an ENGAGE lesson • consider how to integrate the RRI and inquiry based learning into their classroom • Teachers will learn and use practical strategies to explain concepts relating to RRI, such as evidence and ethics. • Teachers will learn ways to take into account students' ideas: existing conceptions relating to RRI Teacher will identify challenges and SHARE strategies for students to talk and debate with Online Teacher's community Teacher will be able to assess and COMPARE students' progress
Teacher Intended Learning Outcomes (Online/MOOC)	**Teachers as 'learners' will:** • be provided with further support, guidance and exemplar curriculum materials to use the OER materials in their classroom (ADOPT RRI toolkit) • evaluate the impact of the ENGAGE ADOPT stage on their own knowledge and skills **Teachers as 'practioners' will:** • have the opportunity to share and disseminate the ENGAGE strategies • have the opportunity to assess and compare student progress **Teacher as 'expert RRI practioners' will:** • have the opportunity to support novice engage teachers

Section	Notes
	• disseminate and share good practice beyond their own classroom/school

Table 5: TRANSFORM STAGE - Outcomes and Course Descriptor EXEMPLAR 3

Section	Notes
Session title	**Transform**
Engage Priorities (for TRANSFORM)	Teachers will be able to borrow successful RRI-engagement techniques from informal education Teachers will be able to sustain RRI teaching in their school (one way would be adapting high-quality Science in Society curriculum materials) Teachers will be able to run RRI projects and establish partnerships with RRI experts with their students.
Duration	**To be decided by local partners**
Curriculum Stage	Media, other RRI resources, partnership with science museum, industries, scientists and other stake holder
Audience	Teachers that have used our OER materials, and are willing to move to a higher level of participation
Summary (to support marketing and recruitment)	Enhance the mechanism of self-selection through various marketing techniques. For instance, web pages will 'upsell' other ENGAGE components, for instance, encouraging Adapt teachers to go deeper and select the longer 'teaching sequence' Materials or sign up to related online courses (MOOC's)
Teacher Intended Learning Outcomes (Face to Face)	Teachers will: • get a deeper understanding of how current science works, and learn how to present current research more realistically • get a deeper understanding of how decision making regarding new technologies is made • be able to borrow successful RRI-engagement techniques from informal education • be able to sustain RRI teaching in their school • be able to run RRI projects and establish partnerships with RRI experts with their students. • identify how to collect evidence of positive outcome from their students' projects and reflect on innovative RRI teaching and learning. • (some teachers) move to a higher level of expertise as reflective experts
Teacher Intended Learning Outcomes (Online/MOOC)	**Teachers as 'learners' will:** • be provided with further support, guidance and exemplar curriculum materials • evaluate the impact of the ENGAGE TRANSFORM stage on their own knowledge and skills

	Teachers as 'practioners' will:
	• **will be able use existing materials and transform them into other activities such as expert panels or role play** • have the opportunity to share and disseminate the ENGAGE strategies • have the opportunity to assess and compare student progress **Teacher as 'expert RRI practioners' will:** • be able to sucseffuly use informal learning strategies • be able to initiate and sucessfuly enact special science projects with their students • be able to initiate and sustain partnership with other RRI stake-holders • have the opportunity to support novice engage teachers • disseminate and share good practice beyond their own classroom/school

Table 6: ADOPT Programme Outline – F2F EXEMPLAR 4

Suggested timings	Session Titles (F2F)	Description of activity/ suggested activities	CPD Activity see Appendix 1	Focus of CPD Activity see Appendix 2	Resources
30 mins	Introduction to Engage What's new? What is RRI	Introducing Engage, Leading a discussion of what is RRI? How it is different from former science & society approaches Have teachers describe their attitude toward including RRI in their teaching	1		Engage media kit, Engage website,
60 mins	Using OER	A guided tour on the website, choosing and downloading activities, filtering activities by topics, downloading ine and exploring its structure and content	2	1	ENGAGE OER
90 mins	Experiencing ENGAGE units	RRI expert teachers **model** the teaching of one unit (that best fit the needs of teachers, local culture and interest), the novice teachers experience it as learners. The novice teachers identify RRI domains, reflect on	8, 14	2,3	ENGAGE OER RRI expert teachers

		what worked what didn't work for them			
60 mins	RRI pedagogy	We will focus on 1-2 RRI strategies that are relevant to the unit that was modelled. Starting with teachers existing experience of how they use this strategy in their current teaching and elaborate on how this strategy can be used RRI teaching	We will chose one of the approached from 5-14	2	ENGAGE OER Video Library RRI expert teachers
90 mins	(*optional) RRI and IBSE	We will not deal directly with IBSE but rather the combination between inquiry and RRI, Need to choose a specific activity that can promote IBSE aspect (for example, ban coke, or ban the beds)	1, 3,4,5	1,4, 5	

ADOPT Programme Outline for online course (MOOC)

1) Teachers will gain confidence and competence using a variety of pedagogies to encourage student discussion and argumentation.

2) Teachers will get to know the OER materials,

3) Teachers will realize the challenge of integrating RRI domains without neglecting the science content, and the Inquiry-based learning.

4) Teachers will effectively use the OER materials in their classes and realize how they ease the challenge of the teacher.

5) Teachers will acknowledge a positive outcome from their students and reflect on 'why did it work'?

Table 7: ADOPT Programme Outline – MOOC EXEMPLAR 5

Suggested timings	Session Titles (Online)	Description of activity/ suggested activities	CPD Activity see Appendix 1	Focus of CPD Activity	Resources
1 session	An intro to ENGAGE	The materials from the face-to-face introduction session will be uploaded here for the benefit of a larger group of teachers	1	Goals no. 2-3	ENGAGE introduction kit
1 session	Using OER	The materials from the face-to-face OER session will be uploaded here for the benefit of a larger group of teachers	2	Goals no. 2,4	ENGAGE OER
1-2 sessions	RRI pedagogical toolkit	Introducing a toolkit explaining and specifying effective RRI strategies	2,8,10,11	Goal no. 1	A pedagogical toolkit
1-2 sessions	Supporting effective discourse	Strat with teachers' examples for effective classroom discussion. Analysing with teachers 1-2 sessions of discourse and specifying some effective do's and don't do Presenting the work done by Shwartz et. Al (2009) "talking science"	3,8	Goal no. 1	Online video library
1-2 Sessions	RRI main concepts	An online expert lecture by an RRI expert followed by a workshop about the concepts of: Evidence – Sources,Reliability, validity	1,2	Goals no. 3	RRI seminar, video library
	Learning by experience		14	Goal no 4	OER
1 session	Reflective session	After trying an RRI unit in their classes - What worked and why?	3, 4	Goal no. 5	Forum On-line discussion writing wiki, blogs providing online feedback to peers
1 session	An adapt activity	This can be a final activity as a criteria for moving to next stage –adapt	4	Goal no. 6	OER Pedagogy tool kit

Following Ratcliffe & Grace (2003) this 5 dimension model as a measure of 'RRI teaching' presented by table 8 is suggested in order to identify expert RRI teachers.

Table 8: **NOVICE RRI TEACHER X *EXPERT RRI TEACHER***

NOVICE RRI TEACHER	DIMENSION	*EXPERT RRI TEACHER*
	1. Teachers' knowledge of RRI	
Anxious about understanding	<-->	Realize the extent of their understanding of socio-scientific issues, and appropriate pedagogical knowledge and skills
	2. Teachers' conception of their own role	
Dispenser of knowledge	<-->	Provide experiences and information from which learners can build new knowledge Facilitator of learning (interpreted for ENGAGE as building on students' existing ideas)
	3. Teachers' use of RRI pedagogies like discourse	
Closed and authoritative	<-->	Open and dialogic
	4. Teachers' conception of learning goals	
Limited to knowledge gains	<-->	Includes the development of reasoning skills
	5. The nature of classroom activities	
Student activities are contrived and inauthentic	<-->	Activities are authentic and owned by students

2. PRINCIPLES STRATEGIES AND TEMPLATE FOR LEARNING MATERIALS

Whats' the purpose?

The purpose for developing Engage Materials Framework is to guide all our materials design and production, to help us define our 'RRI curriculum' i.e what we're teaching, to define the knowledge about the nature of science and scientific practices i.e inquiry skills, argumentation, etc. that we want to promote through our curriculum.

Another reason is to define our RRI pedagogy i.e the kind of teaching we're recommending including teaching strategies, style of student activities

How have we developed the framework?

we started by defining top level aims, using the 'understanding by design' methodology.

We have defined the below components using the most coherent framework available- the US 'next generation' science standards (Schweingruber, Keller, & Quinn 2012):

- Content big ideas

- RRI big ideas

- Nature of science big ideas

- Scientific practices

All these are basically the basis of what the activities in our materials teach towards.

Then we have created "learning performances" which blend knowledge and skills into worthwhile assessment. This also allows us defining accomplishments, and designing transfer tasks (See tables 9-11)

Structure of activity:

All activities follow a similar structure:

Dilemma

Scientific knowledge – recap already learned, needed for task

Students RRI task – simple, structured activity to resolve dilemma

Teachers materials:

"All in One" – a presentation including all that is needed for the implementation

A teachers' guide

Highlights from the teachers' guide will appear as comments below the slides screen – for teachers' who can not or not willing to read the longer guides.

Development process is outlined on ASANA

Partners' contribution:

Suggest and comment on ideas – Is the proposed activity (i) linked to the curriculum and (ii) relevant and engaging?

Provide low-level localization information: answering specific questions on ASANA form, supplying relevant information such as data, research, initiatives and policies

Translate and add further localization to include local research or data and extra scientific background

Table 9: Defining Goals

ID	Big idea/ Scientific Practice	Goal short name	Goal	Coverage	Type
			The aims lead to 10 learning Goals, related to NoS knowledge		
G1	Science in Society	Technology	Science and technology are intimiately linked, driving each other forward. All new science-based technology carries risks as well as benefits. You can assess risk by measuring its probability. People tend to over-estimate unfamiliar, invisible or long-term risks, and accept risks associated with choice, or short-lived effects. To weigh up a risk means combining its probability and the scale of the consequences, and balancing against the benefits to the individuals or groups affected. Technology can also have unexpected consequences, and so people are cautious about making decisions until sufficient research is carried out to consider as many impacts as possible, and Governments regulate the process.		
G2		Scientific community	Claims should make clear the degree of uncertainty. Scientific claims are published in 'journals' and only accepted after they have been evaluated by peers, and been repeated by other scientists, with similar results. Often the results differ, and so there may be disagreements between scientists who support rival explanations that explain the data equally well		
G3		Values thinking	In emerging science and technology, there are often few 'facts' which are certain. Science can weigh up the evidence, and which explanations have the most support, but it cannot provide certain answers.Sometimes implications can are seen as doing something 'wrong'. There are different ways of dealing with ethical dilemmas		

			including utilitarianism (the decision which leads to the best outcome for the greatest number), duty-based thinking (using accepted ethical principles). Decisions should be made by taking into account the views and concerns of all participants. There are different ways of reaching decisions e.g. majority voting, consensus building by resolving conflicts.		
		Media reporting	Much of our scientific information is interpreted by the media, who may give an unbalanced, biased, black and white or sensationalised account, the source of information needs to be assessed in terms of its purpose, and scientific credentials, and recency.		
			... and 4 Scientific Practices (skill)		
G4	**Ask & define**	**Define problems**	Define the issue being inquired into, the scope, what is required for a solution, and to identify the most important factors and the known/unknown information.		Scientific Practice
G6	**Analyse & interpret**	**Evaluate solutions**	Evaluate the merit of a solution or competing solutions to a real-world problem, based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant economic, societal, environmental, ethical considerations.		
G7	**Argue**	**Construct arguments**	Write or present orally an argument supported by empirical evidence and scientific reasoning to support or refute a viewpoint on an issue or a solution to a problem.		Scientific Practice
G8		**Critique arguments**	Compare and critique two arguments on the same topic , in terms of whether they emphasize similar or different evidence and/or interpretations of facts. Identify flaws in their own arguments and modify and improve them them in response to criticism		Scientific Practice
G9	**Evaluate & Communicate**	**Interrogate media**	Critically read media reports about science, identify the data and evidence used to back up the claims, and evaluate its strength in terms of repeatability and reproducibility.		Scientific Practice
G10		**Communicate ideas**	Be able to effectively communicate opinions and accomplishments with text and illustrations, both orally and in writing, in a range of formats, using the major features of scientific writing and speaking.		Scientific Practice

Table 10: RRI transfer tasks

Accomplishment	Transfer task	Short name	RRI Transfer Tasks. Real life things students should be able to do with their knoweldge and skill	Related Big Idea/ scientific practice
Our Aims are 2 accomplishments we want students to have				
A1			Be able to question and evaluate the evidence for a scientific claim	
A2			Be able to analyse issues, apply knowledge, come to reasoned opinions, express these clearly, and consider possible actions	
... or more clearly, 4 transfer tasks we want students to be able to do				
A1	T1	**Evaluate claims critically**	Critically evaluate the strength of the evidence for a claim about emerging science/technology, from a media report	Analyse, Society, Argue
A2	T2	**Weigh up issues**	Come to an informed opinion on a life, community or society decision, taking into account scientific and other perspectives	Question, Analyse, Argue, Society, Decisions
A2	T3	**Argue your opinion**	Argue for your opinion on a socio-scientific issue	Argue, Communicate
A2	T4	**Compare solutions**	Evaluate possible solutions to science/technology problems, developing criteria, applying knowledge, and using data	Question, Society, Communicate, Argue

Table 11: Learning Performances

ID	Related Transfer task	Goal ID	Main Goal	Performance name	Performance description (which main activities in Materials are based upon)
We can create a list of task types, as templates for activities					
P1	T1	G1	Consequences	**Judge a risk**	Accurately evaluate the probability and risks of a medical intervention or susceptibility to disease
P2	T2	G2	Tentative evidence	**Assess a technology**	Decide whether a technology is sufficiently well researched and understood to justify its use.
P3	T2	G3	Values thinking	**Make a decision**	Come to a more informed decision or judgement about a technology, by combining scientifici knowledge, with social or ethical thinking
P4	T4	G4	Media reporting	**Trust but verify**	Judge if a source (online newspaper, blogpost, tweet, youtube video, magazine, F2F expert) is trustworthy based on independence, unbiased, recent etc, or synthesise a range of reports.
P5	T1	G5	Define problems	**Advise your family**	Explaining to a family member or friend with less scientific expertise, the main issues surrounding a dilemma.
P6	T3	G6	Evaluate solutions	**Review a product**	Decide whether claims of advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.
P7	T3	G7	Construct arguments	**Post online**	Reply to a post/article online, with a coherent argument, building upon or rebutting previous arguments.
P8	T1	G8	Critique arguments	**Talk science**	Give a view, supported by reason and arguments and facts, and be able to rebut counter arguments

			Interrogate media	**Assess the evidence**	Consider whether the evidence for a life decision, as presented in one or more media reports, is strong enough to justify action.
P9	T4	G9			
P10	T4	G10	Communicate ideas	**Propose action**	Propose an action, based on scientific knowledge and decision making that you or your community could take towards helping the environment or society

Summary of PILOT MATERIALS, published June 2014 EXEMPLARS OF MATERIALS

10 materials had been developed:

THREE PARENTS

A new IVF procedure which creates babies with the DNA of three people has just been given the go ahead in Britain. In this activity, students use ethical arguments to decide whether they would recommend it to help a couple in need.

RRI objective: Make a decision about a new technology using ethical thinking.

Science objective: describe how to create an embryo with three parents, and explain how this technique could be used.

WHAT DOES THE FOX SAY?

We use the music video with half a billion youtube views to raise a serious question: can we understand animal talk?. Students look at emerging research to decide what else the technology can do.

RRI objective: Construct an argument with evidence and reasoning to support the claim that a device can interpret dog barks Science objective: Apply knowledge about sound waves

BAN COLA?

Now that scientists have discovered that sugar is like an addictive drug, pressure is building for action to reduce the amount of sugar that children and young people consume in sugary drinks. In this activity, students consider the evidence for causal links between sugar consumption, obesity and disease.

RRI objective: Use evidence to decide whether a correlation is causal

Science objective: Apply knowledge about food and health

CAR WARS

It is 2020 and students are about to get their first car. They consider the implications of climate change in choosing whether to buy hydrogen or biodiesel or electric cars.

RRI objective: Evaluate solutions to the problem of increasing carbon dioxide emissions from cars

Science objective: Apply knowledge about atmospheric carbon dioxide

GROW YOUR OWN BODY

As people live longer the demand for new organs to replace failed ones increases. Students use evidence from case studies to work out if the technology of building new organs from a patient's own cells offers a good alternative to transplants.

RRI objective: Access, evaluate and synthesise relevant information to decide if a new technology will be possible in the next ten years.

Science objective: Apply knowledge about cells, tissues and organs in a new context.

ATTACK OF THE GIANT VIRUSES
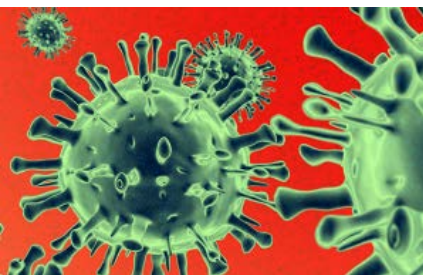
Scientists have discovered a giant 30 000 year old virus still alive under the permafrost. As the world warms, others will be uncovered. Could such an ancient virus wipe out the human race? In this activity, learn how to interrogate sources to separate science fact from fiction.

RRI objective: Evaluate how trustworthy scientific reports are in the media

Science objective: Apply knowledge of microorganisms to check the facts in a newspaper report.

BAN THE BEDS

In preparation for a summer holiday many people turn to sunbeds to top up their tan but could this habit be endangering their life? In this activity students are working as researchers on a TV show planning a report about the claim that sunbeds cause skin cancer.

RRI objective: Use knowledge about UV light to explain the link between sunbeds and skin cancer.

Science objective: Understand how scientific evidence can support a claim

SINKING ISLAND

The Pacific island nation of Kiribati recently announced its purchase of land in mountainous Fiji for its population to move to when sea level rises make life on its own low-lying islands impossible. In this activity students use data to predict sea level rises, including uncertainties, and decide whether humans are to blame for climate change. If humans are to blame, then should the biggest polluters pay for land for vulnerable islanders to escape to?

RRI objective: Apply knowledge about climate change to explain rising sea levels

Science objective: Evaluate evidence to decide whether humans are to blame for climate change

CONCLUSION

We would like to draw our conclusion in relations to wp1 targets in the Dow (p.12)

T1.1 – Conducting a survey to identify opportunities and challenge for RRI teaching in terms of policy, national framework' existing local resources and teachers' preparation. The survey results were reported in D1.1 (month 6), however they were very useful in working on targets 1.2-1.4, especially in designing the curriculum materials, discussing levels of localization with partners to address local needs and opportunities, and setting the goals for teachers' preparation.

T1.2 Prototype OER materials: We were able to develop a framework for designing materials, as well as 10 activities. In general, partners provided feedback that the framework is very well defined and explained. It may need to be simplified in order to be presented to teachers. Some more work will be further conducted to better define certain skills**.**

T1.3 Prototype teacher's course: Based on D1.1 we concluded that RRI concepts are almost not presented in teachers professional development. , The integration of high-order learning skills and IBL in teaching are dominant as "slogan", but practically teachers need support in implementing these skills effectively. Guidelines and a model of the course were developed. Content for specific activities and resources are also available for partners, mostly for the adopt stage, however we assume localization will have to take place in designing the workshops. After 1st year of adopt – an assessment and rethinking of our framework will take place as well as further development of content for adapt and transform stages.

T1.4 Piloting the materials: Pilot was conducted in four countries: UK, Norway, Cyprus and Israel. A total of 120 pupils and 6 teachers piloted the materials in 3 countries during May-July 2014. Four evaluation instruments were developed & translated : Observation guidelines and results form, interview guidelines and questions, teachers' questionnaire and students' questionnaire. In general we got mainly positive results in terms of students' engagement and interest. Some changes to the activities were suggested by teachers & students. In UK 1500 teachers visited ENGAGE website with an average of 400 download to each of the first 4 activities. For the full report of the pilot see Appendix 3.

T1.5 many uses for videos were suggested by partners. We have decided that the main focus will be videos of key RRI Pedagogies in use by expert RRI teachers. These will show what teachers do to make the activities more effective. We have decided on videos that blend animation, Expert explaining RRI pedagogy, expert teachers reflecting on their work, and short glimpses into actual classroom sessions. A format for developing the videos was created.

3. NEXT STEPS

Setting a framework for partners' involvement in materials development for adopt stage which will include: Idea selection, country specific information, post-development changes, translation and localization.

Further development of curriculum materials to reach the goal of 60 units.

Planning and implementing the dissemination of adopt stage, let by wp4.

Further development of the teachers' courses, and uploading the contents of the MOOC on EDx platform to be ready to start by January 2015.

Appendix 1

	Teaching and learning approach	Description
1	Lecture/talk	Expert-led input, perhaps with practical demonstrations, followed by questions and answers.
2	Workshop	Expert led input and activities for individuals and/or groups, followed by discussion. This could include practical work.
3	Curriculum implementation	Introduction to new teaching materials or a new approach, followed by opportunity to try it out and report back.
4	Curriculum development/adaptation	Work as a group to collaboratively develop a new approach to a topic, followed by opportunity to try it out and report back.
5	Supported action research	Identification of a specific problem/issue in current practice, collect data in own context to clarify, design new approach and evaluate.
6	Debate	Structured debate on an issue concerning science teaching and learning, or about a controversial issue that might be used in teaching
7	Role play	Experience of taking part in role-play activities, to develop skills in using role play as a teaching method
8	Modelling practice	Teaching/observing/discussing an exemplary' lesson.
9	Case discussion	Group discussion of example(s) of an aspect of practice (e.g. sample of pupils' work, classroom video, new teaching materials). Focus could be tutor selected, or chosen by discussion at first meeting.
10	Study group	Group discussion of a topic or issue of mutual interest, with tutor (online?) support.
11	Attachment	For example, to a scientific research group, or a local industry, to gain understanding of an aspect of science knowledge or process.
13	Coaching/mentoring	An experienced tutor working with one or more teachers on an aspect of their

		teaching which they have identified.
14	**Learning by experience**	Teachers do a task of the kind they ask their pupils to do (e.g. an Sc1 investigation) to get a better 'feel' for what this is like, followed by group discussion with a tutor.

Appendix 2

Table 13: Purpose of CPD activity

	Focus of CPD episode	Purpose	Examples
1	**Teaching and learning approaches**	To develop knowledge and understanding of a general teaching and/or learning approach or issue, and to develop practitioners' skills in implementing this in their own situation.	Formative/diagnostic assessment; (assessment for learning) Effective use of Practical Work Using fieldwork [Using ICT to enhance science learning – USE the ICT category 8 below] Using informal science learning opportunities (museums, hands-on centres, etc.) Developing awareness of science-related industry Classroom talk Handling controversial socio-scientific issues in the classroom
2	**How to teach a specific science idea, topic or skill**	To develop knowledge and understanding of issues and ideas concerning the teaching and learning of a **specific** science idea, topic or skill.	Teaching forces at KS3 and 4 Teaching photosynthesis Teaching about matter at KS2 ... etc. Teaching about a specific aspect of the nature of science Teaching enquiry based learning
3	**Curriculum knowledge and skills**	To develop knowledge and understanding of the structure of science course provision and its presentation within the whole curriculum	Introduction to new courses/specifications Introduction/update on methods of assessment (e.g. coursework, moderation, etc.) Curriculum development and evaluation (i.e. generic training in how to develop and evaluate a teaching programme) Developing cross-curricular links Developing cross-phase links
4	**Scientific knowledge, and knowledge about science**	To enhance understanding of science ideas and/or practices.	Lecture or workshop on an established science topic New/current developments in science Insights into the practice of science
5	**General educational knowledge**	To develop understanding of issues which apply to many curriculum subjects, from the perspective of a science teacher.	Theories of concept learning Safety The legal framework Behaviour management
6	**Supporting the CPD of others**	To develop knowledge, understanding and expertise in	Mentoring an teacher training student Training the trainers (courses for those involved in CPD,

		working with others (teachers, trainees, technicians) to develop their professional capability.	including scientists and industrialists)

4. **Appendix 3 -** Report of results of Pilot study – See separate file

5. **Appendix 4** – Teachers materials: Set of techniques for discussions, debates and arguments techniques – A working document - See separate file

6. REFERENCES

Bell B. and Gilbert J., (1996), Teacher development: A model from science education, London: Falmer Press.

Bennett, J., Braund, M., & Lubben, F. (2010). The impact of targeted continuing professional development (CPD) on teachers' professional practice in science.*Main Report. Report commissioned by the DFCS through the National Science Learning Centre. York: University of York, Department of Educational Studies. Down loaded from http://www. york. ac. uk/depts/educ/research/ResearchPaperSeries/index. htm.*

Berger, H., Eylon, B. S., & Bagno, E. (2008). Professional development of physics teachers in an evidence-based blended learning program. *Journal of Science Education and Technology*, *17*(4), 399-409.

Borko H. and Putnam R., (1995), Expanding teacher's knowledge base. A cognitive psychology perspective on professional development, in Guskey T. and Huberman M. (ed.), Professional development in education. New paradigms and practices, Colombia University, Teachers College Press, pp. 35–66.

Eylon, B. S., Berger, H., & Bagno, E. (2008). An evidence-based continuous professional development programme on knowledge integration in physics: A study of teachers' collective discourse.

Fishman B., Hoadley C., et al., (1997), Collaboration, Communication, and Computers: what do we Think we Know about Networks and Learning? Annual Meeting of the American Educational Research Association, (AERA), Chicago, IL.

Harrison, C., Hofstein, A., Eylon, B. S., & Simon, S. (2008). Evidence-based professional development of science teachers in two countries.

Johnson J. and Dyer J., (2005), User-defined content in a constructivist learning environment, m-ICTE 2005: recent Research Developments in Learning Technologies.

Kind V., (2009), Pedagogical content knowledge in science education: perspectives and potential for progress, Studies in Science Education 45(2), 169–204.

Lave J. andWenger E., (1991), Situated learning: Legitimate peripheral participation, New York: Cambridge University Press.

Loucks-Horsley S. and Matsumoto C., (1999), Research on professional development for teachers of mathematics