



A pedagogical framework for the Ark of Inquiry project

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European Union's
Seventh Framework Programme

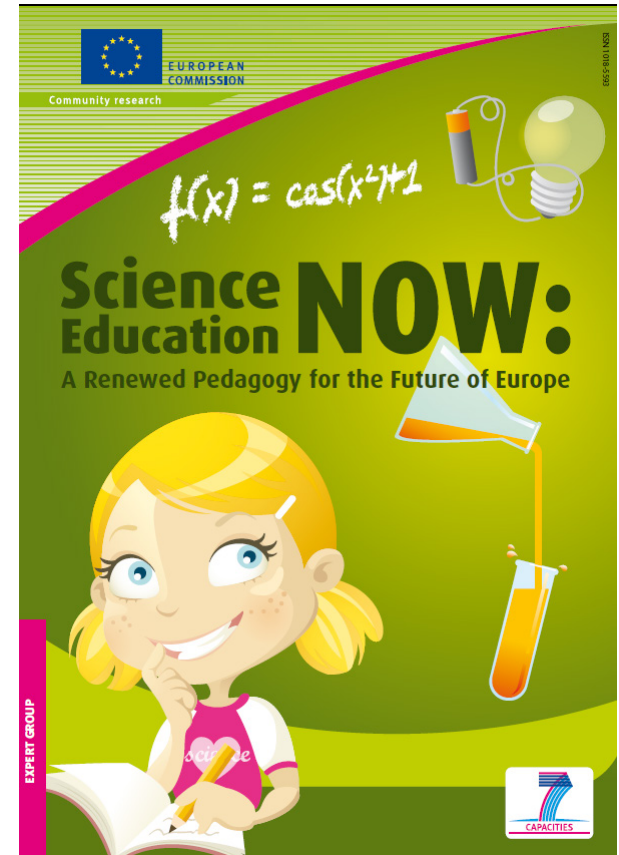


Outline

- Introduction to European funding for science education projects
- Educational policy in Estonia
- The Ark of Inquiry project
- Why a pedagogical framework is needed?
- Inquiry proficiency framework for Ark of Inquiry
- Example inquiry activity
- Conclusion

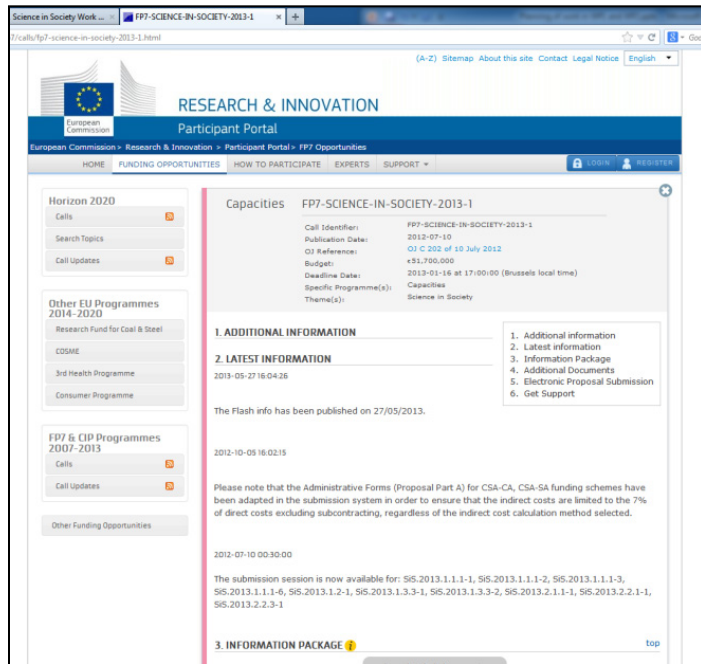
Science Education in Europe

- European Commission expert study on **science education**
- Problem of **low interest** by young people in studying science and mathematics
- Origins of this situation can be found, among other causes, in the **way science is taught**
- **Inquiry-based practices** help motivate a deeper integrated science understanding



Rocard, M., Csermely, P., Jorde, D., Lenzen, D., Walberg-Henrikson, H., & Hemmo, V. (2007). Science education now: A renewed pedagogy for the future of Europe. Brussels: European Commission: Directorate-General for Research.

European Commission funding for large-scale projects supporting science education



Area 5.2.2.1 Supporting formal and informal science education in schools as well as through science centres and museums and other relevant means

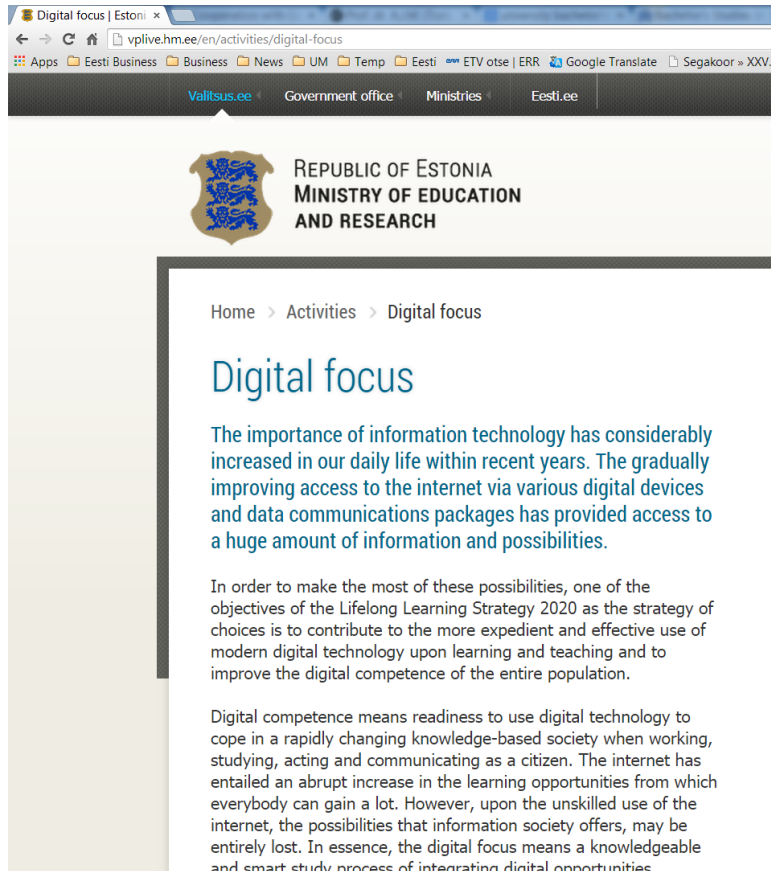
SiS.2013.2.1-1 Raising youth awareness to **Responsible Research and Innovation** through **Inquiry Based Science Education**

FP7-SCIENCE-IN-SOCIETY-2013-1

Education Policy in Estonia

- Since 2011 the Estonian national curriculum made it compulsory for upper secondary students to complete a **research project** or a practical assignment to graduate
- An elective school course “**Bases of Inquiry**” was created to introduce pre-university students to the essence of research work
- Writing a **bachelor’s thesis** is a requirement at Estonian universities



A screenshot of a web browser showing the page "Digital focus" on the website of the Estonian Ministry of Education and Research. The page includes the ministry's logo and name, a breadcrumb trail "Home > Activities > Digital focus", and three paragraphs of text discussing the importance of digital technology and the goal of digital competence.

Home > Activities > Digital focus

Digital focus

The importance of information technology has considerably increased in our daily life within recent years. The gradually improving access to the internet via various digital devices and data communications packages has provided access to a huge amount of information and possibilities.

In order to make the most of these possibilities, one of the objectives of the Lifelong Learning Strategy 2020 as the strategy of choices is to contribute to the more expedient and effective use of modern digital technology upon learning and teaching and to improve the digital competence of the entire population.

Digital competence means readiness to use digital technology to cope in a rapidly changing knowledge-based society when working, studying, acting and communicating as a citizen. The internet has entailed an abrupt increase in the learning opportunities from which everybody can gain a lot. However, upon the unskilled use of the internet, the possibilities that information society offers, may be entirely lost. In essence, the digital focus means a knowledgeable and smart study process of integrating digital opportunities.

<http://vplive.hm.ee/en/activities/digital-focus>

- In fall 2014, Estonian education policymakers added a new general competence, **digital competency**, to the national curriculum for basic and upper secondary schools
- Competence is defined as a compilation of **knowledge, skills, values and opinions**, which ensures readiness to engage in lifelong learning and an ability to attain results in a chosen field
- Digital competence means readiness to use digital technology to cope in a **rapidly changing knowledge-based society** when working, studying, acting and communicating as a citizen

Ark of Inquiry Project

- An **Ark** is a repository of valuable stuff that helps save the world and delivers hope (e.g. Noah's Ark)
- **Ark of Inquiry** (www.arkofinquiry.eu) is a European project for the widespread dissemination of inquiry activities through a network of universities, schools, science centres and museums.



Ark of Inquiry involves 13 project partners from 12 countries.

Ark of Inquiry Goals

To raise youth awareness to Responsible Research and Innovation (RRI) by

- providing young European citizens (7 to 18-year-olds) with a pool of engaging inquiry activities to improve
- their inquiry skills, increase their awareness and understanding of conducting ‘real’ science, and prepare them
- to participate in different roles in the European research and innovation process



<http://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

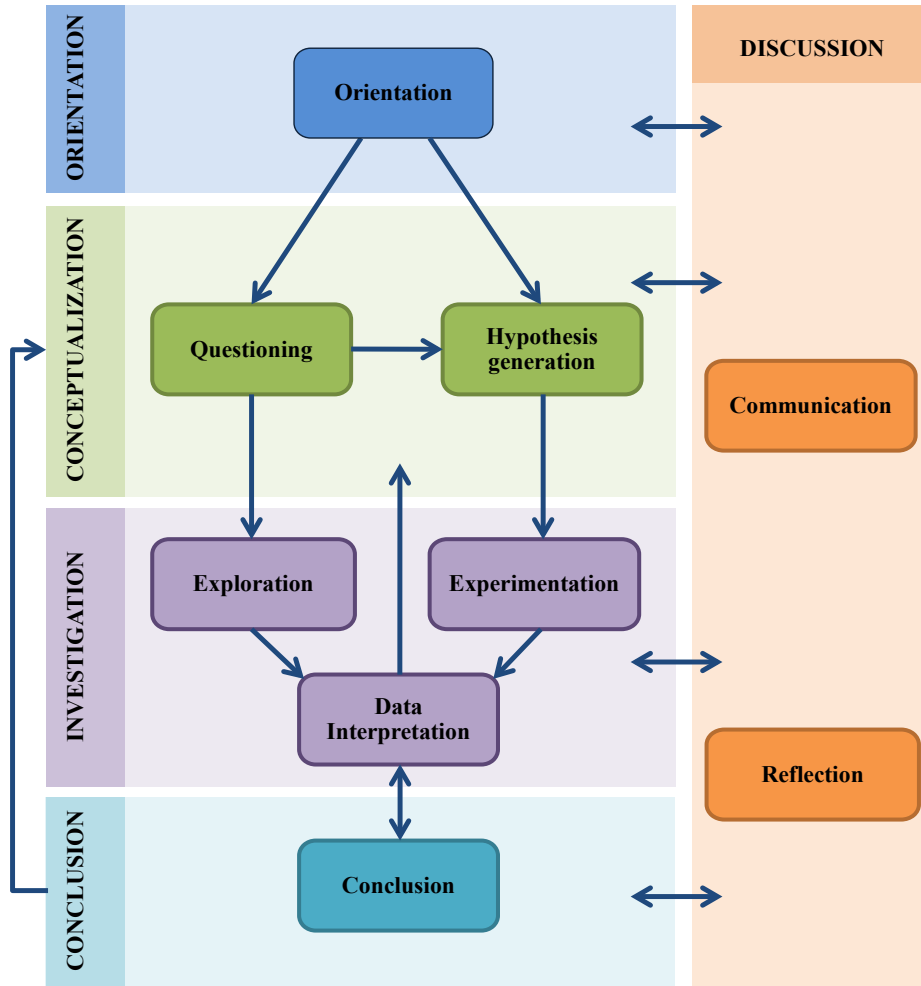
Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society.

In practice, RRI is implemented as a package that includes multi-actor and public engagement in research and innovation, enabling easier access to scientific results, the take up of gender and ethics in the research and innovation content and process, and formal and informal science education.

Ark of Inquiry Pedagogical Approach

- Categorize inquiry activities to match a learner to an appropriate inquiry activity
- Present a framework for inquiry proficiency (basic, advanced, expert)
- Ensure student progress in inquiry and RRI skills across different levels of attainment

Inquiry Cycle



- Five main inquiry phases
 - Orientation
 - Conceptualization
 - Investigation
 - Conclusion
 - Discussion
- Inquiry is rarely a linear sequence through these phases

Inquiry Proficiency

Different levels of proficiency were created based on taking into account three dimensions

- (1) **problem-solving type** (progressing from well- to ill-defined problems)
- (2) **learner autonomy** (progressing from teacher/material-led to student-led processes)
- (3) **RRI awareness** (progressing from sharing with a small audience to discussions and interactions with a broad audience of stakeholders)

Framework for Inquiry Proficiency

Ark of Inquiry: Framework for Inquiry Proficiency

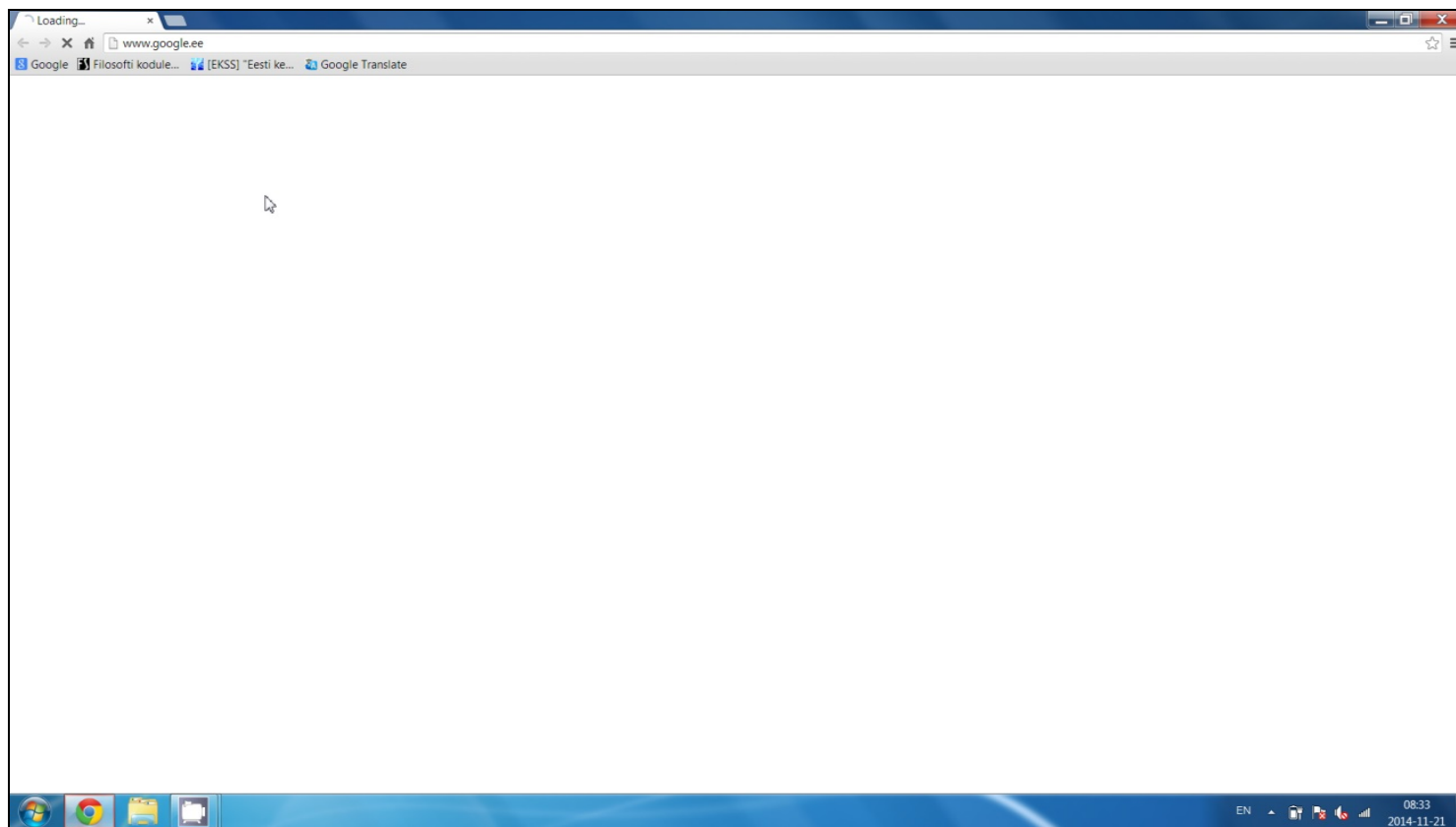
INQUIRY PHASE	INQUIRY PROFICIENCY LEVEL		
	A (basic inquiry)	B (advanced inquiry)	C (expert inquiry)
<i>ORIENTATION</i>	Students are introduced to a problem within a well-defined problem space	Students are introduced to a problem in a semi-structured problem space	Students identify a suitable problem in an open-ended problem space
<i>CONCEPTUALISATION</i>	Students are led to common questions and/or hypotheses that will be studied in the investigation	Students formulate questions and/or hypotheses through guidance	Students explore and formulate meaningful questions and hypotheses
<i>INVESTIGATION</i>	Students collect and analyse data according to prescribed procedures and fixed instruments	Students collect and analyse data in semi-structured steps and formats	Students operationalize procedures and formats through which they collect and analyse data
<i>CONCLUSION</i>	Students reach an understanding of fixed conclusions	Students reach conclusions through (semi-)structured procedures	Students reach conclusions and explain the process
<i>DISCUSSION</i>	Students present in fixed formats to teachers and/or peers	Students present and communicate in semi-structured or self-chosen formats to teachers and/or peers	Students present and discuss at appropriate times and in applicable formats with diverse stakeholders

Mainly teacher-structured \longleftrightarrow Mainly student-led

- Three inquiry proficiency levels
 - **Structured** inquiry
 - **Guided** inquiry
 - **Open** inquiry
- Inquiry activities can be categorized according to the proficiency level of challenge they offer

Example Inquiry Activity

lingid.ee/golab



Conclusion

- Ark of Inquiry project aims to build a scientifically literate and responsible society through Inquiry-Based Science Education
- Will offer a platform to easily disseminate engaging and challenging inquiry activities to students (aged 7-18)
- A pedagogical framework was developed to categorize inquiry activities and facilitate the gradual development of student inquiry skills and awareness of responsible research and innovation
- Teacher training will begin next year to help teachers support their students' engagement in Ark of Inquiry activities



Thank you for your attention!

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<http://haridustehnologia.ut.ee>

