ECO SYSTEMS OF OPEN SCIENCE SCHOOLING

Guidance Collection for Partners

INNOVATION VOCABULARY

Agent of community and agency

The expression “agency” is used by the OECD, the European Commission as well as by leading learning pioneers and increasingly by educational researchers.
The term “agency” is at the very heart of the project innovation.
Agency means “the capacity to act” and not just to “know” or “remember”.
The project is strongly linked to the learning approach that learning becomes effective, useful and relevant when the students are engaged in real-life science in the community.
This also means that the term “agency” forms part of a learning credo, a new way to think education and a new way to learn – not primarily linked to the community or to the specific science topics addressed.
Last, but not least, the “capacity to act” and “to learn through taking action”, should be developed all along the educational system, from kindergarten and onwards.
These are in fact the very words of the European Commission.

Co-creation

Co-creation is a term linked to the modern innovation discourse: problems, solutions and designs can be co-created by for example end-users or students.
Co-creation does not mean that the ones co-creating are responsible for the final outcome, but it means that the co-creators play important roles in the creation of solutions or outcomes.

In our context co-creation is linked to the students: they will be co-creators of the project implementation as well as the project outcomes.
We believe that true educational innovation cannot be created without the students being authentic co-creators of the innovation.
This is even truer now than ever: *for the simple reason that we do not really understand how the new generations learn, live and think.*
“Millennials worldwide are more similar to one another then to older generations within their nations.” - *Time Magazine, 2014*
This makes co-creation in educational innovation urgent and indispensable.

Community

In the *Eco-systems of Open Schooling* project “community” should be understood in its widest sense: local physical community, the region, various science communities and virtual communities.
The globalised world and the 21st century students do not separate these worlds in the way the present educational systems do.
They work with the physical and virtual communities as one world – and local science engagement might very well include considerable virtual social networking.
This is why the project invites the student teams to work in different forms of communities in the two long science mission phases.

Community and science collaborators

When secondary schools and student teams start acting in the community, they will collaborate with a wide range of people and institutions.
These community collaborating resources have many names, so to speak.
Therefore, some clarification might be useful:
In the field of “eco-systems of open science schooling” - where schools become agents of science collaboration in the community and students become agents of science missions in the community – there are basically two types of people and institutions collaborating with the schools and the student teams:

- THE ECO-SYSTEMS OF OPEN SCIENCE SCHOOLING

These are permanent teams of open science schooling collaboration, driven and facilitated by the school team.
The mission of these resources is to provide an infrastructure or platform of resources for the student teams’ science missions.
Examples of such eco-system players are:
- Public authorities with an interest in science learning and science in the community
- Various forms of science educations and research bodies, private or public
- Open science centres in the community or region
- Entrepreneurial hubs engaged in science in various ways
- Citizens’ organisations working with science-related challenges in the community, such as science in society

- MISSION BASED SCIENCE RESOURCES

Whereas the eco-systems of open science schooling are permanent bodies, ad hoc teams of science resources linked to specific science topics will be created through the student teams’ science missions.
Such science resources might be any resources working directly with challenges linked to the student teams’ science missions.

Eco-systems of open science schooling

Even though this expression might appear a bit complicated, its emergence is quite simple:

As strongly recommended by the European Commission we are trying to re-think and fundamentally innovate science education in secondary school, as very many young people grow a strong resistance to science education precisely in secondary school and in their teenage years.

The most efficient and attractive innovation of science education is precisely open science schooling.

Open science schooling is defined across the application and also in this vocabulary.

The open science schooling approach is based on young students learning science through science missions carried out in the communities.

This is where the eco-systems come in:

If open science schooling is to be made a reality and yield the expected innovation, then the student teams' science missions must be realistic, possible and efficient.

Now, the problem is that student teams cannot be expected to build up important collaborative infrastructures each time they set out to accomplish a science mission.

This is why we say: if the student teams are going to act successfully in the community, then the schools also need to act successfully in the community.

The basic science and community resources should therefore be permanent resources the students can tap directly into and get support from in their science missions.

As stated by the Commission, *such infrastructures of science resources must be readily available to teachers and students*.

These permanent open science schooling resources are called "eco-systems", as the resources are expected to be a living organism of a wide range of different resources – and therefore adjusting and changing according to the needs of the students' science learning.

Examples of such eco-system players are:

- Private companies with science-related activity
- Public authorities with an interest in science learning and science in the community
- Various forms of science educations and research bodies, private or public
- Open science centres in the community or region
- Entrepreneurial hubs engaged in science in various ways
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Implementation methodology

To ensure the accomplishment of the project's missions, the project is driven by two different but strongly interacting methodologies: the implementation methodology and the innovation methodology.

The two methodologies are necessary to accomplish the project mission for the following reasons:

- Even if the project from a "project" point of view is well implemented, that does not guarantee that the project's innovation has been successful
- Even if the project has managed to work successfully with the project innovation, that need not lead to successful project results if the project – as a "project" – is not well implemented

Erasmus+ projects constantly struggle with unbalances between these two forms of methodologies.

The implementation methodology answers the question:

"How will the project ensure the progression towards quality outcomes?"

The answer is:

-the project outcomes will result from qualified knowledge creation along the project; this knowledge creation is based on the transformation of documentation of the project practice and experimentation; the project will ensure proper documentation of practice and proper transformation of documentation to knowledge on which the outcomes can be based

Unlike the innovation methodology, covering the most important structural quality parameters in the project, the implementation parameter is about the quality of the project progression – as a project.

It is concerned with the question: *to what extent is the project able to progress well towards its final outcomes?*

This means that the implementation of the project phases (the "scenarios") is crucial, that the transition between the phases is crucial – and that the phases progressively build up to the final outcomes.

The successful application of the implementation methodology is supported by a set of critical quality criteria, forming part of the project's quality assurance platform.

The methodology is further detailed in the application's methodology section.

Innovation methodology

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The innovation methodology serves to ensure that the project innovation is well guided, that the innovation is practiced in real-life, that the practice is documented and is leading to sound knowledge creation and thereby to good final results.

The innovation creation logic:

- state of the art and lessons learned based guidance to create the first basic eco-systems of open science schooling
- double practical testing of the eco-systems through 2 x 6 months student mission engagement in open science schooling based on the eco-systems
- 3 x evaluation processes, ultimately leading to the final outcomes

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Knowledge creation

Knowledge creation can mean very many things in different contexts.

In an Erasmus+ level project the final outcomes cannot be based on research and the final results of the project should be based on practical experience.

However, to produce useful and reliable outcomes the project practice needs to be transformed into knowledge elements from which the final outcomes can be created.

It is not possible to base final outcomes directly on practice, as practice only exists as a line of actions carried out.

These actions and the lessons learned need to be transformed into what we might call "building bricks of knowledge" to inform the project's guidance outcomes.

The most critical process is, then, to document practice and to transform this documentation to knowledge elements. If the transformation to knowledge elements is successful, then useful outcomes can be created.
In any Erasmus+ project this process is closely linked to quality assurance, asking the following questions:
- is the project practice being sufficiently documented?
- is the project able to transform the documentation into meaningful knowledge elements?
- is the project able to create useful outcomes from these knowledge elements?
This is why, in this project, the partnership consists of knowledge partners, practice partners and a dedicated quality assurance partner.

Learning on demand

In traditional education the students are taught through the principle of “learning when scheduled”. That is: learning math Tuesday from 10-12.
To the students of the 21st century this is definitely an abstract justification of the learning.
The learning is organised to please the education system, not to support the students’ learning.
“Learning on demand” totally changes this approach: the students learn when they need to learn, when it is relevant, when they are motived, and first of all: the students learn when they need to learn *to accomplish their science missions*.
This form of learning is based on the students’ interest, not the systems.
In the project this is called “time-outs for learning on demand”.
When the students work in their science missions, they often get stuck: we cannot progress from this point. We need to learn something first, or in parallel. Then we can progress.
Learning when scheduled leads to remembering, whereas learning on demand leads to deep sustainable learning and the capacity to act.
Obviously, schools need to learn how to organise such “learning on demand” – in collaboration precisely with the eco-systems of open science schooling.

Modernization of science education

In recent years very many attempts to “modernize” science teaching have been carried out.
Such “modernizations” might be visits to science resources outside the school, punctual engagement in science activities in the community, new work forms in the class – or participation in various forms of science competitions.
A popular “modernization” is to use new technology and even digital games.
The European Commission states, however, that this is not enough.
We need to re-think the fundamentals of science education and we need to develop dramatically new ways of engaging young people in science.
This is why the Commission invites experimentation with open science schooling.

Open science schooling

The European Commission calls for re-thinking education, and open science schooling is one of the educational changes increasingly recommended by the Commission as well as by critical research.
Open science schooling refers to education that works with real-life challenges in the community and globally, allowing students to learn through engaging in science challenges, problems, and innovation.
This indicates that the learning is no longer linked to the classroom but to the world outside the school.
Obviously, this is no less than a revolution in education, and more so as open science schooling goes far beyond punctual activities outside school such as visits to a science centre or similar.
Open science schooling is incorporated in the schools as drivers of eco-systems methodology, and this methodology in fact takes open science schooling further: not only engaging in science challenges relevant to the community, but creating capacity to take critical action among the students, critical action through long and deep science missions.
A key point is to take open science schooling to a level where the students accomplish something real.

Re-thinking science education

The short version of this complex concept is that it is not enough to “modernize” traditional science education, or to add new features such as project work.
The new generations of students and the new and constantly changing global reality call for fundamental re-thinking of what science education is and should be: re-thinking the very basic axioms of and the very discourse of traditional science education.
As the European Commission says, it will take a sea change for education in Europe to accomplish this radical and urgent mission.

School teams

The project involves one school team from each of the participating secondary schools from the practice countries.
The school teams are drivers and facilitators of the emerging eco-systems of open science schooling and will support the student teams’ science mission.
The school teams represent all major levels of the schools:
- Management representation
- Lead science teachers
- Student captains

It is therefore of great importance that vertical consensus is created along the first two scenarios: from management to student.
Management representation and lead science teachers from the school teams in the different practice countries will meet and interact during the 3 days school teams’ empowerment mobility.
The school team will be represented by a lead science teacher and the student team captains at all partner meetings.

Science missions

In traditional teaching the students work with text books, artificial cases and lots of theory and abstract knowledge.
In open science schooling students learn through working with real-life science challenges and in real-time.
Students do not look at the reality around them through subjects, classrooms and texts, but engage directly in science challenges of all kinds and in close collaborations with community science resources.
This completely alters the traditional educational set-up and places moreover teachers in brand new roles: as guides, as facilitators and as critical friends to the student teams. And, by the way, as learners alongside the students…
Students work in teams to learn through engaging in long missions of science challenges in the various forms of communities.
“Community” in this context is a very broad term; it might mean local physical community, region, or even virtual community.
The way they learn through taking action in the community is to define, create and accomplish science missions.
Missions are projects carried out in real-life and in collaboration with real-life science players. We use “mission” instead of “project” for several reasons:
- The term “project” was once very innovative, such as in project based learning; however, today the term can mean everything and nothing
- The term “mission” is much stronger: it refers to strong intentions, the will to accomplish and the ability to critical engagement
- The term “mission” is used in all sorts of video games and most young people are familiar with the meaning of missions: working through levels and steps to be allowed to advance in the game and to finally accomplish
The infrastructure of a mission is the 10 steps methodology:
This method is developed for the project, but builds on more than 15 years of educational innovation experimentation.
The expression refers to the typical steps that student teams need to work through to accomplish their science missions.
The method is a pragmatic method helping the schools and the students understand and implement the missions – in close interaction with the emerging eco-systems of open science schooling.

Missions might, of course, look different, but the 10 steps are quite typical for most science missions:

STEP 1
Students as science detectives
STEP 2
Science engagement dialogues with the school team and with the eco-system of science resources
STEP 3
Agreeing on science missions driven by the student teams
STEP 4
Science learning on demand and dialogues with mission resources and stakeholders
STEP 5
Discussions with end-users, involved people and institutions and others with an interest in the science mission
STEP 6
Designing the science missions and negotiating needed resources
STEP 7
Working in the science missions (student teams, school team, eco-system)
STEP 8
Evaluation of successes and failures

STEP 9
Sharing the experience with the other teams and in the project and with creative media – story-telling
STEP 10
Lessons learned

Student teams

The project will involve 10 student teams of around 5 students each from 5 different countries along the entire project.
The student teams are at the centre of the project and will co-create its outcomes: innovation WITH, not TO.
In particular the student teams will be drivers of the two 4-6 months long testing of the eco-systems of open science schooling.
The teams will do this through their real-life and real-time science missions.
The most important things linked to the deep involvement of the around 50 secondary school students are for the project to learn about the following challenges:
- In what ways are the students learning science differently through the open science schooling method?
- In what ways are the eco-systems of open science schooling giving support to the new form of science learning?
The student teams will meet and collaborate during the 5 days student teams' empowerment mobility.
The student captains will participate in all partner meetings.