



# WHAT (MORE) DOES IT TAKE TO MAKE OPEN SCIENCE SCHOOLING A REALITY?

Policy paper

Working With Europe

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This paper is based on 2 years of practical experimentation with the participation of four secondary schools, teachers and students, two knowledge partners and one quality assurance partner from different European countries.

The goal of this paper is to use the positive and negative experience from the project to identify the most important challenges when creating permanent and sustainable resources and to demonstrate how such collaboration should take the form of “eco-systems of open science schooling.

The lessons learned are based on dialogues with the students and teachers along the project.

Key messages, unedited and authentic, from the participants are inserted.

The language of the document is non-academic and the text is constituted by short and precise statements, referring to practical experience from similar projects. The aim is to make the report content accessible and attractive to very large audiences.

In other words, the text wishes to contribute to an understanding of what further steps should be taken in the core field addressed.

Thus, the text might inspire new European initiatives based on and going further than the project.

Rich examples of the project experience can be found in the project [website](#)

*Eco-systems of Open Science Schooling  
Making open science schooling a reality for secondary school students  
project 2020-22 is funded by the European Commission Erasmus+ program*

## INTRODUCING THE PROJECT

The idea to create the Eco-systems of OSS emerged from a number of Erasmus+ experimentations with mission based and open science schooling methodologies. The lessons learned from this rich experimentation revealed that it is difficult for secondary schools in Europe to implement and experiment with the full concept and method of what we understand as “open science schooling”.

The challenge for many schools is: when trying to implement the full open science schooling methodology, they experienced – not surprisingly – that the traditional school and science curricula made it almost impossible.

Students and teachers were not provided with the necessary time and space for such experimentation.

To make open science schooling a reality, the Commission recommends schools to have not only access to but permanent and sustainable access to real-life and real-time science resources (locally and globally) for students and teachers to tap into. The project demonstrated how such permanent science collaboration should take the form of “eco-systems of open science schooling”.

The ultimate mission of the Eco-systems of OSS is to help secondary schools and science teachers change traditional science teaching into science learning through science missions in collaboration with permanent eco-systems of open science schooling resources – as this approach is expected to engage students in brand new ways and to help them create new and different images of what science is and could be for them.

Or, at least help the science teachers to include periods of such open science learning in the life of schools.

The question is, how to “help” those schools and science teachers?

The answer is through qualified, realistic, and relevant guidance, of course.

And how to produce this guidance?

Through creating and testing such eco-systems of open science schooling in practice, in real-life and real-time.

And through creating practical experience about how such eco-systems of science resources can help students engage in real-life and real-time science missions in the community.

In the project this real-life and real-time testing of the eco-systems of open science schooling included the schools and students working through their missions.

The results are not based on theory or abstract assumptions, but on dynamic practical experience for this the guidance has been co-created by the students themselves, as this is the credo for all true educational innovation in the 21st century and links the project innovation to re-engaging young students in science and technology learning and in the world of science and technology – one of the top strategic priorities and innovation needs in European education.



## **PART 1 - THE FRAME**

*Encourage “open schooling” where schools, in cooperation with other stakeholders, become an agent of community well-being; families are encouraged to become real partners in school life and activities; professionals from enterprise, civil and wider society are actively involved in bringing real-life projects into the classroom.*

*COMMISSION 2015, SCIENCE EDUCATION FOR RESPONSIBLE CITIZENSHIP*

Recent research, the European Commission, as well as considerable practical experience clearly conclude that the new generations of young students are fundamentally different from earlier generations.

They learn, think, live and work in fundamentally different ways and the traditional education system and paradigms do not work well for these students.

After several Erasmus+ experimentations and lessons learned we can say that 21<sup>st</sup> century young students are incredibly different from the students of earlier generations!

Whether we name them digital natives, rockets (Prensky) or virtual addicts, they live, work, learn and think totally differently from earlier generations, including the teachers’ generation.

### **INNOVATION INTEREST IN EARLY SCHOOLING**

Why all of a sudden, the big global players claim that we need to create interest in innovation from the early days of school?

Unlike most national educational authorities, these global players have a long-term strategic outlook and approach to education and learning.

They know that the safe and secure jobs in which people were doing the same things for a lifetime are long gone.

They know that most citizens will have to change professional direction many times and without having what we used to call the “proper qualifications”. Perhaps we need to build the qualification on the flight...?

And they know that things will change at such a speed that many things will become obsolete almost before they are invented.

They also know that innovation and change will need to come from citizens and will need all talent available, as public spending will not do the job anymore.

But why in early schooling?

There are at least two important reasons:

*First*, the innovation interest agenda states that being interested in innovation, being curious, being action-oriented and growing a desire to change things around you – all this should become a natural part of school and schooling, from the very first day and all across the educational system.

This is parallel to the “digital natives”: the young people are born digital natives, the older generation has acquired some skills, but technology will never be natural to them.

The Commission agenda want the young generations to be “innovation natives”: to think and feel innovation and the need to change things that do not work well.

Of course, this calls for open schooling didactics from the very first school days, as innovation interest can only grow from constant interaction with real life processes. This at the same time calls for “learning on demand”, not “learning when scheduled”. Another challenge to the time and class based educational system...

*Second*, the secondary school years also represent the teenage years: the years in which we create our fundamental identity and personality.

The way of thinking and behaving in “innovation interest” should form part of the development of the young identities, not something that is acquired from the outside later on...

The open schooling mentality becomes a part of the personality, of who I am, how I see myself and how I act and learn.

## THE EUROPEAN SCIENCE LEARNING INNOVATION AGENDA AND OPEN SCIENCE SCHOOLING

The European Commission calls for re-thinking (science) education, and open science schooling is one of the educational changes increasingly recommended by the Commission as well as by critical research.

Why?

Because students in the 21<sup>st</sup> century create resistance towards science, science education and a life in science, based on negative images of science built up in secondary school.

The result of this is Europe losing most of its young potential science and innovation talent, which is unaffordable in times of serious challenges to life on earth and human welfare.

But the problem is not the young students.

The problem is science, science education and science in society.

## STRONG CALL FOR INNOVATION and THE PROJECT

The commission, leading research communities and policy-makers are increasingly and jointly calling for dramatic innovation in all forms of science learning and at all educational levels.

Eco-systems of Open Science Schooling is part of this agenda and set out to contribute to the development of innovation and science learning and experience.

The two years' project experience produced lessons learned about all the obstacles when establishing infrastructures and collaborating student teams to carry through and accomplish open schooling science missions.

The project challenges were met, from European funding to the work conditions of the schools and individual teachers.

The science learning innovation takes place in a strange landscape with many extremes: on one hand it seems that science teaching is conservative, restrictive and traditional of all school subjects; on the other hand, the surrounding community and world offer thousands of dynamic and exciting science cases and missions.

The problem is the giant gap between these two extremes in the science education scenario.

When discussing innovation in science education, this innovation clearly goes in the direction of open science schooling.

There are, obviously, different ways of innovating science education (and education in general), but there are very strong reasons to focus the innovation on open science schooling:

- ✓ Open science schooling is fundamentally different from classroom instruction, reading textbooks, working with artificial cases or performing small experiments in the school laboratory.
- ✓ Open science schooling offers students real-life and real-time science experiences in the surrounding world, in the community and this means that many different lifestyles are possible in the field of science
- ✓ Open science schooling offers students practical, realistic and action-oriented science experience and this might help change their general resistance towards traditional and obsolete classroom science. Such engagement takes place in the form of science missions, designed and carried out by the students, guided by their science teachers and in collaboration with relevant science resources in the community.
- ✓ Open science schooling offers all young students much more realistic impressions of what science is and what scientists do; this might help many young students overcome typical negative imaging of science and scientists as well as overcoming the resistance to science produced in the old classrooms
- ✓ Open science schooling can, contrary to classroom science, offer young students' deep engagement in exciting missions, some of them not much different from what they experience in advanced video games; this will re-

install the feeling of “adventure” in science that was totally lost in the classrooms and be attractive to both genders of digital natives

As mentioned, there are various ways of innovating science education, but we believe that open schooling is the most powerful form of innovation.

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.

This is no less than a revolution in (science) education, and more so as open science schooling goes far beyond punctual activities outside school such as visits to a science centre or similar.

The point is to take open science schooling to a level where the students accomplish something real and allows them to create fundamentally new images of science, to influence science in real-life and to integrate new attitudes towards science in the development of their identities.

In short, open science schooling allows young students to re-engage in and change science.

It is rather a new dimension in learning and schooling, offering young students immersive, continuous and community-based experience and with the clear aim to foster interest in changing things, detecting new opportunities, engaging in interesting collaboration, playing detectives and explorers – and doing all this at the same time playfully and seriously.

In this way, innovation missions and other forms of open schooling develops citizens dedicated to take action in and improve the communities they live in.

#### OPEN SCIENCE SCHOOLING AS RE-THINKING SCIENCE LEARNING OR AS “MODERNISATION” AND ENTERTAINMENT?

*While a shift in educational discourse has been observed in many countries, too many practices remain unchanged.*

*UNESCO, “Education research and foresight” 2019*

When confronted with the challenge of open schooling to create interest in innovation among the young students, most schools and teachers (and students!!) react in what we might call the “way of modernisation”.

This way is about adding “modern” activities to traditional education in the classroom.

The short version of re-thinking science education concept is that it is not enough to “modernize” traditional science education, or to add new features such as project work or computer games.

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.



“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.

One might describe this reaction as a way to “decorate” traditional education, or a way to make “alibi innovation” (aiming to show that we are indeed doing something new...) or a way to simply do what the school find possible at the moment.

This might sound bad and in the negative case it is bad, as it is a way to “avoid” the real challenges, but in general it must be like this: we need to dismantle old forms by acknowledging their limitations.

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, and also why this project aimed to develop a realistic and implementable Guidance based on eco-systems of open science schooling tested in practice.

It takes several rounds of experimentation and evaluation to break through to what are the real challenges and the real innovation.

A spiral of learning and experience is needed to create real change. A single jump will never do the job.

And in many schools the real innovation is not even possible.

And what are the traditional reactions, or the way of “modernising” traditional classroom practice?

There is a well-known set of such measures:

- the activity is punctual, easily fitted into the curricula
- the activity is event-based: not meant to be integrated in everyday learning
- the activity is entertaining: pleasing the students and perhaps the project, at least for some time

In short, such activities are add-ons to traditional classroom teaching, they do not basically aim to change classroom teaching. And they are not open schooling.

It is important to point to the fact that these “modernisations” lack *didactic depth*: they do not change the didactics of classroom teaching, they do not create genuine open schooling – and they do not create lasting and sustainable innovation interest in the students.

They do not succeed in becoming a part of the young student’s identity, mentality and behaviour.

To become a way of thinking and acting the activity needs to give the student long-term, immersive, epic and personal experience of the “new”.

We know that this works. What we don't know is how to do within the restricted reality of European education.

But if we know that this works why is so difficult to implement it?

Why is so difficult to jump from traditional education to open science schooling fostering innovation interest among students?

The answer is extremely important: because schools and teachers and students need to create such capacity through stepwise dismantling the traditional forms of education!

And this is not wrong, it is just simply necessary: schools, teachers and the students themselves need to dismantle traditional mentality and behaviour step by step and slowly arrive to what was actually the intention.



## PART 2 - THE SCHOOLS



### TEACHERS

It seems to be of great value that OSS devoted to the classes alongside the curriculum. It is then easier for students to learn curriculum issues. The challenge is the time that has to be devoted to the classes at the alongside with the curriculum.



An important motivation is to see how much students gain from OSS activities. OSS classes enhance students' creativity. Openness and creativity are basic skills needed by students in their further academic life.



The biggest challenge now seems to be finding enough time to implement OSS activities. Other issues such as finding the right partners seem much easier. Additionally, it is quite a challenge to make the classes/activities attractive for students very often overloaded by their duties on the daily basis.



The most important thing is to show theory in practice through visualization, creating opportunities to "touch", to see something with your own eyes and do an experiment. It is also important what terminology is used, so that it is a language indicating a high scientific level. And that the people who teach the classes also represent a high scientific level and have a lot to say. It really appeals!



Teachers need more autonomy and less bureaucracy, they need to be encouraged and sustained in their work, ideas, solutions found. Experienced teachers can easily become mentors for young teachers.



Each good practice, method, prototype can function in a transdisciplinary approach and you can't be limited by the curricula if you are an enthusiastic, creative, inspirational teacher and mobilise all your resources.



I think we live in a world where, as teachers, we have to convince our students that we live in an era of innovation, where their creative potential has to be developed and their schools could be the right place for discovery.



## STUDENTS

Apart from teaching by a textbook students like to see real-life examples and experiments that they can do with newly gained knowledge.



Students really appreciate each new approach, each applied learning and especially an open teacher-student partnership.



The students enjoy it when learning is not limited by curricula, when they REALLY are in action, learn by doing, explore, and discover.



## THE SCHOOLS AND STUDENTS AS DRIVERS OF CHANGE AND INNOVATION IN THE COMMUNITY

*To help enable agency, educators must not only recognise learners' individuality, but also acknowledge the wider set of relationships – with their teachers, peers, families and communities – that influence their learning. A concept underlying the learning framework is “co-agency” – the interactive, mutually supportive relationships that help learners to progress towards their valued goals. In this context, everyone should be considered a learner, not only students but also teachers, school managers, parents and communities.*

*OECD Learning Framework 2030, OECD 2018*

This chapter is addressing teachers and schools that might like to take the students' innovation activities further.

They might wish to take the engagement from a student team level to a school level – a “school in the community” level, so to speak: the school doing what the student teams are doing.

And, what is that about?

Traditionally, schools are responsible for education in classes, tests and exams, not engaging in any form of community activity, in community politics or community innovation.

In the limited version open schooling is about students' and student teams' learning through interaction with the community and real-life challenges in the community. In the extended version open schooling is about the engagement of the *school as organisation* in community challenges.

In a 21<sup>st</sup> century context innovation is no longer expected to only be driven by public authorities or major private enterprises within a top-down approach.

On the contrary, innovation is expected to be driven by citizens, all sorts of community resources – and by any stakeholder in the community able to and willing to drive change.

Such a stakeholder able and willing to drive change might precisely be... a school!

Of course, we know this is not obvious if we think about a traditional school. The traditional school will mind its own business, so to speak.

But what about a school that:

- organises open schooling activities for teams of students to create innovation interest and mentality
- works to create entrepreneurial mentality among its students
- increasingly integrates real-life challenges in the students' learning
- would like to be a pioneer school offering its students 21<sup>st</sup> century skills and competences

This school might be willing to take the innovation engagement to a higher level, from a few student teams to the school at large, and to integrate open schooling didactics more and more in the schools' learning activities and in the school's "identity".

Interestingly and importantly this school has the full support of the European Commission!!

In fact, the European Commission encourages schools not only to be more active in the community, and not only to facilitate students' learning through community interaction – but to play the role of drivers of change and innovation in the community.

The reasoning of the European Commission is at the same time extremely advanced and really simple: when we organise open schooling activities for students, learning through community interaction (for example in science), and support the student teams' engagement in innovation, why not see this form of activity as a resource for creating bottom-up and citizen-driven innovation and change in the community?

Why not allow the community to benefit more systematically from these new learning processes, offering students powerful learning and creating change in the community at the same time?

One thing is sure: the more "real" and "serious" the students' engagement, the better the students' learning and the more benefit for the community!

In short, such a school works to integrate its learning activities in the life and needs and future of the community.

In this way the school becomes an important stakeholder in the community, becomes a driver of change and initiative-taking and becomes a meeting place for innovative resources in the community.

And, not to forget, becomes a pioneer of 21<sup>st</sup> century learning, from which the students will benefit tremendously.

This will give new life to the school and will offer the school important social dynamics to invest in the students' future-oriented skills and competences.

*Easier said than done, of course...*

Such engagement of the school as driver of change needs strategic planning, dedication and pioneer spirit – from the management as well as from groups of teachers.

Let us try to give some advice on HOW THIS COULD HAPPEN.

Each school will find its own way, but there are certain general approaches that we would like to share:

✓ STRATEGIC APPROACH

Schools wishing to engage in such roles as drivers of change and innovation are strongly recommended to apply a strategic approach: careful discussions and preparations are needed, and in particular it is important to build on strong consensus among management and teachers, as well as create serious dialogues with potential community alliances.

✓ BOTTOM UP

It is also of the utmost importance not to create top-down initiatives through organisational agreements between leaders and managers in the community resources: ecosystems.

The extended roles in the community of the school should build on the students' open science schooling engagement and take this engagement to a higher level.

This bottom-up approach will ensure that the school's engagement is continuously focused on the students' learning and co-driving.

✓ STUDENTS' CO-DRIVING

The ultimate aim of the school's new ecosystems roles is to offer students' relevant 21<sup>st</sup> century learning opportunities. To maintain this aim students should always be at the centre of the school's engagement, as co-drivers of the innovation missions. The school should not attempt to replace the students' engagement, on the contrary: the new roles of the school should increase the quality of the students' learning and allow more and more students to engage in and benefit from open schooling.

✓ CREATING ALLIANCES

One of the prominent new roles of the school, in support of the students' innovation science missions and innovation learning, should precisely be to continuously build new permanent alliances with institutions, resources and citizens in the community, this means a continuous ecosystem building process. In this way the school will allow the students to benefit from a still growing ecosystem of collaboration in the community and will allow the community to benefit from a systematic and sustained engagement of the students and the school.

#### ✓ SHARING THE STORIES

The school should take advantage of its new roles and of the students' innovation missions: it should systematically share the stories with all relevant resources in the community and describe the benefit of the engagement for students and for the community and its citizens. Visibility is key...

Evidently, the students must be deeply engaged in this sharing, including through the social networks.

#### ✓ EXPLOIT FUNDING

In case the school is willing to take on such new ecosystems, the school will inevitably become a *pioneer school*. This means that the school can apply for a variety of funding – from local and national funds to the European programmes.

This is a great way to create more economy for the activities and to share the new experience in wider circles

#### ✓ OPEN SCIENCE SCHOOLING MAINSTREAMED

Most schools will start its new pioneer journey through engaging a few student teams in such innovation science missions.

It is important for the school to build further engagement on this practical experience.

However, as soon as the school wishes to extend the science missions to more students and to widen considerably the number of students engaged in such open science schooling learning, it will be necessary for the school to take the approach to a higher level: precisely to a “school as organisation” level.

It is at this point the school will benefit from engaging as driver of change in the community, as this would be the best framework for engaging more and more students in innovation learning.

Mainstreaming open science schooling for innovation learning might precisely happen through the systematic engagement in community innovation of the school as organisation.

You will find examples of eco-systems of open science schooling missions studying the material in the project [website](#)

#### WHAT NEEDS TO BE CREATED BY THE SCHOOLS?

Basic eco-systems of community collaboration for the students to tap into when engaging in learning through becoming change agents.

Obviously, such basic eco-systems are living organisms and will flexibly be adjusted to the needs of the students and also to what the students' activities will bring to the eco-system.

The eco-systems are not expected to deliver to the students all the collaboration and resources needed for the students to accomplish their change missions, but are expected to provide the schools with some basic collaborative infrastructures in support of the schools' becoming and “agent in the community”.

Typically, institutions such as the municipality, a chamber of commerce, a research institution and entrepreneurial hubs might participate in such permanent infrastructures and support the student teams' community engagement.

*For the student to learn through becoming a change agent, the school must become a driver of change.*

In fact, the student will be engaged in becoming a change agent precisely when the school is an agent of change in the community, works with the community and thereby provides open schooling opportunities for the student teams.

Precisely when the school is deeply engaged in community, the most useful and authentic learning opportunities will appear for the students to engage in.

#### SUMMARIZING

Schools and teachers cannot wait for the education system to change; first of all because it will not change; second, because if it should change it will take decades.

Schools and teachers, and their local/regional educational authorities, are therefore challenged with the mission to find out to what extent it is possible to create as good and authentic open schooling engagements for the students as possible.

Policy-making should ensure increasing self-governance in schools, allowing the experimentation needed in the globalised 21<sup>st</sup> century.

Open room to move should be integrated in all educational planning and curricula.

Small first steps might lead to more engagement.

*Remember that the Commission knows all this. This is why the Commission encourage “rule-breakers”; in the sense of schools and teachers experimenting with new didactics even if the education system is not moving.*

#### TO WHAT EXTENT CAN OPEN SCIENCE SCHOOLING BE INTEGRATED IN THE SCIENCE CURRICULA?

Let's start by mentioning that only experimentative practice will create the needed schools and teacher capacity.

No courses or online provisions can replace the experimentative practice.

The schools, the teachers, should join the students and work with them on equal terms: as learners of innovation.

This way all them will grow with the students and the students will enjoy and benefit from this new school and teacher's role.

Pioneer schools will need to start from point zero and make their way alongside the students.

What is important is that the “first schools and teachers” manage to tell the stories in the school and to share their experience with their colleagues, creating a lot of peer learning.

The school should – at organisational level – feel ownership to the new engagement and support the sharing of experience among as many teachers as possible.

The school might also competitively wish to promote itself in the community as the most innovative and future-oriented school!

Teachers using private time to support the activity should be celebrated and rewarded.



We know that the European Commission calls for powerful innovation of science learning in schools, and in particular invites experimentation based on the open science schooling approach.

Open science schooling innovation engagement should not be a new subject in the curriculum, says the Commission, nor should it be a series of punctual events across the school year.

BUT, what is the reality?

- School curricula are increasingly overloaded in most European schools and leave very little space for alternative and innovative learning activities.
- There are few signs that this will change in the near future, and therefore experimentation must happen *in spite of* school curricula.
- Most European governments are more interested in the average national test scores than in the young students' learning.

This means that what are needed are open science schooling approaches that appears REALISTIC to the schools and the teachers and can be EASILY EITHER INTEGRATED IN THE SCIENCE CURRICULA OR ALTERNATIVE CARRIED OUT IN PARALLEL TO THE SCIENCE CURRICULA and still meet the Commission's key open science schooling requirements and criteria.

Therefore, when approaching the crucial question about how innovation missions can be integrated in school curricula, we need to provide answers at three different levels:

#### CHANGING SCHOOL CURRICULA

Schools, teachers and students should continuously put pressure on educational authorities at all levels to change school curricula with the aim to reserve considerable time in the weekly schedules for non-subject defined and test-free activities.

Such non-subject defined and test-free activities might precisely be used for innovation missions, entrepreneurial engagement – or similar forms of experimentation equipping the young students with 21<sup>st</sup> century skills.

For example, public authorities in future-oriented community, regions or countries might decide that 1 day a week is reserved for such experimentation, and that the school will be open after normal school hours to continued student engagement

#### INTEGRATING IN SCHOOL CURRICULA

Until dedicated time and space is reserved for such experimentation as innovation missions, the missions need, at least partly, to be integrated in the school curricula.

Teachers dedicated to working with the students in innovation science missions are constantly negotiating such curricula integration with the school management and with the other teachers.

First of all, teachers engaged in such missions need the full support of the school management, and the school management should help negotiate flexible integration of the missions in the weekly schedules.

Lessons learned from other Erasmus+ projects tell us that there are different ways to integrate innovative science missions in the curricula:

- in some schools a few weekly hours are reserved for various forms of “open activities”

- sometimes a teacher decides to devote an entire subject-semester to the innovation; the teacher will try to link the missions to that subject

- sometimes a team of teachers of different subjects agree to jointly create the time needed for the innovative missions; the team of teachers will try to integrate the subjects into the missions

In most cases the involved teachers need to combine various options to ensure the needed time for the innovation.

In most cases these mosaic strategies are rather unsolid and less satisfactory for the teachers as well as for the students.

However, no matter how flexibly the missions are integrated in the curricula over a certain period, the students (and sometimes also the teachers) need to add “personal time” to work in them.

Educational authorities and schools should therefore make strong efforts to build a new learning culture for teachers and in particular for students.

This learning culture does not need to depend on dramatic changes of the volume and restrictiveness of school curricula, as our young generations cannot wait for such changes. They need time and space to develop the 21<sup>st</sup> century skills and capacity they will need in their further education and in their professional and personal lives.



### PART 3- THE COMMUNITY



#### TEACHERS

The collaboration between the NGOs and schools is important because they realize together effective, well planned environmental non-formal education programmes that will stand the students in good stead in achieving their ultimate goals to have a better eco-system.



Partnerships between schools and community groups offer a clear benefit: They enhance learning opportunities by providing students with resources, experiences, and environments they would not otherwise have.



Considering our school as the center of the ecosystem, it includes the entire population inside the school (teachers, students, managers), as well as outside (local community, NGO) which through a common context and available material resources influence students' interest in science.

On the other hand, our students being the center of the ecosystem model, we try to influence their behavior through other methods of teaching science and not only through classical methods.



The collaboration can be established when very capable teachers are sustained and encouraged to develop a STEM' culture' not only by inspiring, motivating and making the students more responsible but also when they collaborate with other stakeholders in the community.



#### STUDENTS

Most of the students are willing and working for a positive change in our community.



Students always enjoy ALL that is not theoretical, conservative, not appropriate anymore to their digital native generation!



*A 'whole school approach' also implies a cross-sectoral approach and stronger cooperation with a wide range of stakeholders (social services, youth services, outreach care workers, psychologists, nurses, speech and language therapists, guidance specialists, local authorities, NGOs, business, unions, volunteers, etc.) and the community at large, to deal with issues, which schools do not (and cannot) have the relevant expertise for.*

Education & Training 2020, Schools policy, EU Commission 2015

In the Eco-systems of Open Schooling project “community” was understood in its widest sense: local physical community, the region, various science communities and virtual communities.

The globalised world and the 21<sup>st</sup> 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 invited the student teams to work in different forms of communities in the two science mission phases.

A number of people and institutions from various forms of physical and virtual communities were involved through the students’ missions.

There are no “right or wrong” communities.

The roles of the community are many and important in open science schooling scenarios and experimentation.

Open science schooling is still in its first stages in schools, and even more so in the collaborating communities.

This means that innovators, entrepreneurs and research professionals are not at all used to and geared to collaborate with schools and students along considerable time periods and not at all used to integrate student teams in their research and innovation circles.

They are used to punctual engagements only: meetings at the school, students’ visits, workshops, events and similar.

And the reality is that science communities and their professionals can only develop such collaborative competences through continued practice.

These players are deeply engaged in their innovation missions, but they do not know how to handle open schooling.

## HOW CAN THE NEEDED COLLABORATION WITH THE COMMUNITY BE ESTABLISHED?

As just said, there are no “right or wrong” communities.

The key criteria for identifying the community to work in is that it allows the intended immersive learning in innovation missions and at the same time matches the key principles in innovation learning.

A most important lesson learned is about HOW to create good collaboration with the community and with relevant players in the community.

In almost all innovation missions the student teams cannot go directly to certain community resources and accomplish the mission.

In most cases the student teams need to work through many phases and steps to finally accomplish the mission and start implementing the innovation.

Therefore, we have learned that there is a very close connection between “community” and “alliances”.

Working with the community and creating good alliances is at the same time the best guarantee for the sustainability of the innovation: the stronger the alliances, the more resources to continue the innovation.

A very positive lesson learned is that most people and resources in the community appreciate and value initiatives taken by young students 😊

In Eco-systems we also learned that indeed “community” can mean very many and very different things and that very often, the missions can address a combination of social and virtual communities, and virtual communities are extremely important for the students’ “time-outs”: privileged periods in which the students need to build knowledge to work through and accomplish their missions: knowledge creation *on demand*, not *when scheduled*.

### BY WAY OF AN EXAMPLE...

Let’s imagine a pioneer school starting from point zero, the school will need to invest considerable time in analysing and scanning the community for relevant innovation missions – to follow or to create.

It does not make sense in the start-up phase to bring a lot of stakeholders together. They would not know what to do and how to act.

It is much better to involve new resources step-by-step when it is possible to include them actively in the missions – whether ongoing or new.

It will take hard work to establish the needed connections and collaborations, and it is crucial they the students co-lead this collaborative work.

It will take creative thinking: who might be interested, who might benefit – and who might be willing to engage and collaborate.

Serious innovations as well as entrepreneurial skills are involved in this process.

New collaborations might need to be established for different student teams – and when new student teams join the activities.

Several rounds and circles of collaboration and alliance creation will be needed.

The long-term aim is to establish a “eco-system of innovation learning” in the community/region and systematically expand this eco-system.

This will enable new students to step into already existing structures and networks, and it might also benefit the innovation players if they learn how to “exploit” this network of young generation users.

Open schooling includes long-term engagement of students, students following the life circle of innovation and students going as deep as possible into the mysteries of the innovation, including its many cross-subject implications and directions.

Community collaborators need a strong outlook to see the meaning of this interaction.

Once the science communities are mobilised to work with open science schooling, the community will be able to deliver important resources to the schools and to the teachers.

Then, early science learning will become a collective mission, not simply a school responsibility.

The point is, however, that the mobilisation of the science communities requires many rounds of (accumulative) experimentation, and it doesn’t happen if schools and teachers are not given the needed space to create such experimentation.

This simply means that all the players in open schooling and creating innovation interest among students must learn: the educational players as well as the innovation players, and the educational authorities that should support those activities actively, but rarely do so...

The point is, however, that the innovation players might benefit strongly from this engagement when they learn how to use the long-term contact with the future generations of citizens!

To quote once again the simple OECD words:

*Users are being involved in earlier phases of the innovation process - already when companies are identifying opportunity areas. The innovation process is becoming user-driven.*

*OECD, New Nature of Innovation*

Obviously, this will take much experimentation and much learning among the innovation players.

In particular it will take sustained activity, creation of eco-systems of collaboration and evaluation of the innovation players’ benefits.

If pioneering and experimentation are not supported locally and nationally, the education systems will lose its dynamics, its creativity and its ability to change and address new challenges and therefore the schools will not have the tools to move and build such eco-systems of open science schooling in the community.

All this process needs time, years, and the problem is: *who will fund, invest in and drive such sustained and long-term experimentation?*

Policy-makers in particular at local and national levels should bear in mind that it is of paramount importance to mobilise the motivation, creativity and dedication of these educational and community players.



## PART 4 - THE SCIENCE MISSIONS



### TEACHERS

The most important principles are to show students that science doesn't need to be boring by showing real-life examples and keeping them engaged.



Missions are sure to leave a footprint on the students. But in order to make it more sustainable, the activities must be sustained. We must not let ourselves be overcome by the daily routine and the overload of daily duties.



Open Science is now a requirement. I think the most important challenge is that it increased our COLLABORATION and community-building. It made us more open to finding new ways of teaching content by using digital technologies and collaborative platforms/tools.



The aim was to involve the students in real-life situations, to make them respond and find innovative solutions for how the missions challenges could be addressed and find practical implementation. They practiced their decision-making in the context of real-life situations, built their working knowledge, collaborated and built connections.



OSS really increased the students' motivation and self-learning, developed their social interaction and scientific understanding.



## STUDENTS

Science missions were all forms of acquiring additional knowledge from external sources that fell under our topic.



Missions have to be unconventional and engaging for the students to leave a good and lasting impression.



Students said that the mission's aims were met, they felt thought-provoked and proud of the outcomes.

OSS activities provided them with hands-on science, made them better observers, got them excited about science and proficient in collecting, analyzing real data and explaining conclusions



*Education institutions should be encouraged to become more entrepreneurial in their wider approach, to ensure that they develop and live a culture of entrepreneurship and innovation through their missions, leadership, stakeholder engagement, curricula and learning outcomes.*

*European Commission, "Entrepreneurship 2020 Action plan"*

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 this is definitely an abstract justification of the learning.

The learning is organised to please the education system, not support the students' learning.

In traditional teaching the students work with text books, artificial cases and lots of theory and abstract knowledge.

"Learning on demand" totally changes the perspective: the students learn when they need to learn, when it is relevant, when they are motivated, and first of all: the students learn when they need to learn to accomplish their 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.

Obviously, schools need to learn how to organise such "learning on demand" – in collaboration with community resources. This is a part of the open science schooling experimentation.

Unlike traditional teaching innovation missions address *real-life* and *real-time* challenges in the community.



In the project the students learnt through working with *real-life* science challenges and in *real-time*.

*Real-life* means that the innovation missions are carried out in the real social and virtual worlds outside the artificial classroom.

Traditional teaching exclusively reflects the real world through educational material and exemplary cases.

Traditional teaching does not invite students to *act* in the realities outside the classroom.

There is a big difference between “knowing about” and “acting in”.

Unlike more punctual and tangential activities linked to the real world, innovation missions also strive to impact the real-world, to change it.

*Real-time* activity means that the innovation missions address challenges or problems here and now.

The missions need to work with things that matters to the community and its people today and in the near future.

This is one of the demanding aspects of innovation missions: the flow of activities cannot depend on the school curriculum but must follow how things happen here and now in the community, for better or worse.

And things take time and are depending on many factors in the reality.

This is why flexible and long-term engagement must be possible for the young teams.

Obviously, acting in real-time in the real world generates totally different sets of skills, competences and capacity than classroom teaching.

In this way, innovation missions and other forms of open schooling develops citizens dedicated to take action in and improve the communities they live in.

This also means that the innovation missions will need to depend on and address real-life and real-time *conditions*, such as:

- Perhaps some community players are not interested in the innovation mission
- Perhaps the resources for the mission are scarce or limited
- Perhaps there are political conflicts in the community
- Perhaps raising financial resources is very difficult
- Perhaps community stakeholders have little respect for young students

Very many things can obstruct a mission – as always in real life ☹️

## HOW TO ENSURE THAT OPEN SCIENCE SCHOOLING ACTIVITY WILL HAVE A LASTING AND SUSTAINABLE IMPACT ON THE YOUNG 21ST CENTURY STUDENTS

A valuable lesson learned from the project is that the science missions will NOT automatically have a deep and lasting impact on the students.

Many students might work through such learning processes with very little lasting results.

*What does “deep and lasting impact” mean?*

Open schooling, entrepreneurial learning and innovation missions aim to have a lasting impact on the young students. If not, the engagement has not been successful.

Lasting impact means:

- The young student has engaged in the science missions in such a way that the experience integrates in the IDENTITY BUILDING of the student along the teenage years
- The science missions are, unlike punctual experience, precisely long and deep enough to have an impact on the young student's MENTAL STRUCTURE, behavior and self-image ("I am a person that can accomplish this and that...")
- The experience integrates into the young person's PERSONALITY, so to speak
- The student builds up STRONG IDEAS about how to learn through taking action, how to bring about change, how to work with other people, and how to feel proud when accomplishing sometimes demanding missions
- The student proves to himself or herself that he or she is able to plan and pursue things they never thought about in the classroom: he or she is now an IMPORTANT AND RESPECTED PLAYER in a community
- The student builds up a practice-based SELF-CONFIDENCE easily transferable to other contexts

Lasting impact therefore means different behavior, different mentality and different learning patterns that can be used and will be used in the young person's future education and working life – and as an active citizen.

It should be noted that open schooling and innovative learning methods will in particular benefit what we might call "less academic learners" not doing so well in the classroom.

*Why is that?*

Because these learning methods are action-based, not theoretical knowledge based.

Many so-called less academic learners appreciate such action-oriented learning, and they often do better than very academic learners.

They are therefore extremely inclusive.

*But how can we ensure that the science missions will have a lasting impact on the young students – along with similar types of activity, of course?*

We can ensure the maximum impact by making sure that the innovation science missions meet the basic quality criteria of the missions, of which the most important are:

(This is what we call "basic engagement criteria")

- The science missions engage the young people in REAL-LIFE challenges, not in artificial challenges
- The science missions are EPIC in the sense that they are deep, long-term and immersive, creating considerable impact on the young people, unlike traditional punctual and superficial engagement
- They create an atmosphere of ADVENTURE, exploration and complicated challenges, known to be very attractive to the young people, creating very similar experience as the global video games in which the young people are deeply engaged

- They create RESPECT for the young people in the community through the various forms of community collaborations and alliances
- They allow the young people to take PRIDE in the accomplishments and thus support personal growth
- They allow young people to fluently integrate their OWN TECHNOLOGY and media preferences and activity in the learning processes

*In short, the lasting impact on the students is simply depending on the quality and authenticity of the innovation missions.*



## KEY OBSTACLES TO THE BUILDING INNOVATION INTEREST OPEN SCIENCE SCHOOLING DIDACTICS

Let us, in short, mention some of the main obstacles when creating innovation interest through open science schooling.

The list of obstacles is addressing policy-makers at in particular local and national levels: *what should they be aware of, and how can they help overcome those obstacles?*

### INCREASING INFLEXIBILITY IN SCHOOLS

Many schools and teachers experience that rules and regulations and curricula are becoming still more restrictive.

New public management, private competition patterns introduced in public schools, increasing quantitative testing of the students, publishing of schools' achievements and results, cuts in the funding of public educations...

All this is by many schools and teachers experienced as increasing inflexibility.

Educational policy should be careful not to suffocate teachers' creativity and desire to seek new directions.

The short-term financial benefit of new public management will be manifold offset by lack of innovation.

### ROOM TO MOVE, ROOM FOR EXPERIMENTATION

The increasingly restrictive European education system makes it difficult for schools and teachers to move, to create experimentation that addresses the many new challenges in the globalised world.

Without practical local experimentation the education system will stiffen and the new generations will not be able to manage globalised Europe.

The long-term effect is a Europe falling behind due to short-term and short-sighted policy-making.

### EUROPEAN VISIONS AND NATIONAL POLICY-MAKING

The European Commission's educational policy is extremely innovative. In fact, the Commission's educational agendas call for no less than a revolution in education and learning.

This is evidenced in a long line of policy papers and educational guidelines published by the Commission across the last two decades.

The problem is that most national educational policy-making directly contradicts and works against the educational innovation promoted by the Commission.

The Commission's educational innovation calls for considerable, long-term and well-funded experimentation, but national policy is preventing this from happening.

What is worse, it seems as the more innovative Commission policy, the stronger national educational policy contradicts this innovation.

This might be called a European disaster.  
When European policy and national policy is moving in totally opposite directions, it is difficult for schools and teachers find their way.

National governments should re-think why they short-sightedly are undermining instead of supporting sound and necessary European educational innovation.

All this is not theory: partners in European projects, such as Eco systems, are confused by the innovation promoted at European level – and increasingly restricted national educational policy, making it difficult to implement the European innovation.

The winds blowing over Europe are not in any way supporting the implementation of educational innovation so strongly recommended by strategic players such as the European Commission, the OECD, UNESCO and even the World Bank.

#### MENTALITY, PIONEERING, MOTIVATION

The innovation in education is depending on schools, teachers and students' motivation.

If pioneering and experimentation are not supported locally and nationally, the education systems will lose its dynamics, its creativity and its ability to change and address new challenges.

Policy-makers in particular at local and national levels should bear in mind that it is of paramount importance to mobilise the motivation, creativity and dedication of these educational players.

Society at large will increasingly suffer from dead educational systems, not at all able to meet the challenges of a constantly changing globalised world.

Policy-makers should take very seriously how to re-install motivation and dedication in schools and among teachers and how to explain the long-term societal benefit from such motivation.

#### CROSS-SECTOR OBSTACLES

Last, but not least, policy-making should support open schooling as the adequate learning didactics of the globalised world – instead of restricting and narrowing the room to move for schools and teachers.

This includes supporting the motivation of resources from different sectors to work with the schools.

The vision of cross-sector learning communities is increasingly undermined by sectors focusing on their own challenges and not engaging in more complex but also more profitable and benefitting cross-sector collaboration.

All major educational innovation agendas in Europe are based on and depending on cross-sector collaboration and public and private stakeholders' engagement in learning processes.

These extremely important innovations are all depending on the promotion and motivation of substantial collaboration between schools, teachers and students on one side and a variety of organisations on the other.

The problem is, though, that if schools are not able to move and the sector players are increasingly focused on their own challenges, then open schooling cannot happen.

Policy-makers should revise the way they directly or indirectly undermine such vital collaboration, and develop strategies for how to re-motivate and re-mobilise both sides of the open schooling communities.

*In recent years UNESCO has launched a global Learning Cities network, and one of the key missions of this network is precisely to support learning everywhere in the communities – and in particular through cross-sector collaboration.*



## THE STUDENTS AS ROLE-MODELS

We wish to share with schools, policy-makers and researchers a very interesting and future-oriented perspective emerging along the last years of several Erasmus+ projects.

We believe this sharing could be of value to secondary schools engaging in innovation mission learning and open science schooling.

Along the Eco-systems OSS and other projects, it became clear that a number of students from different schools and countries appeared extremely *dedicated and empowered*:

- they worked as leaders during the many projects' activities
- they had a very sharp understanding of the project and what innovation missions mean, even beyond partners and collaborators
- they boldly took the scene whenever needed, including delivering critical input about the project, the teacher roles, etc.
- they were clearly driving their teams towards quality results

However, the most important observation was that they were prepared to continue the missions in their schools, to serve as guides for new generations of students and even to make such innovation missions grow into a new school culture.

We think that this small extra might be very important in the long or not so long-term.

*Why is that?*

Because words like students' "co-creation" and "co-driving of educational innovation" are still mostly theory in Europe; still just words and blue visions.

To make those visions a reality, we precisely need dedicated young students: role-models and leaders.

The especially dedicated young people we saw during the different projects possess all the necessary resources to serve as:

### DRIVERS OF EDUCATIONAL INNOVATION

This means that one of the outcomes of this project might be local and perhaps European level initiatives to ensure that these students are engaged in further innovation missions and open science schooling activities - in the school, in the community and maybe even at European level.

The most visionary version of this perspective would be to organise these students at European level 😊

*What does all this mean – "at school level and at European level?"*

## SCHOOL / LOCAL COMMUNITY

Schools participating in such European projects as Eco-systems and similar projects might wish to become national and European role-model schools!

They could help other schools develop a school culture of open science schooling based on innovation and student missions.

Most schools across Europe desperately need such concrete and school-2-school guidance!

*What does such a pioneer role mean?*

- the school wishes to make open science schooling and community ecosystem missions a school culture in which more and more students will be involved, including expanding the students' learning space from the classroom to the social and virtual communities
- the school can promote its open science schooling skills and experience locally and nationally and offer to provide interested schools with the needed guidance
- the school might collaborate with local or national educational authorities to make the school's experience and expertise available to other schools
- such services might at some point provide new forms of income for the school
- these activities and the pioneer role might be used as a competitive parameter by the school when promoting the school in the community

Now, to become such pioneer and role-model schools, the schools precisely need the especially dedicated students as co-drivers.

To be credible and really innovative such school roles need to place our dedicated students at the forefront, not as "examples" hiding in the background.

This means that the student role-models should be:

- appointed student innovation or open schooling guides by the school
- co-driving any new open schooling mission initiative in the school and in the community
- guiding new generations of students
- constantly expanding the community network to support the students' missions
- co-create new European initiatives, for example through the network of student role-models created

*We believe that creating a small but very dynamic team of student role-models from the participating schools in several Erasmus+ is possible and who knows maybe they might be the leaders of new Erasmus+ initiatives...*

*Of course, they should receive full support from the schools.*





## THE ECO-SYSTEMS OF OPEN SCIENCE SCHOOLING SUPPORT

The project is terminated. What remains is the inspirational material available on the project [website](#).

This does not mean that schools cannot establish contact with the project and with the different partners.

*Schools and teachers interested in going deeper into how open science schooling and eco systems strategies can create innovation interest and capacity among young students are welcome to contact the Eco systems resources:*

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*The ECO-SYSTEMS OF OSS has ended, but we can still help...*