

Citizen Science in Schools

Schools as agents of community well-being through science and research

Welcome and introduction

- Welcome

Welcome to the Citizen Science in Schools training module, my name is Maria Inês Veríssimo and I'll be your course coordinator.

I work at the Open Science Hub - Portugal, in Portuguese *Plataforma de Ciência Aberta*, a social innovation project from the Municipality of Figueira de Castelo Rodrigo, that arose as a partnership with Leiden University, in the Netherlands.

Figueira de Castelo Rodrigo is located in the northeast of Portugal, in a low density territory close to the border with Spain, traditionally with limited access to science and culture.

As such, we strive to bring together science, technology and innovation with the daily lives of local communities. In doing so we collaborate with schools, universities, companies and policy-makers to tackle local relevant challenges, such as promoting school performance and active citizenship, preserving fresh water quality and boosting entrepreneurship.

At the international level, we are part of the Open Science Hub Network, funded by the European Commission H2020 programme, which is composed of several european partners, all with the common goal of engaging and supporting schools and local stakeholders to use research and innovation as tools to sustainable community development, via open schooling.

This means that Open Science Hubs support schools to become active agents for collaboration between families, universities, industry, local governments and civil society, by engaging in lifeworld projects that meet community's needs, thus positioning schools as drivers for societal innovation. In this regard, citizen science constitutes a key opportunity to bring together citizens and the reality of their territory, through science and research processes.

But what is citizen science?

Citizen science projects actively involve citizens in a scientific endeavour that generates new knowledge or understanding, where citizens may act as contributors, collaborators or even as project leaders, therefore having a meaningful role in the project.

As such, at Open Science Hub - Portugal, we use Citizen Science as a tool to empower schools and local stakeholders to use science and research to tackle local relevant challenges and opportunities, therefore promoting open schooling.

Our combined experiences have now allowed us to create this training module which has been designed to guide educators throughout the process of implementing a citizen science project at school, in a way that is meaningful and integrated in their daily practices, while contributing to tackle local relevant challenges or opportunities and ultimately promoting a more active citizenship through science and research.

To learn more about Citizen Science and Education visit the EU-Citizen.Science online platform to find resources and training to help you get familiar with Citizen Science.

- Introduction

This is a free 2 hour course that guides the implementation of citizen science projects in schools.

It is designed to guide educators through the process of incorporating citizen science in their daily school practices, in a relevant and organic way, creating meaningful learning experiences for students through the development of projects and activities aimed at tackling local relevant challenges based on collaborative work with local partners. This way, we expect to promote an active citizenship while contributing to the development, innovation and welfare of the community.

The course is divided into seven learning sections, one final self-assessment quiz and one further information and reading section.

These seven learning sections work as a roadmap that guides educators from the identification of their motivations, goals and local challenges or opportunities to the implementation and evaluation of a collaborative participation in a citizen science project to test a locally relevant scientific question.

To guide you throughout this roadmap we have designed a planner for you to fill in after each learning section, so that the development of your citizen science project builds-up throughout the course. This planner is made available as a PDF document at the end of each learning section.

To make this experience real, concrete and practical, throughout the learning sections you will get to hear from first hand experience of a teacher who has implemented a citizen science project in her own school to monitor biodiversity in her school's park. This project was developed by the french National Museum of Natural History and it's called Vigie Nature Ecole.

You will also get to hear from first hand experience of a researcher who has co-created with teachers and local stakeholders a citizen science project called Plages Vivants to monitor the biodiversity that lives in marine litter at the shores of France.

By the end of this course, hopefully you will have built a strategy to integrate citizen science in your school daily practices, allowing you, together with your students, to tackle a local relevant challenge or opportunity within your community, while learning from the experience and expertise of local partners.

So, let's get started...

Citizen Science in Schools

Schools as agents of community well-being through science and research

Section 1 - Why to implement citizen science in school practices?

Citizen Science Projects actively involve the public in scientific research with the goal of generating new scientific knowledge.

As such, Citizen Science opens up the opportunity for all members of society to take an active role in research, innovation and in the development of evidence-based actions, from local to international level.

In schools, Citizen Science has the potential to be an integrative approach to link science education and lifeworld experiences, increase meaningful learning and participation in society, and contribute to societal transformation.

For example, Citizen Science can be used as a tool to engaged learning experiences - making observations, collecting data and sharing results are central activities in citizen science. Students may gain first-hand experience using and sometimes even building research instruments.

Citizen Science can be used as a tool to responsive learning experiences - asking questions is as much a part of citizen science as collecting data. When asking questions about the world around them, research becomes more relevant to students' interests and their lives. With enough support, students can use their new understandings to take action into their own communities.

Citizen Science can be used as a tool to connected learning experiences - when you take part in citizen science you join a community of learners all engaged in the same research and your contributions help scientists to better understand the world. This helps build a sense of responsibility and increases fluency in skills such as observation, technology use and data interpretation. Citizen science can also introduce role models in STEAM areas - that is Science, Technology, Engineering, Arts and Mathematics - revealing possible careers and building STEAM literacy, regardless of career choice.

It's important to recognise citizen science as an educational tool that will help you better achieve your curricular goals and to reflect how it can fit into your teaching methodologies and your school's philosophy.

So, what makes you want to implement a citizen science project in your school's daily practices? Which benefits do you think you would be able to gain from it?
Let's start by listening to our teacher.

(Teacher interview)

The participation in this Citizen Science project quite simply began due to the place where I teach because it is an establishment where there is a very large park, with remarkable trees, with alleys, birds, an important biodiversity and students cross this park daily, at 8 am, at 10 am, at noon without really paying attention to this rather rich environment. So the primary motivation was to make them discover this biodiversity and for me it was obvious that, regarding citizen science, we had the space to do this type of activity.

In terms of benefits, I would say that the foremost thing is learning to observe and listen. The students were not aware of how rich biodiversity is in this park. Listening and observing - this really is the main benefit. Then, little by little, in due time, there is actually another benefit that comes into place, and that is learning how to improve this biodiversity. A number of students have become more aware of this characteristic: what to do to improve, so that there are more species, more insects. "Could we plant this or that flower" because they had noticed that certain insects were particularly attracted to flowers in vases... That's it, with some students we further developed this notion of interaction between living beings. And they asked questions, a lot of questions!

Another benefit was that a small group of students wanted to take action for biodiversity. We created nesting boxes and feeders to try to improve biodiversity. We have also created a wild space, a small wasteland where biodiversity can live a little bit freer. It all actually started from these observations.

Now what about you? What would be your motivations for implementing a citizen science project in your school practices?

For instance, your motivations might be related to raising awareness about nature conservation, like the teacher that we just heard: she wanted her students to discover the biodiversity in their own school park.

Or, they might have to do with your students' daily challenges, for example, making them more motivated about a specific topic or school itself.

Or maybe your motivations are related to your own teaching daily challenges. You might want to integrate meaningful outings in your classes, using real scientific research to explore your surroundings, and fuelling a sense of collaboration in your community.

Whatever your motivations may be, the participation in a citizen science project might help you get there, all the while still working on your curricular goals. Citizen Science can be a tool to help you approach the school curriculum and reach your educational goals in an organic and meaningful way.

Let's look at our planner and focus on the Why section. We suggest you take some minutes to reflect about your own motivations and fill out the two fields: professional motivations and personal motivations.

In the next section we'll explore how citizen science in schools can help you tackle local challenges or opportunities through the research process and community collaboration.

Citizen Science in Schools

Schools as agents of community well-being through science and research

Section 2 - Citizen Science as an opportunity to connect science, citizens and the territory

So far you have heard our teacher sharing how citizen science can be relevant to tackle daily teaching challenges and potentially increase the participation of students in key aspects of their local community.

But what about the scientists' motivations? What does a scientist have to gain from having citizens collaborating in a scientific research project?

(Researcher interview)

Plages Vivantes (Living Beaches) is a citizen science project developed by the National Museum of Natural History in France. It started in 2017 with the goal of better understanding how the socio-ecological systems of the upper shores function, in particular those related to marine litter. The project aims both at better understanding the relationships between the different biological compartments linked to sea debris and, above all, to better understand the way in which these relationships are affected by local and global environmental changes. The project is composed of different biodiversity monitoring protocols focusing on seaweed that exist on litter, upper shore vegetation and birds. These protocols were designed to be adapted to different types of audiences - schools, managers, the general public - and to be distributed at a large scale along the French coastline.

The program has three objectives: First of all, to collect and compare data that allows us to better understand the dynamics of the ecosystem. But also to make participants aware of the scientific approach, as well as of the issues in the conservation of these ecosystems. We hope that by observing the biodiversity of the upper shores, through these protocols, participants will want to know it better and therefore protect it better.

Plages Vivantes aims to tackle challenges both locally and globally:

- At the local level, raising awareness of volunteers, the actors of this socio-ecosystem, to the challenges of ecosystem conservation, through the protocols but also through the communication around the project, as well as by supporting the initiatives which go towards more complete management, more compatible with the conservation of biodiversity.
- On a global level, in particular at the scientific level, through the comparison of data collected on a large spatial and temporal scale, we will work to identify the distribution patterns of species, their relationships and especially the way in which changes affect them over time. Essentially, we seek to better understand the effects of environmental changes - especially global ones - on the way these socio-ecosystems function.

To our scientist, the main reasons to involve citizens in research projects are to raise awareness and connect citizens to societal challenges, possibly changing mentalities and fuelling participation, while producing scientific knowledge through the massive collection of data at a large spatial and temporal scale, as she explained.

However, for citizen science to work there has to be a large collaborative effort between scientists and citizens that ultimately will generate results with enough scientific quality.

To obtain good data quality and quantity, commitment to engage in collaborative research is required both from scientists and teachers.

On one hand, scientists put a strong emphasis on the scientific value of a project, while on the other hand, teachers are generally motivated to prioritise their educational targets within their classrooms.

And that is perfectly fine, each one is an expert on its own professional field. And actually the key for citizen science to achieve its potential within education stems exactly from the partnership between these different professionals and fields of knowledge, it needs significant teamwork between practising scientists and practising educators.

When this happens, the impact of the collaboration can go beyond students' individual learning outcomes, leading to benefits in the educational process through increased engagement of the students and involvement with topics of social relevance.

Indeed, studies suggest that shifting the emphasis of the citizen science project from purely scientific testing to matters of concern for the local community serves as a driver for learning and for change by emphasising situational motives and lifeworld contradictions, while contributing to educational targets within the classroom.

Studying a curricular topic through lifeworld challenges and real life experiences can work as a motivation factor for students. When using Citizen Science to look for answers on how to tackle local challenges or opportunities, students can become increasingly more engaged with the topic they're studying, without even realizing that, simultaneously, they are successfully achieving their educational goals and working on school curriculum. For teachers this means that Citizen Science can improve learning and engagement efficacy, generating more relevant and connected experiences, with almost no extra work.

(Teacher interview)

My expectations for this citizen science project were to approach certain domains of the curriculum through an outing or an observation of living things instead of using documents from a school book which are very interesting but sometimes located very very far from where the students live. We have everything at hand. The objective was to make a real outing and observe biodiversity directly. Another goal was to make the students understand that they play a part in the monitoring of biodiversity, that we can help scientists monitor biodiversity. That was also a plus. The students played along and that was a very important aspect of this activity.

So let's try to find a matter of concern for your local community!

Observe your surroundings and your school's community to find a specific challenge or opportunity that will trigger your students to play along in the activities, as the teacher said.

For her, the local opportunity was her school's undiscovered park and she picked the loss of biodiversity as a challenge of social relevance so that it could be a driver for her students to improve it.

Let's go back to the planner again and take some minutes to identify local challenges and opportunities that will also be relevant for you and for your students from the educational perspective. Once you've picked your local challenge or opportunity, fill in the local challenge or opportunity field on your planner.

Now let's connect the challenge or opportunity that you just identified and the motivations you wrote down in the beginning. What do you expect will happen? What would you like to achieve?

Take a look at the goals section in your planner. This section is divided into 2 fields: the scientific goals and the educational goals.

In our teacher's case, her scientific goal was to observe biodiversity directly.

Her educational goals were to approach certain domains of the school curriculum by performing outdoor activities and field work, so that her students would understand that we all play a part in monitoring and protecting biodiversity.

Now it's your turn! Look back at your motivations and local challenge or opportunity to build your goals from there.

In the next section we'll explore how citizen science can be a tool to tackle local challenges and opportunities through the implementation of the scientific process.

Citizen Science in Schools

Schools as agents of community well-being through science and research

Section 3 - Citizen Science as a tool to tackle local challenges or opportunities

The scientific process entails a rather complex dynamic structure...however, a research project always starts with a scientific question, something that you want to discover, the missing piece of the puzzle. And in order to answer this question, you need to be aware of the existing knowledge about that topic. This will prepare the ground to build your hypotheses, which will then be tested, through rigorous and systematic protocols and procedures, allowing you to collect data that will then be analysed, interpreted and shared with others.

Citizen science, by definition, involves the public in scientific research, but how can citizens actually become part of this process? Let's hear some examples from our researcher.

(Researcher interview)

Participants intervene at all stages of the scientific process but in particular during the phase of co-construction of the protocols and associated tools, and mainly in the phase of data collection at a large spatial and temporal scale. Indeed, this participation allows scientists to collect standardized quality data which allows comparisons at a large spatial and temporal scale, and therefore advances in community ecology, and in macroecology.

The scientific goals, the explanation of the method, the analyzes and of course the results are communicated to the participants during meetings, trainings and via various tools. The program also aims to support participants to increase their skills, and knowledge about biodiversity and how these ecosystems function, but also about data analysis-interpretation. Thus, educational sessions about these objectives are set up in partnership with players in education and training, and various support tools are developed. The challenge is for participants to become equally involved in this phase of analysis and interpretation.

So how can one go from identifying a local challenge or opportunity, like you did in the last section, to creating scientific knowledge through citizen science?

Well, you can think of your local challenge or opportunity as the trigger for this scientific quest. So, for the next step you will have to seek for more information about your identified challenge or opportunity. Diversify your search and look for knowledge from different sources: scientific books or articles, newspapers, conversations with family and members of your community...

As you make new discoveries and look for more information, you will also begin to understand that there are still a few things left unanswered. Look at all the information you gathered and fill in the What I know section of your planner. For those questions you can't find information about, fill in the What I don't know section.

At this stage, the information you gathered should sparkle some interesting questions.

Questions are an essential part of science. A good scientific question is one that can be answered by observation or testing and therefore needs to be defined, measurable, and

controllable.

Scientists may start with a broad question but then they break it down into smaller ones. The final question is stated in a way that can be answered by investigation or experimentation.

Here's a suggestion of how you could do it with your students:

- 1- Begin by asking several questions about your investigated topic.
- 2- Break down these broad questions into smaller ones that can be investigated one at a time.
- 3- Structure questions in a way that allows you to answer them by an experiment.

A nice way to structure a scientific question is through a cause and effect relation between two entities.

Here are some good ways to begin scientific questions:

“What is the relationship between . . . and ... ?”

“What factors cause . . . ?”

“What is the effect of . . . on ... ?”

So, let's take our teachers example:

(Teacher interview)

I participated in the citizen science project with 12-year-old students, to study biodiversity, the notion of ecosystem. We discovered in the park what an ecosystem is, at different scales. And we studied the biodiversity of pollinating insects in different spaces of the park, some observed the lawn, others observed apple trees in bloom and, because I had different classes that followed each other in the same morning, we did this at different hours of the day, which enabled us, by gathering all the data, to see that, depending on the hours, we do not necessarily have the same pollinating insects. We saw a number of bumblebees, bees and, on the lawns, bee flies. This makes it possible to show that there is a very strong link between pollinators and pollinated flowers, by introducing a relation with food, and with the mouthparts as well, even if this is not really on the program these are comments that can be added.

If you recall, our teacher's local opportunity was her school's undiscovered natural park and her scientific goal was for her students to discover the biodiversity in it.

She and her students did some local search on the park and discovered that it had different areas, each area had its specific vegetation and they spotted different insects in these areas.

Once they had gathered all this information, they were able to pose their scientific question.

Their question was: What is the relationship between the pollinating insects and the pollinated vegetation in the park?

So now it's your turn!

Gather your students and learn more about your local challenge or opportunity. Then formulate your scientific question and add it to the planner.

In the next section we'll explore how to find and collaborate with a citizen science project that

will allow you to test your scientific question and tackle your local challenge or opportunity.

Citizen Science in Schools

Schools as agents of community well-being through science and research

Section 4 - How to start collaborating with ongoing Citizen Science projects?

Now that you have identified your local challenge or opportunity and the scientific question you'd like to answer, how can citizen science help you? How can you start collaborating with existing citizen science projects? And how can you find them?

One solution is to find citizen science projects available online.

Although you can search for individual projects directly, there's an easier way to start which is to use existing platforms that combine the information of several citizen science projects.

These can be national platforms, compiling information of projects of that same country. Or international ones, that combine the information from projects from all over the world. That's the case of SciStarter, for example - an American platform supported by several entities from the US, or the EU-Citizen.Science - an European platform which resulted from the efforts of several European countries.

Let's look at the particular case of EU-Citizen.Science. This online platform is an entry point for citizens and scientists worldwide to easily access citizen science projects, resources and training modules.

To find Citizen Science Projects that could be interesting for you and your students, you could start by using education as a keyword, or type in the topic you're looking for. Alternatively, you could use the search engine and filter the projects by country or by topic, by choosing from a long list of scientific areas.

You can then click on a project to get access to its summary and find out more about how to participate and what equipment you will need.

Choose the project that better fits your objectives by combining your scientific question, your local challenge or opportunity and the goals you have defined.

Let's take the example of our teacher...

In her case, she could have used as keywords, education or biodiversity, for example, and as a topic nature and outdoors. This generates several results, from which she then could have chosen the Vigie Nature Ecole project to help her with her local challenge for students to discover biodiversity in their school's park.

A few tips to keep in mind while searching for citizen science projects to use in schools are:

- make sure that the protocols used are suitable for student exploration, evaluate the difficulty

level and how much assistance you will be offered

-keep in mind your scientific question about your local challenge or opportunity, to make sure that the project you pick allows you to achieve your initial goals

-think how you can align the citizen science project with the school curriculum and your educational goals

-lastly make sure that you have access to the project in your region

Once you have decided which citizen science project to collaborate with, go back to your planner and fill in the field which project?

In the next section we'll explore how citizen science can be a great opportunity to create collaborations that will help you to tackle your local challenge or opportunity.

Citizen Science in Schools

Schools as agents of community well-being through science and research

Section 5 - Citizen Science as an opportunity for local to international collaborations

As we have seen before, citizen science results from a collaborative effort, requires collaborations to be effective, and boosts further collaborations.

(Researcher interview)

In our opinion, non-scientific participants, and in particular schoolchildren, can collect and transmit quality data allowing us to answer original scientific questions. The condition being that the scientific questions are defined beforehand and therefore that the protocols, methods and support tools are thought out, considered, developed, so as to answer these questions and therefore limit bias and errors that can happen.

This co-construction requires a strong investment, in terms of tests, back and forth trips, exchanges, modifications, and therefore in time. For example, the construction of the ALAMER protocol for Plages Vivantes, which is intended for schools, started two years before its launch and distribution at a larger scale. Also, for us, at a purely scientific level - in ecology - this investment is interesting as the protocol makes it possible to collect data which allow us to answer questions that would not be possible to answer otherwise, without this shared collective participation, for example without developing a very important collection effort. Of course, these citizen science projects go beyond this sole scientific interest, but it remains an important point for us.

This collaborative effort is an essential condition in citizen science and constitutes an excellent opportunity to build stronger connections between schools and academia, helping students get to know different careers and professionals and to identify role models in STEAM areas.

Let's take the example of the Plages Vivantes project aimed at monitoring the biodiversity that lives in marine litter at the shores of France.

And let's make the exercise of listing all the different types of science and technology professionals that you can imagine related to this topic.

Humm... Biologists, geologists, nature conservationists, engineers...

Now let's do the same exercise for the citizen science project you selected and imagine all the researchers you would like your students to meet!

Take your planner and note all this down on the with whom section, so that you can contact them later.

As we have also seen before, citizen science can work as a powerful tool to connect science, citizens and their territory. Therefore collaborating with a research project of this sort opens up the possibility to meet community partners, to contact with different careers and to value your community.

(Teacher interview)

Thanks to this project, a very large number of students went to ask questions to our gardener, watched the work a lot, and there was a lot of discussion to try to understand how maintenance was performed. Especially when students became aware of their movements in the park, because they tend to walk on lawns, so we made students very aware of this. And this work about biodiversity made them aware of this need to protect it, to develop it, and to understand why in certain places we allow, what we could call weeds, to develop around the feet of trees, of some buildings, in the wasteland. The discussions with the gardener showed them that this year orchids have developed where they did not exist last year, and the students began to understand this notion of enrichment. It's quite interesting at that level.

Like the gardener in this story, get to know the stakeholders in your community that could help your students implement their citizen science project and think about how you would like to work with them. What do they do, where do they work, which questions would you like to ask them. Write it down on your planner and invite them to come to your school or visit them at their workplace.

And don't forget that collaborations can also happen inside the school, by transforming this citizen science adventure into an interdisciplinary work in collaboration with other teachers and colleagues and with other subjects and school projects.

Identify who could be your partners inside your school and once again write it down on your planner.

In the next section we'll plan the implementation of the citizen science project you picked and the activities you thought of in your daily practices.

Citizen Science in Schools

Schools as agents of community well-being through science and research

Section 6 - How to integrate Citizen Science in school practices?

Now it's time to think about how you can put into practice all your ideas and plans in a way that is useful, relevant and feasible within your daily school practices and your educational goals.

Let's first listen to our teacher.

(Teacher interview)

In my classes I mainly used SPIPOLL - the pollinating insect observatory - with 12-year-old students, because it is really anchored in the curriculum the notion of biodiversity, the relations between living beings in ecosystems, pollination... It is therefore a way to discover biodiversity. With the 15-year-old students, we also studied the notion of biodiversity at different scales, the ecosystem, the biodiversity of species within the bird observatory. With 17-year-old students, in science classes, the study of biodiversity and the implementation of citizen science projects to count and estimate biodiversity are part of the curriculum. I did it for the first time this year with the 17-year-old students.

One important decision to make in the process of integrating citizen science in your daily school practices is to decide in which context you want to work these matters with your students.

It could be either in a strictly formal or non-formal education scenario, or a mix of both.

Much like our teacher did, for formal education, think about the school years you would like to involve, which subjects would be more relevant and which particular curricular themes you would like to approach.

For non-formal education you could, for example, think of creating a new school club focused on citizen science, integrating citizen science in a pre existing science club, or organizing a series of school trips and a science day at your school so that students and teachers get the chance to participate in the project.

Once you have made your decisions write them down on your planner for citizen science implementation in school practices in the corresponding fields of the how section.

(Teacher interview)

In the beginning we studied what citizen science is, we looked at the Vigie Nature École website, we learned the principles using small, very short videos, so they would understand the project. After that, because you don't do an outing to recognize birds spontaneously, we had to practice recognizing birds. So the students did small activities, I showed the class how it works, they had identification cards and we tried to do quizzes. Some even continued at home. Only after that did we study the protocol, the observation conditions with all the rules: do not observe birds in flight, always count the maximum number of birds that we see at the same time ... You really have to set the rules because otherwise you risk generating errors. We really worked all the features of the protocol previous to going out. And this outing

is always very popular because the students spontaneously love to work outdoors.

As our teacher just explained, implementing citizen science in schools is not a one step task. It's essential that your students first know what citizen science is, what the chosen project is about, to get familiar with the protocol and to understand the purpose of the activities. As such, don't forget to take this into consideration while planning your project.

Next step: Find out which resources you will need. Check if there's any special equipment or material that you need to buy or if all you need are standard material easy to find. Of course, this is entirely dependent on the citizen science project you have chosen and on the respective protocol.

(Teacher interview)

Despite everything, little is needed for the implementation of these protocols. We did get some binoculars to observe the birds, we got two digital devices for the students who didn't have smartphones. And that's about all we need! There is also the digital part in a computer room, but this now exists in all schools.

Finally, decide on the timeline for implementing your citizen science project, and then, you're almost ready to go. Try to answer the following questions to help you make some decisions:
How often do you want to do your citizen science activities?
How long will each activity take?
And for how long do you want to do them?
Is there a specific time of the year that you should consider?

(Teacher interview)

In terms of frequency of activities, the ideal would be to do this over the course of the year. I do all these activities at the beginning of spring. For the birds, just before the trees have their leaves so that they can be better observed, while still, without difficulty. And the pollinating insects as soon as the first flowers blossom, when the pollinators hatch. It is always during the month of March, before spring break, that I do these workshops with almost all of my classes.

Remember to note down the decisions on your planner in the fields for resources and timeline of the how section.

In the next section, we will discuss how to measure the impact of integrating citizen science in your school daily practices.

Citizen Science in Schools

Schools as agents of community well-being through science and research

Section 7 - How to measure the impact of Citizen Science in schools?

Ok, so let's recap what you have defined so far: local challenge or opportunity, scientific and educational goals, scientific question, citizen science project, collaborations and ways of implementing it all...but how can you understand if you and your students have achieved the goals you have previously defined?

There are lots of ways to measure impact and you should choose one that fits your context, subject, students, activities and all other factors that you find relevant.

Regarding your scientific goal, for example, think about the activities that will be developed in the context of the selected citizen science project and which indicators will allow you to tell if you will be able to answer your scientific question or to implement your citizen science project in a successful way.

Regarding your educational goals, how can you tell if the integration of citizen science in your daily practices will help you meet your curricular objectives and improve student's engagement and learning outcomes?

According to the "User's guide for evaluating learning outcomes in citizen science", published by the Cornell Lab of Ornithology - an experienced institution in the conservation of biodiversity through research, education, and citizen science - there are different dimensions one could assess when evaluating students' engagement and individual learning outcomes from citizen science projects. Here are their examples:

Interest in science and the environment - interest in pursuing science and environmental topics, careers, activities and issues

Knowledge of the Nature of Science - understanding the scientific process and how science is conducted by researchers

Skills of science inquiry - procedural skills such as asking questions; designing studies; collecting, analyzing and interpreting data; experimenting; argumentation; synthesis; technology use; communication; critical thinking

Self-efficacy - the extent to which a learner has confidence in his or her ability to participate in science or to successfully perform stewardship behaviours

Motivation - motivation to pursue science and environmental goals such as STEAM careers and citizen science project activities

Behavior and Stewardship - behavior change resulting from participation such as place-based and global stewardship, new participation and community or civic action

As our teacher told us earlier, she wanted to be able to observe biodiversity directly, while approaching certain domains of the curriculum through nature activities, and ultimately to develop in her students the feeling and attitude that we all play a part in monitoring and protecting biodiversity.

Let's hear how she has been monitoring the impact of the citizen science project and the activities that she has been developing with her students.

(Teacher interview)

For middle school students, the impact, also counting the role played by our gardener who complemented our actions, was mainly felt in the park, to understand why it should not be degraded, why we should not walk on lawns, break branches... simple little things. Since last year, we have set up a garden club, where we have more and more students who join to carry out these actions regarding biodiversity. With this small group we have made insect hotels, nesting boxes that we clean every year, then we set up feeders, a composting area ... And we also made them responsible for a small portion of the garden where their mission was to develop biodiversity. They did a lot of observations to see what type of flowers we had, what insects appeared on these flowers, and how, focusing on plants that were already there, to develop biodiversity in this small space.

For 17-year-old students in science classes, this practice of observing biodiversity has enlightened a certain number of them who had not taken a scientific specialty, who were more into geopolitics, history, economics and social sciences. Suddenly they say to themselves "we have an explanation, we have the means to assess biodiversity" and that gave them insight on what data they could work with in geopolitics, and the impacts that this can have worldwide. For me it was a great achievement because the students were motivated by this activity, even if they had not taken a scientific specialty in previous years.

Monitoring impact is indeed a multidimensional and complex task, and again, there are multiple ways of evaluating the impact of your citizen science project and it depends on several variables that are fundamental to take into consideration.

For example, as our teacher just highlighted, the impact of citizen science in students' learning outcomes varies with age and, as such, impact evaluation needs to be adapted to each of the grades you teach.

Another key aspect to keep in mind are the timepoints at which to assess impact in order to have a clear idea of progression, which will depend on what you're trying to measure. Should you take daily measures or would you only need to do an assessment at the beginning or at the end? In the case of our teacher who wanted her students to understand why the park shouldn't be degraded, she could have taken regular notes of little things like not walking the lawns and not breaking branches, or she could have done an initial assessment of attitudes at the beginning of the project and a final measurement at the end.

Now it's your turn.

Look back at the goals you have set in the beginning of this process and at the planned citizen science activities. Reflect if your activities will allow you to achieve your goals.

In order to measure the success of your citizen science activities in relation to your goals, define the indicators that will allow you to track this, as well as the ways to measure them (survey, interview, photographs) and respective timeline, and then add this information to the Did it work? section of the planner.

You can always re-adjust them or make them more specific throughout the process. This is a continuous and iterative process.

Now that you have completed your planner, hopefully you will have built a strategy to integrate citizen science in your school daily practices, that will allow you, together with your students, to approach the school curriculum in a more relevant and organic way and to reach your educational goals while tackling a local relevant challenge or opportunity within your community, and learn from the experience and expertise of local partners.

We know that this may seem, at first, a challenging task but we believe it will lead to meaningful and long-lasting effects. Our teacher has been developing citizen science projects with her students for the last 10 year, which has allowed her to make a difference in her own school's community.

Now it's your turn! Your students, your school, your community and a research team are waiting for you!