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eu-citizen.science

The Platform for Sharing, Initiating and Learning Citizen Science in Europe

Deliverable 5.1: Report on training needs

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Abstract	This deliverable is based on Task 5.1, and presents the training needs that were identified in the literature and by the stakeholders analysis in Task 2.2. The analysis will review the outcomes from previous studies about the learning in citizen science projects and the

	necessary training to support it.
Keywords	EU-Citizen.Science, Citizen Science, Training

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1. Version Log

Version	Date	Released by	Nature of Change
DRAFT V1	20/01/2020	Christian Nold (UCL), Alice Sheppard (UCL)	Draft Version
DRAFT V2	27/01/2020	Christian Nold (UCL), Alice Sheppard (UCL)	Submitted for review by the Consortium Members
Final Version	29/02/2020	Christian Nold (UCL), Alice Sheppard (UCL)	Incorporates the reviewer changes

2. Definitions and Acronyms

CA	Consortium Agreement
CC	Creative Commons
CS	Citizen Science
CSA	Coordination and Support Action
Data	Information, in particular facts or numbers, collected to be examined and considered as a basis for reasoning, discussion, or calculation. In a research context, examples of data include statistics, results of experiments, measurements, observations resulting from fieldwork, survey results, interview recordings and images. The focus is on research data that is available in digital form. (European Commission, 2016)
Dataset	A grouping of data
Digital Curation	Selection, preservation, maintenance and archiving of electronically stored data
DMP	Data Management Plan
DoA	Description of Action
DS	Data Set
EB	Executive Board
EC	European Commission
ECSA	European Citizen Science Association
FAIR	Findable, Accessible, Interoperable and Reusable
GA	Grant Agreement
GD	Google Drive
GDPR	General Data Protection Regulation

GPF	Grant Preparation Forms
H2020	Horizon 2020
IPR	Intellectual Property Rights
Metadata	A description of data
MoRRI	Monitoring the evolution and benefits of responsible research and innovation
Open Access	Access that is free to all and free of any restrictions
Open Data	Data that can be freely used, shared and built on by anyone for any purpose
OpenAIRE	Open Access Infrastructure for Research in Europe
PPSR	Public Participation in Scientific Research
Repository	A location in which data is stored or managed
RIA	Research and Innovation Action
RRI	Responsible Research and Innovation
SDGs	Sustainable Development Goals
WP	Work Package
WPL	Work Package Leader

3. Executive Summary

This document combines four elements: a review of the socio-demographic context of citizen science, a literature review of learning in relation to citizen science, a community survey of training needs and a detailed analysis of a set of training resources. These four activities identified five distinct clusters of training needs/gaps:

1. **Scientific Training:** topic-specific training that targets scientific methodologies and issues.
2. **Volunteer Management Training:** topic-specific training that targets the engagement, maintenance and management of volunteer participants.
3. **Critical / Reflexive / New Possibilities Training:** is training for unrepresented & critical agendas as well as the inclusion of marginalised groups in citizen science such as art and culture, activism & social justice, ethics and legal questions as well as practical crafting and 'making' skills.
4. **Schools Training:** audience-specific training that is the most tightly focused training in that is targets teachers and young people in formal education.
5. **Practical / Operational Training:** training that covers the practical and operations processes, methods and tools required to run and communicate citizen science projects.

The majority of the training material analysed requires at least one hour of training with some requiring more than a day to complete, which is a significant time investment. This research sets the foundations for a typology of citizen training needs that will be presented in forthcoming deliverable D5.2.

4. Introduction

4.1 The EU.Citizen Science Project

Citizen science (CS) actively involves the public in scientific research that generates new knowledge or understanding, and thus has the potential to bring together science, society and policy makers in an impactful way. As a core dimension of Open Science, it opens up the opportunity for all members of society to take an active role in research, innovation and the development of evidence-based policy, at local, national and EU levels.

The EU-Citizen.Science project ('the Project') aims to build on the growing impact of citizens participating in research across the full range of scientific enquiry, by developing a sustainable platform to act as a mutual learning space for CS, focusing on Europe, but relevant globally. The overall vision for the EU-Citizen.Science platform ('the Platform') is to aid the mainstreaming of CS in Europe, such that it becomes an appreciated and widely established means for the democratisation of science in Europe, as shown in Figure 1 below.

Figure 1: The Vision, Mission and Objectives of the EU-Citizen.Science project

The building of the Platform is being pursued through three interconnected lines of activity:

1. Coordinating CS actions, and making use of existing resources in the presently fragmented citizen science landscape in Europe,
2. Engaging quadruple helix stakeholders at local, national and European levels, and
3. Creating a mutual learning space and a set of comprehensive, co-designed training modules for different target audiences.

In keeping with our mission, we aim to engage equally with CS participants, practitioners, researchers, policy makers and society throughout the course of the project. In order to do so effectively, it is therefore necessary to have a clear view of our stakeholders - both in the success of the project, and the usefulness of the platform itself.

4.2 The Purpose of this deliverable

The fifth work package within the Project (*WP5: Training Needs Assessment, Creation and Delivery*) is focused on creating appropriate training modules for the Platform. The first Task 5.1 '*Assessment of training needs and desired formats'* is focused on identifying the CS community's requirements and laying the groundwork for a subsequent typology of training needs. To address this, the deliverable offers four elements:

- S**ocio-demographic review** of the context of citizen science (Section 5)
- **Review of literature about learning** in citizen science (Section 6)
- **Community survey** of citizen science training needs (Section 7)
- **Detailed analysis of training material** (Section 8)

These four elements are used to identify a range of training needs in CS.

5. Socio-demographic context of Citizen Science

A socio-demographic review of the context of CS helps us identify some specific training needs, accessibility issues, and possible target audiences. The growth of CS can be examined in a historical context and alongside the growth of education in European countries. According to Silvertown (2009), CS started with 'gentlemen scientists' in the 17th century at the time of the founding of the Royal Society. At this time, 50% of men and 90% of women were illiterate. The 'gentlemen scientists' (often alongside unacknowledged wives and servants) engaged in activities such as astronomy, geology or specimen collecting, first styled 'natural philosophy' and later 'science' with the term 'scientist' appearing in the 1830s. They were, with few exceptions, wealthy men with access to private tuition, leisure time and resources to dedicate to the pursuit of knowledge. Later on, school education became compulsory for all children and, at roughly the same time, science became professionalised. In a way, the creation of universities and paid positions to allow people earn a living by carrying out scientific research was the first steps of opening up science and democratising it. However, this opening became, by the mid 20th century, a more of an exclusive grouping, which excluded the general public from participating in scientific research.Although through the decades untrained volunteers or labourers were recruited to assist with experiments, data collection, and analysis, they were frequently unrecognised and not considered as equal participants in the scientific endeavour. The past 30 years have seen another step in the opening up of science, with the term "citizen science" was not coined until the 1990s, which is also roughly when the World Wide Web and the Internet began to grow in popularity.

Today, the number of CS projects is growing fast. This is illustrated by Zooniverse which was first established in 2007 as Galaxy Zoo. As of January 2020, it hosts 102 projects, with an additional 31 finished. Figure 2 demonstrates this steady increase in technology-based projects in the past 7 years:

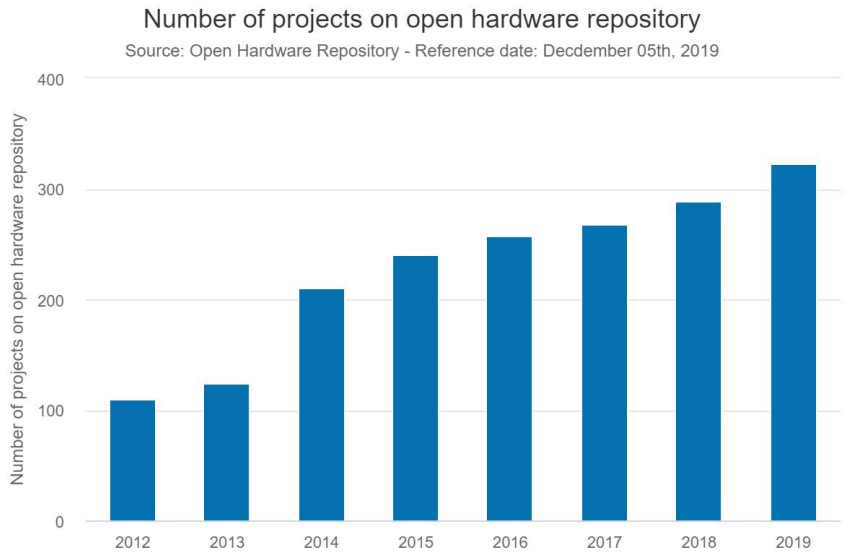

Figure 2: Increasing numbers of projects in the open hardware repository (Open Science Monitor)

This growth of CS has corresponded with the growth in education of the population in particular in the developed world, suggesting that a certain degree of education facilitates participation in CS (Haklay 2018)[1]. At present, a larger proportion of citizen scientists have some form of tertiary education (university level or above) than that of the general population. This varies from project to project, with an extreme example being 'Transcribe Bentham' where 97% of participants have tertiary education (Haklay, 2018). This suggests that CS has not yet reached the population as a whole. Citizen scientists - and the questions they have and the concerns they raise - may therefore not be representative of the population of Europe. There are large variations in the level of participation in tertiary education between European countries and within them.

[1] Yet there are cases where CS tools and apps are deliberately designed for low- or non-literate people, such as the ECSAnVis project, but these are rare.

However, the general trend is of increasing education. Tertiary education is increasing across the European Union with 40% of Europeans aged 30-34 having been to university (European Commission. 2019b, p.5). This will not, however, necessarily lead to broader representation in CS, especially as the EU Commission warns that half of EU countries do not set specific targets regarding the tertiary education of under-represented groups e.g. "*people with disabilities, migrants or students from disadvantaged backgrounds*" (ibid, p.3), which might have implications for future participation in CS projects which do not have an explicit outreach effort

In the U.S., Rajul Pandya, an atmospheric scientist and educator, found that "*members of certain ethnic, racial, and socioeconomic groups are ... less likely to reap the benefits of citizen-science programs*" (p.314, 2012). There is evidence for a similar situation in European countries, for example in the UK (Dawson 2014). Pandya suggests that poorer people, and ethnic minorities, are less likely to take part in CS. The reasons for this vary from education, income, time, family commitments, language skills, a lack of access to green spaces, or simply a feeling of this being "not for me", a sentiment highlighted by science communication researcher Emily Dawson (2014) who explains that informal science education can reinforce feelings that these spaces are "not designed for us". To take a recent example in London, City Nature Challenge[2], although there were several events, the bulk of the publicity concentrated on the central event taking part in the wealthiest part of London.

Barriers of education, time, money, physical ability or lack of confidence can be lowered by, for example, providing simple structured training exercises that are targeted at under-represented groups (Soleri et. al. 2016). Designing an activity to be based on inexpensive equipment, providing tasks with a range of subjects and entry points, hosting training material created by people with a range of backgrounds and, above all, two-way communication. Pandya recommends that "*new efforts should be made to develop participatory approaches, where … research questions are aligned with community priorities; and where scientific knowledge is placed alongside other ways of knowing and making decisions*" (p.317, 2012) and this applies as much to CS training and platform design as to projects. It will therefore be important that the EU-Citizen.Science platform allows participants to share and discuss their views and experiences.

[2] City Nature Challenge is a friendly competitive bioblitz that began in the U.S. in 2016 and has now spread to over 150 cities with over 35,000 participants.

We therefore have a complex challenge in identifying and addressing the training needs in citizen science. On the one hand, there is a need to continue and engage the current profile of participants, with their ability to understand material with reasonable level of complexity and sophistication, while also creating material that is inclusive and encouraging people who are currently outside the scope of participation in projects to join in. The need is not only for the participants, but also for project initiators, researchers, and public engagement experts. We also need to consider the context in which the people who will actively engage different groups operate - they can be part of a formal education system at primary and secondary level of education (school), tertiary education (universities and research performing organisations), as well as public institutions (museums). There is also scope for informal education through public institutions as well as other bodies in society (e.g. the Scouts).

5.1 Citizen science in educational and public institutions

Citizen science in schools

Several citizen science projects have written material explicitly for schools - projects such as the Zooniverse, SciStarter, iNaturalist and City Nature Challenge have all produced materials such as lesson plans and suggested group projects. For very high-achieving students, programs such as Orbyts[3] pair researchers with schoolchildren to do CS. The Doing It Together Science partners CRI-Paris and Medialab Prado ran extensive programs working with schools. It is likely that many science teachers, especially in English speaking areas, are therefore familiar with citizen science, but how much they use it will vary from school to school.

Citizen science in schools may be promoted by the fact that there is research interest in the topic. For exmple, the educator Carrie Green (2012) argues that CS enables people to solve problems in their communities and local environments. It is noted by biomedical scientists Shah and Martinez (2016) that CS in schools allows students to “think outside the box” and use genuine applications of the scientific method, rather than mere exercises or fact memorisation; this may be seen as valuable by some teachers and schools, but less so by those with fewer resources or more pressure to “teach to the test”. It is therefore vital that, in designing training for schoolteachers, aspects such as the relevance of the project to school curricula and the benefits to students are taken into account. We should utilise any lessons learned from studies

[3] “Original Research By Young Twinkle Scientists”, a partnership between the Twinkle missionUCL and the London and Lancaster school systems

of citizen science education, such as the Natural History Museum's LEARN CitSci project and the Institute of Educational Technology and Universitat de Barcelona's CitSci Edu.

If citizen science were to be formally integrated into the school curriculum, this could potentially lead to greater equality and inclusion across society as almost every school pupil would have access to citizen science. In the meantime, it may be worth designing specific training for teachers in schools with fewer resources, or a high proportion of pupils from socio-demographic backgrounds which are historically excluded, which could emphasise projects which are not costly in terms of resources or time, would teach the pupils skills valued by the school, or would be enjoyable activities in lunchtime or after-school clubs. There could even be training aimed directly at schoolchildren and parents, such as how to use CS in an individual homework project.

Tertiary education

There is currently only one CS course aimed directly at university students: the UCL Citizen Science and Scientific Crowdsourcing MSc course module, which is costly in terms of time and commitment. However, other training is available; for example, LERU has provided a guide[4], which stresses high quality science and policy so may be regarded as quite advanced.

It is worth training not just university students but also researchers on the benefits of CS in terms of public engagement, real-world concerns, interdisciplinarity, and science in society. Univeristy students are by default less likely to be marginalised in terms of education, but it is worth providing training for those advanced and those less so all the same, for example with introductory (for example, 10 credit) modules aimed at all students, not just science students.

Parks, museums and other public institutions

Public places can offer a lower entry barrier and be more widely known about than a CS project, are also increasingly using CS, such as birdwatching and BioBlitzes (DITOs BioBlitz, 2017). Significantly, the most popular subject area in CS seems to be conservation and nature (Figure 3), which is exactly the area in which such public institutions are most often able to involve people; many training resources in our list so far emphasise projects and activities relevant to conservation.

[4] https://www.leru.org/publications/citizen-science-at-universities-trends-guidelines-and-recommendations

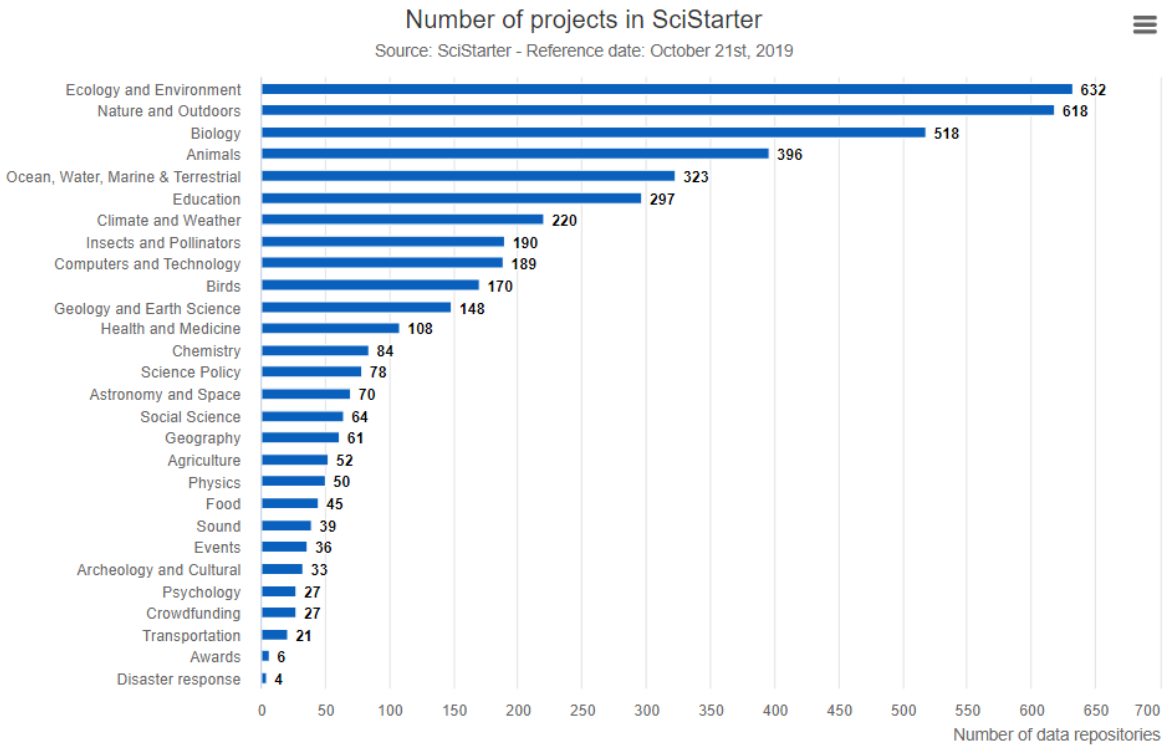

Figure 3: The most common topics of Citizen Science projects (Open Science Monitor)

However, most of these seem quite advanced and specialist. A few training materials, such as iNaturalist, do offer guides for introducing the public to citizen science, but most assume a high level of commitment, such as for scuba diving to record fish types.

Informal citizen science

This is the most wide-ranging area of citizen science, with the widest variety of accessibility. It is therefore the hardest to quantify in terms of training needs.

In terms of confidence and learning, there is a great deal of research on citizen scientists generally, and some research on their learning (e.g. Jennett et al, 2016) and in catering for citizen scientists who are “drop-outs and dabblers” (Eveleigh et al, 2014), which would include those who are least confident. However, much of this has not yet been translated into accessible training materials, and was asked for in the questionnaire.

	Specialised/highly educated	**Likelihood of marginalisation**

Schools	Large amount of research and training	Some research, which could well be applied to training
Tertiary education	Fairly large amount of research and training	Some gaps in research and training
Parks, museums and public institutions	Fairly large amount of research and training	Some research and training
Informal	Some research and training, but some gaps	Some research and training, but some gaps

In conclusion, judging by the amount of research that has been carried out and the number of training materials available, it seems that schools and museums have the most materials produced in order to train their facilitators. This could be greatly expanded for university students and for less specialised citizen scientists in particular. For informal citizen science it is harder to pinpoint exact examples, but there has been great interest expressed in the questionnaire and in some research about the relationship between citizen science, learning and education, and how to make citizen science accessible for everyone. Training in citizen science therefore needs to emphasise accessibility, and how citizen science platforms can "build in" learning and allow a low entry barrier.

6. Review of Literature about Learning in Citizen Science

6.1 Citizen Science and Learning

The potential of CS to enrich learning has been widely acknowledged. A 2018 report by the U.S. based National Academies of Sciences, Engineering, and Medicine concluded that "citizen science has the potential to support science learning in a unique way", and confirmed that CS supports a variety of learning outcomes related to scientific practices (National Academies, 2018, p. 3). However, for more than ten years there have been calls for "research on the best ways for people to learn through the CS process, and on how that process may differ among different cultures and languages" (Bonney et al., 2009, p. 983).

While the term 'citizen science' can be applied to a variety of scientific endeavours that involve non-scientists taking part in scientific research, one of the main challenges to the successful alignment of CS and learning is that CS exists as a distinct field of research in its own right, while

also serving to advance public scientific literacy (Bonney et al., 2009). In order to connect those involved in CS projects – researchers and practitioners alike – numerous CS associations have been established globally. Internationally, the most prominent of these are the Citizen Science Association, the European Citizen Science Association, and the Australian Citizen Science Association; all of which have confirmed that education and learning are of crucial importance to CS as an emerging professional field (Storksdieck et al., 2016; Roche and Davis, 2017). While CS may be integrated into the learning processes that take place in both formal and informal learning environments, the specific role of CS in science education is debated (Bonney et al., 2016). Similarly, the issue of how projects may be designed for learning requires consideration (National Academies, 2018).

6.2 Early References to Citizen Science and Education

Jenkins (1999) and Trumbull et al. (2000) both tentatively discussed CS in terms of learning and scientific literacy. Trumbull et al. (2000) demonstrated the potential for education and learning in CS projects. They showed that CS was not just a movement "to involve nonscientists in scientific investigations through projects in which a range of individuals gather data for use by scientists to investigate questions of research importance" but that participants in a CS project showed evidence of engaging in scientific thinking, i.e. they "engaged in thinking processes similar to those that are part of science investigations" (Trumbull et al., 2000, p. 265).

Jenkins (1999) felt that CS could be described as a science "which relates in reflexive ways to the concerns, interests and activities of citizens as they go about their everyday business" (p. 74). In this way, citizens are interested in science that serves specific social purposes, e.g. medical and environmental matters; to engage fully with such issues they must have access to relevant scientific knowledge in an accessible format. By incorporating CS into school science education, the interaction between science and society could be explored, acknowledging the relationship between science and production and profit. Formal science education could then enable students to engage with the practical, science-related issues that are likely to impact their lives as citizens (Jenkins, 1999).

6.3 Developing the Role of Learning in Citizen Science Projects

Bonney et al. (2009) created a 9-step model for building and operating CS projects that acknowledged how 'citizen science' projects have been remarkably successful in advancing scientific knowledge" (p. 977). They also highlighted the importance of learning being taken into account and how the full potential for CS in education has not yet been realised. They recommend more interdisciplinary research and collaborations, especially linking science and education.

To further understanding of the educational impact of CS, Jordan et al. (2012) argue that paying more attention to learning outcomes is crucial. They contend that engaging in CS projects can increase understanding of the scientific process and advance interest in science, as well as knowledge in general, but that future work should focus on the educational impact of CS and the evaluation of individual learning outcomes. CS project leaders should consider SMART (specific, measurable, attainable, relevant, and timely) learning goals of the project alongside the scientific goals and should establish an evaluation plan at the outset. Jordan et al. (2012) also believe that learning through CS projects "may not only be an outcome to be measured but may also be a driving, or perhaps influential force for meeting project goals, whether ecological or social" (p. 30-309).

Gray, Nicosia, and Jordan (2012) conclude that scientists, teachers, and students would require significantly more resources to effectively integrate CS projects into traditional science education. They also feel that the limited accessibility of certain scientific knowledge is an additional major barrier to efforts to democratise science through CS projects and "the real and perceived hierarchies among scientists, scientific knowledge, teachers, and students that are built into the structure of formal science classrooms present major challenges" (Gray, Nicosia, & tJordan, 2012, p. 5). Jenkins (2011) continued to argue that science educators need to link science to their students' everyday lives and that engaging in CS projects can bridge that gap, providing context to scientific information that many students find difficult to absorb through traditional teaching methods.

6.4 Contemporary Views on Citizen Science and Learning

Jennett et al. (2016) explored themes of motivation, learning, and creativity in CS and found that the more participants engaged in these aspects, the more likely they were to sustain involvement in CS projects. The skills that participants developed included project mechanics, content knowledge, pattern recognition, and improved scientific literacy. They showed that, participants in online CS projects learn on micro- and macro-levels; micro-learning is derived from direct contribution to the task, while macro-learning results from the use of external resources, project

documentation, and personal resource inspired by participation in the task. Participating socially in the online communities associated with these projects also boosted learning.

In 2018, the National Academies carried out one of the most thorough reviews to date of the role of CS and learning. Among the many assertions was that CS supports science learning by engaging participants with real data in a real-world context and therefore has the potential to enhance individual and community scientific literacy. Participation is motivated by personal interest and concern and is often a social activity. Learning is more likely to take place when projects are designed with learning outcomes in mind. The review also suggested that there should be continuous cycles of feedback in order to refine project design. One of the key recommendations was to "link the project's scientific goals with its learning goals" (National Academies, 2018, p. 137). These outcomes are related to the motivations, interests, and identities of the learners, and therefore should be set with this in mind. Finally, it was highlighted that additional support might be needed for CS projects to achieve certain learning outcomes through CS.

6.5 Views from the European Commission

To understand the strategic positioning of learning in citizen science in relation to other related concepts such as open science, this section carries out a scientometric analysis of the funding landscape of these two concepts. In 2014, the new European Commission led by Jean-Claude Juncker established its vision for the European Commission and through Carlos Moedas—the then Commissioner for Research, Science and Innovation—highlighted open science as "an increasingly crucial ingredient" to that vision (Ramjoué, 2015, p. 167). While the European Commission focused on a policy vision for open innovation, open science, and research being "Open to the World" (Moedas, 2016), 2015 also saw a marked change in how CS was discussed. Policy documents began to refer to CS as being something that could give "citizens a greater role in science" and could potentially "deliver the vision of science for the people, by the people for Europe" (European Commission, 2015). Looking at how often the terms "Open Science" and "Citizen Science" were used in the "Science with and for Society" Work Programme of Horizon 2020 (the research funding programme of the European Commission), suggests the funding focus on CS appears to be somewhat replacing by a focus on open science (Table 1).

Table 1. Comparing how often the term "Open Science" was mentioned in three successive European Commission "Science with and for Society" Horizon 2020 Work Programme (European Commission, 2019) compared to Citizen Scien* (The use of the asterisk (*) wildcard at the end of the root term "scien" meant that the mentions of both "Citizen Science" and "Citizen Scientist" were accounted for).

SwafS Work Programme	Mentions for the term “Open Science”	Mentions for the term “Citizen Science*”
2014 - 2015	2	0
2016 - 2017	26	6
2018 - 2020	12	65

There has also been an increase in the amount of European Commission funding for CS as can be seen in the number of CS related projects funded through a range of Horizon 2020 funding schemes, such as SwafS, ERC, and MSCA. Since 2011, more than €200 Million has been invested by the European Commission in 80 projects that identify as having some role to play in CS (Annex 2).

7. Survey of Training Needs in Citizen Science

The survey builds on the stakeholder mapping carried out in D2.1 and D2.2. As outlined in *D2.1, Stakeholders, Network & Community Mapping Report*, the key stakeholders for EU-Citizen.Science are ‘Any person, group, or entity with a common interest or stake in the outcomes of the Project and the success of the Platform’.

Since its start, the Project has engaged with key actors who are implementing CS initiatives at the European level (either as project coordinators, project partners, third parties or project supporters), together with newcomers who can introduce and promote CS practices in their respective countries. The main stakeholder groups for EU-Citizen.Science can be summarized in six groupings, as shown in Figure 4. A detailed description of the composition of each stakeholder group is provided in D2.1.

Figure 4: Shows the citizen science stakeholders identified in the EU-Citizen Science deliverable D2.1.

As identified in D2.1, the Platform's core user groups can be divided into those who are 'producers' of CS, i.e. people who do CS, and those who are 'consumers' of CS, i.e. those who use the outcomes of CS. Both groups contain people who are acting in different contexts, and also reflect a range of experience levels, from those who are new to CS ('Interested') to those who have active experience with CS ('Active').

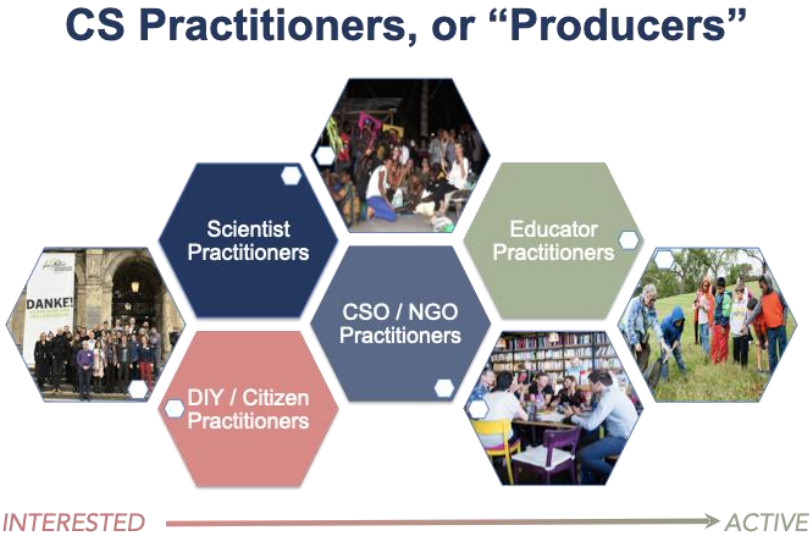

Figure 5: Shows the citizen science 'practitioners' identified in EU-Citizen Science deliverable D2.2

In terms of training, the main focus is on users of the training material in the form of 'practitioners' identified by WP2. The aim of this deliverable's survey is to extend this audience-targeting process by empirically identifying the users of CS training.

7.1 Survey Design and Methodology

The survey had an overall agenda of gathering information for defining a typology of CS training. The survey design was based around three goals:

1. Gather a **list of existing training material** as well as Tools, Guidelines and Materials (TGM).
2. Identify **what** new training material is needed by the community.
3. Identify **who** training should target.

The survey was iteratively designed to address a variety of existing CS audiences (from members of the public, CS project coordinators, as well as academics as defined in the Project DoA) but also new audiences. The online survey form was created by the UCL team with input from the consortium and is included in Annex 1. Practically, the survey design includes open text fields to gather large quantities of existing training material and to enable extended and open-ended responses. This was combined with a multiple-choice field for the intended training audience that used the Project's core categories of audience as well as an 'Other' field for questioning these categories. The whole survey was designed to be filled in less than 10 minutes.

During testing of the form with CS coordinators, it was found that the testers were often unsure about the definition of 'Tools Materials and Guidelines' (TMG) and how they might differ from training. This feedback has been passed to WP 3 *Content - Framework, Quality Assurance and Curation* and has been addressed going forward by clarifying these terms. The testers also questioned the audience of the survey, or from which perspective they should answer the survey. The team considered creating multiple surveys for segmented audiences but chose a single survey since the questions would not be significantly altered for different audiences. Nevertheless, this test feedback suggests that the question of roles and identities within CS is a significant issue, which needs to be kept in mind in future surveys and in relation to the question of CS as a whole.

To distribute the survey, a link to the online survey was sent to the following lists and services:

ECSA citizen science mailing list
ECSA newsletter
DITOs internal list
DITOs old mailing list
EU-Citizen.Science mailing list
EU-Citizen.Science internal
Citizen Science Discussion List
ACSA (Australian) mailing list
UCL ExCiteS Facebook group
UCL ExCiteS Twitter
EU-Citizen.Science Facebook page
EU-Citizen.Science Twitter page
Citizen Science Facebook Group
UCL ExCiteS mailing list
French Citizen science list
Austrian Citizen sci mailing list
LandSense mailing list
WeObserve mailing list
British Ecological Society list
Spanish cit sci mailing list
WeObserve SDGs CoP mailing list
SDGs and CitSci Maximization group mailing list
DITOs advisory board members
Citizen Science Office Switzerland

In addition, EU funded CS projects were contacted to fill in the survey. These CS projects were identified via a CORDIS search on the test term "*citizen science*" and selecting "*project*" which returned 77 results [5]. For each of these 77 projects a project email address was identified as well as specific individuals associated with the project. These project and individuals addresses were each emailed a link to the survey form.

It proved surprisingly hard to identify contact details for these EU CS projects, as some did not have project websites or only generic contact forms rather than listing participating individuals

[5] CORDIS search string: https://cordis.europa.eu/search/en?q=(%27citizen%20science%27)%20AND%20contenttype%3D%27project%27&p=1&num=10&srt=Relevance:decreasing

with email addresses. Since the CORDIS search included many projects that are no longer funded, a significant number of emails bounced, researchers had moved onto new positions, or in one case, passed away. In all, the UCL team managed to successfully contact 49 European Commission projects funded in relation to CS. From communications with the projects it was noted that earlier CS projects from more than a decade ago were reached as well as projects targeting more marginalised geographical areas such as CS in Africa.

7.2 Survey Results

The survey took place in summer 2019 and had a total of 63 responses (including the EU funded CS projects). The results were analysed using a mixture of quantitative and qualitative methods and then thematically clustered.

7.2.1 Survey Results: Existing Training Material

The survey aimed to gather information for defining a typology of CS training. The analysis of the survey results suggest that there are four different **types of training**:

1. **Topic-specific training:** focused on a single clearly identified and specific topic. For example this Sensing Storm Surge Training Video: https://www.youtube.com/watch?v=1vfdIxG-rv0

2. **Location-specific training**: focused on CS in a specific geographical area; this could be small local areas such as a specific park or as large as a continent such as Australia. For example the The Australian BioBlitz Hub: https://citizenscience.org.au/the-australian-bioblitz-hub/

3. **Audience-specific training**: specifically targeted towards defined audiences such as librarians or teachers. Audience-specific training often has specific restrictive aspects such as training for teachers requiring official accreditation. For example the ORION MOOC specifically targets researchers in biomedicine, life sciences for training: https://www.open.edu/openlearncreate/course/view.php?id=3980

4. **Generic training**: covers multiple topics and addresses a broader or non-specific audience. For example the UCL MOOC covers a broad range of citizen science topics: https://www.ucl.ac.uk/lifelearning/courses/citizen-science-scientific-crowdsourcing

There are overlaps and ambiguities between these categories, yet these four typologies provide a useful starting point for separating out different kinds of training found in CS.

The results of the suggested training resources include dynamic elements such as mailing lists, discussion forums, and a number of named individuals. This means **CS training might need to look beyond static documents and involve dynamic, living elements that adapt and respond to community needs**. The notion of specific people as resources, suggests that CS involves knowledge that is difficult to transfer to another person by means of writing it down or verbalising. This knowledge has not been fully articulated into static documents but instead resides within certain people as tacit knowledge. This suggests that EU-Citizen.Science might need to treat training as a social process taking place within a community of practice: '*a group of people who share a craft or a profession*' (Lave & Wenger 1991) rather than just a cognitive process. There is a large amount of literature on online social learning and the importance of providing learners with the occasion to reflect and discuss online with other learners who stimulates and supports critical discourse and deepen learning effects (Selin, C. et al. 2017). How to facilitate this on a web platform is an interesting challenge that will be addressed in future deliverables.

A number of training materials were mentioned many times in the survey responses (UCL MOOC, SciStarter, Cornell lab of Ornithology, California Academy of Sciences, UK Natural History Museum). **This suggests that there are established training resources that are acknowledged as valuable within the CS community**. The EU-Citizen.Science project needs to decide how to relate to these resources either by highlighting these resources or focusing on showing the range and breadth of other training that is currently not being seen.

There were some notable absences in the survey responses. For example, **Training focused on cultural and artistic aspects of CS were rare** and **pollution monitoring and environmental justice, which comprise a large part of the CS literature, were absent from the survey results.** Perhaps these aspects of training are not discussed within the CS community or perhaps there is a specific lack of training resources for these more marginal areas of CS. This might also indicate a limitation or distortion in the survey sample that focused on EU-funded projects and institutional mailing lists defined by the term 'citizen science'.

7.2.2 Survey Results: Training Needs

The responses to the question about training needs suggested that there is a large variety of needs that fall into five clusters:

1. **Scientific Training** (topic-specific training)
2. **Volunteer Management Training** (topic-specific training)
3. **Critical / Reflexive / New Possibilities Training** (topic-specific training)
4. **Schools Training** (audience-specific training)
5. **Practical / Operational Training** (generic training)

1 Scientific training is topic-specific training that targets scientific methodologies and issues. To quote some survey responses, training should be "*indicating the benefits of CS*" for scientific work and "*help with methodological development of citizen science questions*". Training that shows how to do "*quality assurance in citizen science measurements*" and how "*to get data through peer review, including correspondence with reviewers about citizen science data quality issues*" were also desirable. As well as how to interact with participants on scientifically important issues such as the "*importance of null data and submitting zeros. It would be great to see something encouraging volunteers to submit even when they didn't find what they're looking for*". **The most commonly requested focus in this cluster was training for ensuring data quality.**

2 Volunteer Management Training is topic-specific training that targets the engagement, maintenance and management of volunteer participants. As the name implies the focus is from the scientists or coordinators perspective on how to organise volunteers as outsiders. To quote some survey responses, the focus is on the "*motivations of citizen scientists*" and "*best practices for volunteer engagement and management*" in the form of "*Engagement Guides*. These should also cover practical topics such as communications with participants and "*badging and accreditation as an incentive*". The suggestion is that "*there is a lot of information to find on 'how to start' , but not as much information about the problems you run into and how to sustain a project […] keeping participants engaged and funds coming*". **The most commonly requested focus is best practice around volunteer management.**

3 Critical/Reflexive/New Possibilities Training is topic-specific training which represents the most diverse cluster in that it includes training for unrepresented & critical agendas as well as

the inclusion of disadvantaged and marginalised groups in CS (such as art and culture, activism & social justice, ethics and legal questions), and practical crafting and 'making' skills as well as critiques of CS. To give a flavour of the diverse survey responses in this cluster, training was suggested for "*different participative methods and tools*" as well as "*basic crafting skills: wood, metal; basic electronics; bottom-up resources and open-the-box tools*". Training on the "*involvement of underrepresented audiences*" including "*not only English-speaking citizens should be able to create their own science*" as well as issues "*concerning ethics and legal questions*" were also requested. A number of responses requested training for "*citizen science in arts and culture*" as well as an "*interdisciplinary focus*" with an aim to "*widen how we understand the scope of citizen science*". There were also requests for "*training for activists groups to do citizen science - How can you combine political objectives with science?*" and "*tools to affect change, or that have more of a social justice focus*". **The most common focus is on training for currently marginalised groups and underrepresented agendas in a variety of different fields.**

4 Schools training is the most tightly focused audience-specific training in that it targets teachers and young people in formal education. The focus is on teaching material for teachers to run CS. To quote, "*we need help finding ways to get a whole class and whole school involved*". This might be a "*guide for teachers to do practical citizen science in schools*" that would "*show pupils and teachers how they can extend their teaching experience by using CS*". This could also involve parents as well as the young people: "*you make it easy for parents, and they will LOVE that you have an activity for their kids for the coming weekend*". **The most typical focus is on practical guides on how to do CS within schools.**

5 Practical / Operational Training is generic training that covers the practical and operational processes, methods and tools required to run and communicate CS projects. To quote some survey responses, this involves "*video tutorials to show how to do citizen science*" which might include "*example mini-projects highlighting examples good and bad design choices*". A lot of the request in this cluster focused on the diversity of formats for training such as "*workshops, summer schools, open access to scientific publications, video material, apps*" as well as "*E-learning-Courses MOOCS, Webinars, video Text, Quizzes, Blogposts exercises with gamification - and in the end with a certificate*". There were also suggestions for "*discussion forums. This would not just be an 'exchange ideas' place but also a place to help each other out and mix socially and have a bit of fun*". There were also recommendations on how to do this: "*I would build all training modules into mobile friendly packages, almost like the Udemy*" and "*what is needed for the field is a way to easily create such resources by using plug-and-play templates*

and software tools generated by the community". **The most typical focus is on practical training for 'how to do citizen science' presented to the community in a variety of formats.**

7.2.3 Survey Results: Audience Targeting

The survey suggests that **the main audience that should be targeted with training are Practitioners (Coordinators & Project Managers)** (Figure 5). Interestingly, the **second most frequent response was for Public (Citizen scientists & Newcomers to citizen science)**. If the intention is to address people who have not been in touch with CS before or had limited experience then this training might be a first introduction to CS. These kinds of holistic first introductions are currently missing in CS and might be a valuable element to introduce. **Notable is the fourth most frequently mentioned category of training for teachers is currently underrepresented in current training material**. It is notable how few responses suggested targeting policymakers, press and industry. While this might be a representation of the current lack of this kind of training, it raises questions whether this is something desired by the CS community.

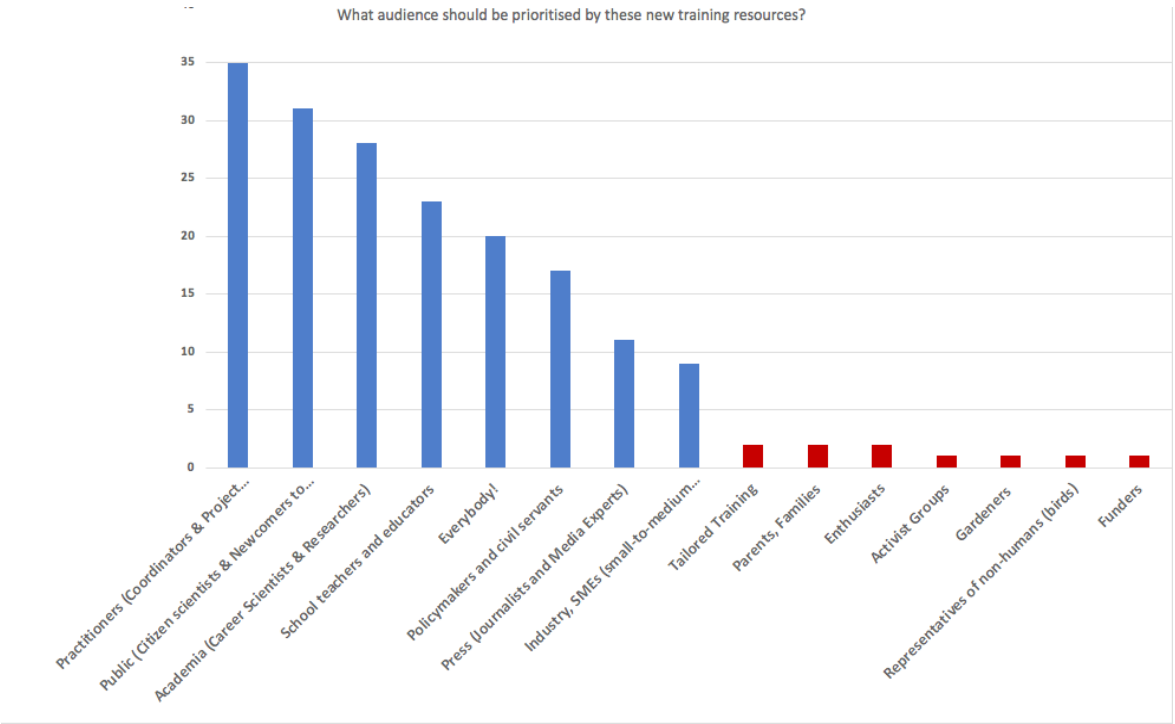

Figure 5: The Graph shows the number of responses to the multi-choice question: '*what audience should be prioritised by these new training resources?*'. The blue lines are multiple choice options, while the red lines were response via the 'Other' option and thus require special attention.

The red bars to the right in Figure 5 represent entities that were not part of the multiple choice and should thus be seen as important outliers. Targeting parents with training is an interesting unexpected result from the survey.

8. Detailed analysis of training material

There is a wide diversity of what training consists of in CS. This can be as simple as instructions on how to take a picture of a flower that will assist its identification (e.g. a close up of a flower and the leaves), to an elaborate protocol for measurement that requires a training day. In addition to the community survey, a more detailed semantic analysis was carried out on 30 training materials in order to understand the material audience targeting, language focus, time requirements and readability see (Annex 4 List of training materials examined for the detailed analysis).

This work was carried out by the Centre for Research and Interdisciplinarity (CRI) of the Université de Paris over the period of September to December 2019.

8.1 Methodology for detailed analysis of training material

The 'training material' targeted included 13 websites, 10 available as PDF files, 3 MOOCs, 2 podcasts, and 2 workshops. To take advantage of the fact that knowledge of the French language was available, the team analysed French and English materials. The team selected the following pertinent metadata: the type of material (area of science, publication date, geographic area, Formal/informal education purpose), the type of audience (Audience, Size, Readability score, Level of education based on ISCED 2001, Age, Language) and the accessibility (Accessibility by W3C recommendations, Connectivity, Time required to complete the training). The form went through six iterations and it is now in its seventh version (Annex 3).

The detailed analysis was carried out on 30 training materials of different lengths, language, areas of research, etc. The search at this stage was not systematic but exploratory, to evaluate the methodology and therefore the findings of the following analysis should be seen as preliminary. To ensure that the process of work can be shared with other interested researchers and also replicated in the future, a data collection protocol was devised, evaluated and tested by the UCL team. The protocol included nine steps:

Step 1 - Using a web browser, searched for appropriate resources. Keywords combinations were: [citizen science | PPSR | Community science | participatory science | sciences participatives | sciences citoyennes] & [training | tutorial | introduction | instructions | listen | MOOC].

Step 2 - To ensure that the link is operational and the material relevant for the project, the material was opened, and read / viewed / listened to. That allowed the researcher to have familiarity with the material.

Step 3 - Archived the material, and in cases where it is only available as a web page, it was turned into a PDF using the print function of the browser. This was to ensure that the material would not disappear after recording and analysing.

Step 4 - A template table on Google Drive was copied, to have a pristine version in the original form. In addition, a backup copy was kept.

Step 5 - The fresh copy was then linked to the material spreadsheet to provide a single point of reference to all forms. The table was updated with basic metadata about the item.

Step 6 -The form was used as a questionnaire for the analysis of the training material and the details of the material were recorded in the Registration Form.

Step 7 - Following the guidelines, the training material was evaluated and the readability tested, by copying a paragraph or two into the evaluation software.

Step 8 - If needed: Copyright authorisation was requested by sending an email to the project contact. The email was standardised, with an explanation of the project, why we need the copyright authorisation and the different types of Creative Commons Licence that can be used.

Step 9 - Peer review - the completed form and the training material was checked by another team member to ensure that the information is accurate and consistent.

8.2 Results from detailed analysis of training material

Among the 30 documents the team analysed, there was a steady linear growth over time of new material appearing by year of publication. The oldest one was dated 2004 and the latest 2019 (Figure 6).

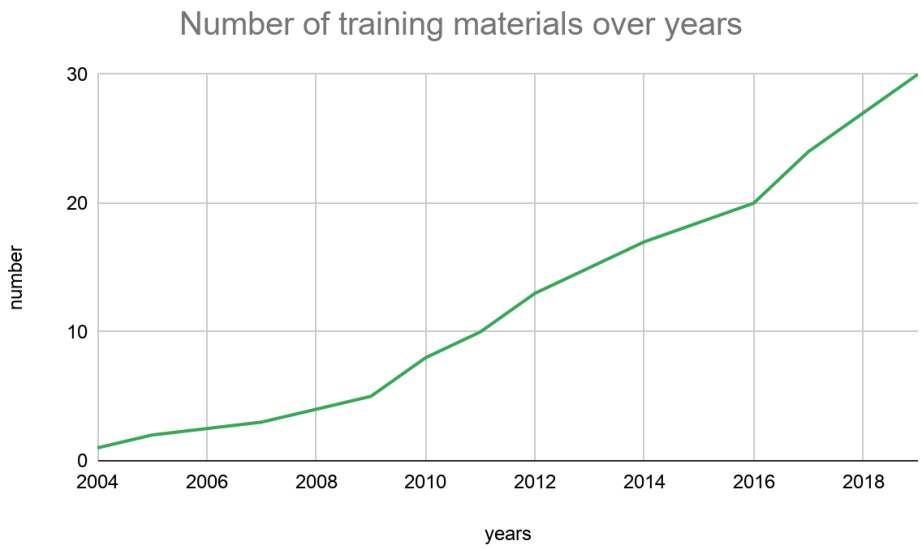

Figure 6: Cumulative number of training material in the survey

The majority of the material was in English (14) followed by French (10) and resources that are available in multiple languages (Fig. 7). For example, the project Participatory Plant Breeding (PPB) of CIRAD is available in French, Spanish and English[6] and the FLOAT Beijing project is accessible in Chinese and English. [7]

[6] http://participatory-plant-breeding.cirad.fr

[7] https://f-l-o-a-t.com/page/2

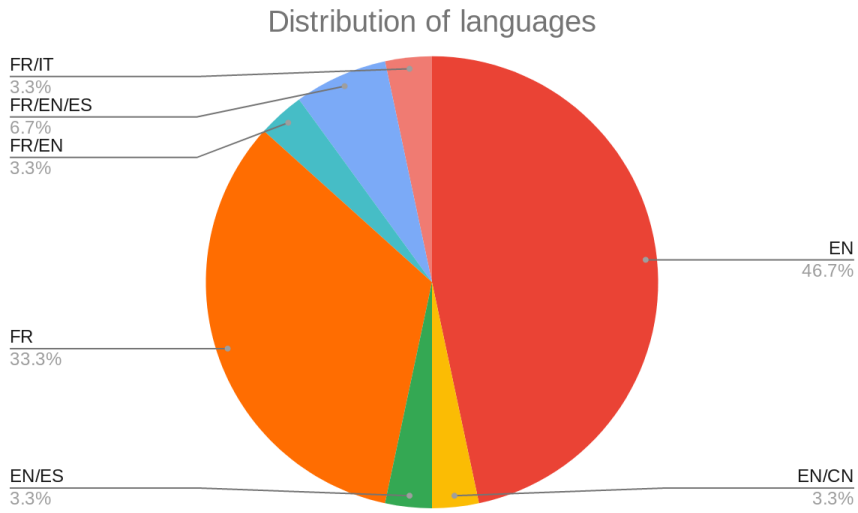

Figure 7: Distribution of language in training material in the survey

In terms of geographical areas covered by the materials, we found that 14 out of 30 were without any specific locations and could take place anywhere. There were seven place-based materials and nine concerning one specific country.

In terms of the time required to complete the majority of training materials, there is a significant diversity between material that takes a short time to complete (30 to 60 min), while others take more than a day to be completed (Fig. 8). For example, the NERC Community for Engaging Environments (NC4EE) training organised by Earthwatch[8] is a 5 day workshop, while the Birdlab of VigieNature observatory[9] training material can be completed in less than 30 min.

[8] https://www.rmets.org/news/nerc-community-engaging-environments-training

[9] Birdlab : http://www.vigienature.fr/fr/vigie-manip/birdlab

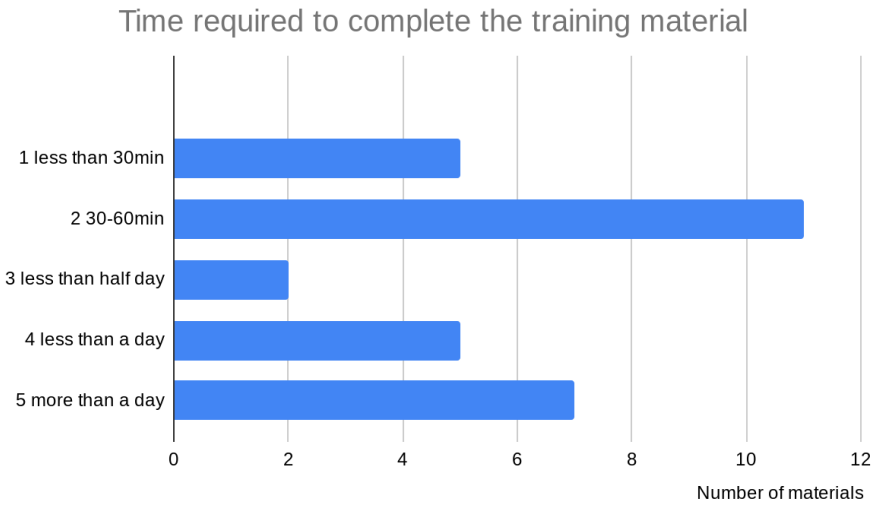

Figure 8: Time required to complete the training

The majority (25) of training materials were designed for individuals (Fig. 9).

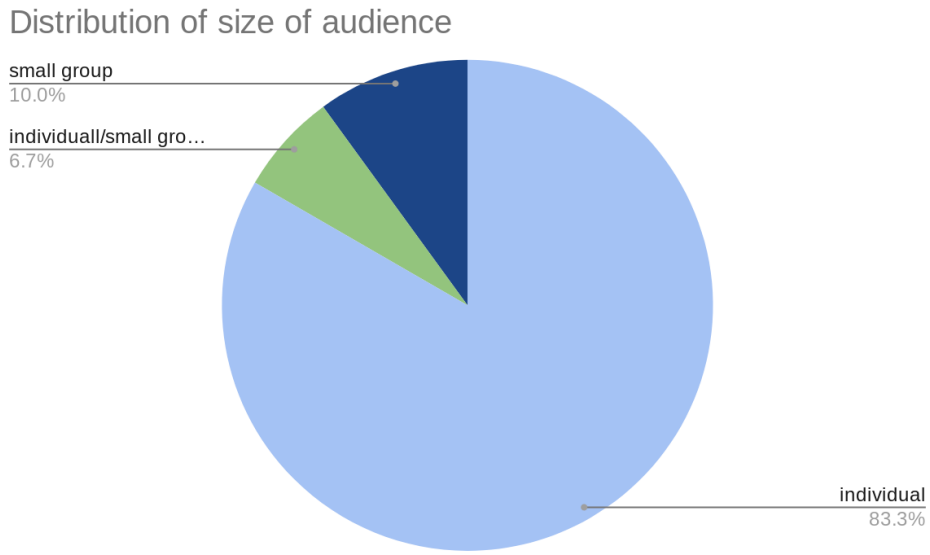

Figure 9: Size of audience the material is aimed at.

In terms of specificity of the materials, for all materials dealing with the design of a CS project without any aimed subject, for example, the Citizen Science Toolkit[10] designed by the California Academy of Sciences, we called “generic”. “Specific” materials are dealing with a particular area

[10] Citizen Science Toolkit: https://www.calacademy.org/educators/citizen-science-toolkit

of science or a particular project, such as the Observatoire des Saisons[11]. This supports the earlier finding from the community survey of differentiating between **Topic-specific, Location-specific, Audience-specific,** and **Generic** training.

The team evaluated the readability of the material in French and English using the Scolarius automated system[12]. The table below shows the approximate number of years in school that someone needs in order to read the material and therefore 5 is equivalent to a primary school level, 8 to a secondary, 11 or 12 to high school and everything above 14 is university level. The N/A notation corresponds to podcasts or workshops. The results show that 10 are readable by high school students, 7 by university students and 9 by under high school students. I**t is worth noting that almost a quarter of the training material required higher education** (Table 2). The Participatory Plant Breeding (PPB) project[13] is an example that requires higher education to participate in, because of the complexity of the process.

Table 2: Readability scores of the training material

Readability	Number of materials
5	3
8	6
11	1
12	7
13	2
14	3
15	2
17	2
N/A	4
Grand Total	30

[11] Observatoire des Saisons: https://www.obs-saisons.fr/participez/comment-observer
[12] Scolarius: http://www.scolarius.com/
[13] http://participatory-plant-breeding.cirad.fr/

The levels of education in Table 3 correspond to the International Standard Classification of Education 2011 (ISCED) and used this to estimate and classify who the materials targeted. **Most training materials were aimed at people with at least a secondary education**; nevertheless, almost 1 in 5 training materials were aimed at people with a Masters level of education.

Table 3: Estimated level of education for training material

Levels of education	Count
1 Primary education (5-7 years)	1
2 Lower Secondary Education	4
3 Upper Secondary Education	6
4 Post-secondary Non-tertiary Education	7
5 Short-cycle tertiary education	4
6 Bachelor or equivalent level	4
7 Master or equivalent level	4
Grand Total	30

In terms of re-use licences for training, the number of training materials for which it was easy to classify, and which contain clear information about their copyright is only 3 out of the 30. Messages to email addresses associated with a further 16 materials elicited a further four responses, and for the final 11 it was difficult to even identify who to contact. Furthermore, in terms of the use of permissive licenses, such as Creative Commons **only 9 out of the 30 training materials had a permissive license**.

More generally, the identification of copyright and the process of gaining permission was time-consuming and complex. **In many cases, the material does not contain explicit information about the copyright or contact information about the author.** Furthermore, in some cases, organisational policies complicate matters - for example, the UCL course '*Introduction to Citizen Science and Scientific Crowdsourcing*' is hosted in an online system that carries a general copyright notice of the university, and there is no easy way to identify who should be contacted to clarify the copyright.

With regards to the aesthetic quality of material, we have noticed that when the information is well-organised and signposted, it was easy to engage and follow the document. In the French websites, there was a dedicated area for educators and trainers, which assists in identifying material and using it. The accessibility of training material was good, but that does not necessarily represent the project websites that the material is referring to.

9. Summary

In summary, the review of the socio-democratic context of CS and literature on learning have identified:

- CS and learning need to be more formally integrated. CS projects can help facilitate participants to engage in scientific thinking and help citizens learn more about socio-scientific issues affecting their lives.
- More collaboration between research fields (e.g. science and education) has been recommended to realise the full potential for learning in CS.
- Training is needed in the design and development of learning outcomes and the effective implementation of evaluation/feedback solutions.
- Learning outcomes and evaluation processes should be designed at the outset and considered at all stages of the process so that feedback can be continuously gathered.
- Training needs to be seen as a social process that includes two-way communication between participants and researchers.
- Science educators need to find a link between science and the everyday lives of their students and engaging in CS can bridge that gap.
- History shows us that there is a strong correlation between the availability of education and participation in CS.
- Barriers to participation may be educational as well as due to socio-demographic factors such as income, confidence, resources. Genuine community participation and ensuring a diverse range of voices are heard, requires the provision of a range of subjects and entry levels.
- CS training for schools and educational institutions should be greatly expanded and formally integrated into school curricula.
- Training for wildlife and conservation can be tackled by public institutions such as schools, parks and museums.

The empirical surveys of existing training resources and community needs as well as detailed analysis of 30 training materials has identified that:

- There are established training resources that are acknowledged as valuable within the CS community.
- It was difficult to ascertain the copyright status for much of the training material which may prohibit public replication and reuse of training materials.
- The majority of the training material requires at least one hour of training with some requiring more than a day to complete which is a significant time investment. What is missing is 'bite-sized' training that might be more accessible on mobile phones for example.
- Not enough attention is paid to readability and levels of education required by CS training material. A quarter of the training material required a university education to complete, which creates a barrier to entry for the majority of the public.
- CS training needs to look beyond static documents and engage with dynamic, living elements that are in flux and responsive to community needs.
- It has been noted that during the writing of this deliverable, resource links have been disappearing and it is not clear how this should be addressed by the project going forward.

- There are four different types of CS training that differentiate training material and might be useful as metadata categories.
    - **Topic-specific,**
    - **Location-specific,**
    - **Audience-specific,**
    - **Generic.**

  There are five distinct clusters of training needs/gaps:

  1. **Scientific Training** is topic-specific training that targets scientific methodologies and issues. The most commonly requested training is for ensuring data quality.

  2. **Volunteer Management Training** is topic-specific training that targets the engagement, maintenance and management of volunteer participants. The most commonly requested training is on best practice.

  3. **Critical / Reflexive / New Possibilities Training** is training for unrepresented & critical agendas as well as the inclusion of marginalised groups in CS such as art

and culture, activism & social justice, ethics and legal questions as well as practical crafting and 'making' skills. The most requested focus is training around underrepresented agendas across different fields.

4. **Schools Training** is audience-specific training that is the most tightly focused training in that it targets teachers and young people in formal education. The most common request is for practical guides on how to do CS within schools.

5. **Practical / Operational Training** is training that covers the practical and operational processes, methods and tools required to run and communicate CS projects. The most common request is on the practical aspects of 'how to do citizen science'.

In addition there seems to be a gap in terms of CS training for **Pollution monitoring and environmental justice,** which was not represented in the survey.

- There remain a number of unresolved issues that will need further attention in the future:

    - How to deal with the fact that a significant amount of citizen science knowledge is tacit and embodied in people rather than fully articulated as documents and resources?
    - There is a significant component of social learning that is currently being missed in the focus on training as static resources. How can EU-Citizen.Science deal with this?
    - How EU-Citizen.Science should deal with the small number of established resources either by highlighting these or foregrounding others?
    - Many current training resources require a large time investment and there is few bite-sized training material. Should EU-Citizen.Science focus on this?

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Annexes

11. Annex 1 Survey Form

Citizen Science Training Needs & Resources

This is the first survey from the EU.Citizen-Science project, which aims to create a global Citizen Science platform that features custom-made training modules that address community needs.

We need your help in compiling existing Citizen Science training resources for 'how to do citizen science' as well as general tools, guidelines and materials. In addition, we would like to know what new Citizen Science training resources are needed and which audiences should be targeted.

All survey responses are anonymous and will be used to build the platform and create new training modules. Please take a quick look at the five questions before starting. We are looking for global resources - so language doesn't matter.

Thank you for taking the time to fill out the questionnaire! :)
Muki Haklay, Christian Nold & Alice Sheppard
http://eu-citizen.science

Q1) Please list as many Citizen Science training resources for 'how to do citizen science' that you are aware of. (Use a separate line for each one - there is no word limit)

These could be formal courses, MOOCs, or simple handouts and videos. Please add URL's and references to the resource.

Long-answer text

Q2) Please list any high-quality Citizen Science tools, guidelines and materials. (Use a separate line for each one - there is no word limit)

For example this could be software tools, diagrams, policy reports, technical manuals for apps, etc. Please add URL's and references.

Long-answer text

Q3) In your opinion, what kinds of new training resources are needed in Citizen Science?

Please be as specific as you can in terms of training topics or skills and the format in which you would want to access this in (text, video, podcast, etc).

Long-answer text

Q4) What audience should be prioritised by these new training resources?

- [ ] Public (Citizen scientists & Newcomers to citizen science)
- [ ] Practitioners (Coordinators & Project Managers)
- [ ] Academia (Career Scientists & Researchers)
- [ ] Press (Journalists and Media Experts)
- [ ] Policymakers and civil servants
- [ ] Industry, SMEs (small-to-medium enterprises & new entrepreneurs)
- [ ] School teachers and educators
- [ ] Everybody!
- [ ] Other...

Q5) If you answered "Other" in Q4 please tell us more! Do you have any other thoughts about Citizen Science training?

Long-answer text

12. Annex 2 Citizen science related projects funded by the European Commission

This form examined multiple sources of citizen science training in French and English. It went through six iterations prior to this seventh version.

Project Name	Funding	Topic	Countries Involved	Start and End Dates	Website
SeaChanges	€4,218,207.84	H2020-EU.1.3.1.	6 (GB, NL, DK, IT, ES, NO)	1-Apr-2019 31-Mar-2023	https://sites.google.com/york.ac.uk/seachanges
CITSCI	€122,050	H2020-EU.1.3.5.	1 (PT)	1-May-14 30-Nov-15	http://www.noitedosinvestigadores.org/
EXPERIM	€421,200	H2020-EU.1.3.5.	1 (FR)	1-May-14 30-Nov-15	http://www.nuitdeschercheurs-france.eu/
BIG4	€3,874,278.60	H2020-EU.1.3.1	15 (DK, SE, DE, AT, FI, CZ, BG, ES, BE, CN, JP, US, NZ, CH, AU)	1-Jan-2015 31-Dec-2018	http://big4-project.eu/
Green Bubbles	€1,611,000	H2020-EU.1.3.3	6 (IT, TR, MT, NL, US, ZA)	1-Jan-2015 31-Dec-2018	http://www.greenbubbles.eu
LIGHT2015	€979,808.75	H2020-EU.2.1.1.6	6 (FR, SP, IE, IT, NL, BE)	1-Jan-2015 30-Jun-2016	http://www.europe.light2015.org
C-CASCADES	€3,112,980.61	H2020-EU.1.3.1	8 (BE, UK, FR, GB, DE, NL, SE, CH)	1-Jan-2015 31-Dec-2018	http://c-cascades.ulb.ac.be/
ConnectinGEO	€999,995.94	H2020-EU.3.5.5.	9 (ES, IT, DE, AT, NL, BE, FR, GB, NO)	1-Feb-2015 31-Jan-2017	http://www.connectingeo.net
EGI-Engage	€8,000,000	H2020-EU.1.4.1.3.	24 (NL, AT, BE, BG, CZ, CH, DE, ES, FR, GR, FI,	1-Mar-2015 31-Aug-2017	https://www.egi.eu/about/egi-engage/

			HR, HU, IT, PT, SE, GB, PL, SK, TR, TW, PH, ID, MY)		
EUSPACE-AWE	€1,999,965	H2020-EU.2.1.6.1.	7 (NL, BE, DE, GB, GR, PT, ZA)	1-Mar-2015 28-Feb-2018	http://www.space-awareness.org/
ESAIRE	€170,121.60	H2020-EU.1.3.2.	1 (ES)	1-Apr-2015 31-Mar-2017	http://www.esaire.eu/
ENVRI PLUS	€14,683,534.25	H2020-EU.1.4.1.1.	11 (FI, FR, SE, IT, DE, GB, CH, NL, AT, NO, ES,)	1-May-2015 31-Jul-2019	http://www.envriplus.eu
ECOPOTENTIAL	€14,874,340	H2020-EU.3.5.5.	18 (IT, DE, ES, FR, GB, GR, PT, CH, IL, ZA, AT, NL, NO, RO, LT, KE, CH, AU)	1-Jun-2015 31-Oct-2019	http://www.ecopotential-project.eu/
ASTERICS	€14,991,194	H2020-EU.1.4.1.1.	6 (NL, FR, IT, GB, ES, DE)	1-May-2015 30-Apr-2019	http://www.asterics2020.eu
AQUAINVAD-ED	€2,079,605.16	H2020-EU.1.3.1.	3 (GB, ES, IT)	1-Jun-2015 31-May-2019	http://www.aquainvad-ed.com
ESOF2016	€999,999	H2020-EU.5.	1 (GB)	1-July-2015 31-Oct-2016	http://www.esof.eu/home.html
Making Sense	€1,547,774.50	H2020-EU.2.1.1.	5 (NL, GB, BE, ES, XK)	1-Nov-2015 31-Dec-2017	http://making-sense.eu
CAPTOR	€1,963,982.50	H2020-EU.2.1.1.	4 (ES, AT, IT, FR)	1-Jan-2016 31-Dec-2018	https://www.captor-project.eu
hackAIR	€2,000,406.25	H2020-EU.2.1.1.	5 (GR, NO, DE, BE, NL)	1-Jan-2016 31-Dec-2018	http://www.hackair.eu/
STARS4ALL	€1,970,140	H2020-EU.2.1.1.	6 (ES, IT, BE, GB, FR, DE)	1-Jan-2016 31-Dec-2018	http://www.stars4all.eu
ACROSSING	€3,860,209.32	H2020-EU.1.3.1.	6 (GB, DE, ES, AT, IT, GR)	1-Jan-2016 31-Dec-2019	http://www.acrossing-itn.eu/
COMRADES	€1,999,021.25	H2020-EU.2.1.1.	5 (GB, NO, BE, NL, KE)	1-Jan-2016 31-Dec-2018	http://www.comrades-project.eu

IASS	€170,121.60	H2020-EU.1.3.2.	1 (ES)	1-Jan-2016 31-Dec-2017	http://activityspaceproject.com
SETA	€5,565,247.50	H2020-EU.2.1.1.	5 (GB, ES, PO, NL, IT)	1-Feb-2016 31-Jan-2019	http://setamobility.eu/
GRACE	€5,277,554	H2020-EU.3.2.	9 (FI, DE, DK, ES, EE, NO, SE, CA, GL)	1-Mar-2016 31-Aug-2019	http://www.grace-oil-project.eu
STEM4youth	€1,776,936.25	H2020-EU.5.a.	6 (PO, GR, IT, CZ, SI, ES)	1-May-2016 31-Oct-2018	http://www.stem4youth.eu/
CLARITY	€180,277.20	H2020-EU.1.3.2.	1 (IT)	9-May-2016 8-May-2018	http://www5.unive.it/pag/33194/
Waste4Think	€8,818,566.12	H2020-EU.3.5.4.	6 (ES, GR, DK, IT, DE, PT)	1-Jun-2016 29-Feb-2020	http://waste4think.eu/
RNest16-17	€164,000	H2020-EU.1.3.5.	1 (EE)	1-Jun-2016 30-Nov-2017	http://www.researchersnight.ee
Re(search)	€159,900	H2020-EU.1.3.5.	1 (IE)	1-Jun-2016 30-Nov-2017	http://www.tcd.ie/research/probe/
AMBER	€6,020,172.75	H2020-EU.3.5.2.	12 (GB, DK, IE, NL, ES, PO, IT, FR, CH, DE, SE, BE)	1-Jun-2016 30-Sep-2020	https://amber.international/
DITOs	€3,498,953.75	H2020-EU.5.c.	10 (GB, BE, FR, NL, DE, ES, PO, CH. AT, SI)	1-Jun-2016 31-May-2019	http://www.togetherscience.eu/
LANDSENSE	€5,088,291.88	H2020-EU.3.5.5.	8 (AT, SI, GB, FR, RS, DE, BE, NL)	1-Sep-2016 31-Aug-2020	https://landsense.eu/
SCENT	€3,264,675	H2020-EU.3.5.5.	6 (GR, NL, IL, IE, IT, RO)	1-Sep-2016 31-Aug-2019	https://scent-project.eu/
YnotSing	€165,598.80	H2020-EU.1.3.2.	1 (NL)	1-Sep-2016 31-Aug-2018	http://www.femalebirdsong.org
CANVAS	€1,000,000	H2020-EU.3.7.	7 (CH, FI, BE,	1-Sep-2016	http://www.ca

			DE, IE, NL, ES)	31-Oct-2019	nvas-project.eu
MOPEAD	€2,043,000	H2020-EU.3.1.7.	9 (ES, GB, BE, SE, IE, SI, DE, NL, LU)	1-Oct-2016 31-Dec-2019	http://www.mopead.eu
ECSAnVis	€2,500,000	H2020-EU.1.1.	1 (GB)	1-Nov-2016 31-Oct-2019	
GROW	€5,096,919.64	H2020-EU.3.5.5.	9 (GB, AT, IT, NL, ES, IE, GR, FR, HU)	1-Nov-2016 31-Oct-2019	http://www.growobservatory.org
GAPARS	€573,297	H2020-EU.2.1.1.	7 (CH, FR, HU, NL, SE, BE, IS)	1-Jan-2017 30-Jun-2019	http://gapars.mmos.ch
FoodSmartphone	€2,843,040.96	H2020-EU.1.3.1.	6 (NL, GB, CZ, ES, SE, CH)	1-Jan-2017 31-Dec-2020	http://www.foodsmartphone.eu/
ORION	€3,157,301.25	H2020-EU.5.f.	6 (ES, CZ, DE, SE, IT, GB)	1-May-2017 30-Apr-2021	http://www.orion-openscience.eu/
DEEP-HybridDataCloud	€2,988,750	H2020-EU.1.4.1.3.	7 (ES, PT, IT, DE, CZ, SI, PO)	1-Nov-2017 30-Apr-2020	https://deep-hybrid-datacloud.eu
CLAIM	€5,654,786,01	H2020-EU.3.2.5.	12 (GR, DK, SE, IT, NL, BG, ES, DE, EE, FR, GB, LB)	1-Nov-2017 31-Oct-2021	
WeObserve	€1,069,507.50	H2020-EU.3.5.5.	7 (AT, NL, GB, ES, GR, DE, IT)	1-Dec-2017 30-Nov-2020	https://www.weobserve.eu/
SHARE4RARE	€1,921,962.50	H2020-EU.2.1.1.	5 (ES, NL, SE, GB, BE)	1-Jan-2018 31-Dec-2020	https://www.share4rare.org/
OpenAIRE-Advance	€9,999,997.50	H2020-EU.1.4.1.3.	33 (GR, DE, IT, PO, CH, PT, NL, BE, NO, GB, FR, AT, BG, DK, EE, FI, HU, IE, IL, UY, HR, CY, IS, LV, LT, LU, MT, RO, SI, SK, CZ, TR,SE)	1-Jan-2018 31-Dec-2020	https://www.openaire.eu/openaire-advance-project

ICEDIG	€2,999,755	H2020-EU.1.4.1.1.	7 (FI, NL, BE, EE, FR, GB, CH)	1-Jan-2018 31-Mar-2020	https://www.icedig.eu/
PIONEER	€158,121.60	H2020-EU.1.3.2.	1 (ES)	8-Jan-2018 7-Jan-2020	
TWIGA	€4,979,622.50	H2020-EU.3.5.5.	1 (NL)	1-Feb-2018 31-Jan-2022	https://www.futurewater.eu/projects/twiga/
D-NOSES	€3,158,612.50	H2020-EU.5.f.	9 (ES, GB, DE, GR, AT, IT, PT, BG, CL)	1-Apr-2018 31-Mar-2021	https://dnoses.eu/
BEES	€360,000	H2020-EU.1.3.5.	1 (IT)	1-Apr-2018 30-Nov-2019	https://www.frascatiscienza.it/pagine/notte-europea-dei-ricercatori-2018/
OPENRESEARCHERS18-19	€202,326.18	H2020-EU.1.3.5.	1 (ES)	1-Apr-2018 30-Nov-2019	https://lanochedelosinvestigadores.fundacion descubre.es/
urbanbird	€177,598.80	H2020-EU.1.3.2.	1 (NL)	1-Apr-2018 31-Mar-2020	
NOCMOC	€175,062.50	H2020-EU.1.3.5.	1 (SI)	15-Apr-2018 14-Dec-2019	http://www.nocmoc.eu
Sci4all	€149,132.50	H2020-EU.1.3.5.	1 (AT)	1-May-2018 31-Dec-2019	http://sci4all.eu
PERSEUS	€183,454.80	H2020-EU.1.3.2.	1 (GB)	1-May-2018 30-Apr-2020	http://www.perseus-net.eu/site/content.php
PROBE	€203,750	H2020-EU.1.3.5.	1 (IE)	1-Jun-2018 30-Nov-2019	https://www.tcd.ie/research/probe/
REFRESH	€208,125	H2020-EU.1.3.5.	2 (BG, GB)	1-Jun-2018 31-Jan-2019	https://nauka.bg/night/eng/
GRECO	€2,973,220	H2020-EU.5.d. H2020-EU.5.c. H2020-EU.5.e.	6 (ES, PT, DE, CH, BG, BR)	1-Jun-2018 31-May-2021	https://www.greco-project.eu/

NHM Night 7	€181,194	H2020-EU.1.3.5.	1 (GB)	1-Jul-2018 29-Feb-2020	https://www.nhm.ac.uk/events/archive/visit/evening-events/world-wild-webs.html
THREAT	€165,598.80	H2020-EU.1.3.2.	1 (NL)	1-Aug-2018 31-Jul-2020	
LUCCA	€212,194.80	H2020-EU.1.3.2.	1 (DK)	1-Sep-2018 7-Apr-2021	http://luca-project.eu/
PEPPER	€208,400.40	H2020-EU.1.3.2.	1 (NO)	3-Sep-2018 2-Sep-2020	http://www.pepper.eu.com/
BE OPEN	€1,997,283.75	H2020-EU.3.4.	10 (GR, NO, BE, DE, IT, CY, NL, FR, ES, IE)	1-Jan-2019 30-Jun-2021	https://beopen-project.eu/
MICS	€1,944,428	H2020-EU.5.c.	5 (GB, IT, NL, HU, RO)	1-Jan-2019 31-Dec-2021	https://mics.tools/about-mics
CitieS-Health	€2,000,500	H2020-EU.5.c.	5 (ES, SI, IT, NL, LU)	1-Jan-2019 31-Dec-2021	http://citieshealth.eu/
EU.Citizen-Science	€1, 999,878.75	H2020-EU.5.c.	10 (DE, AT, GB, BE, IE, SE, NL, LU, PT, ES)	1-Jan-2019 31-Dec-2021	http://eu-citizen.science/
ACTION	€1,994,911.25	H2020-EU.5.c.	6 (GB, IT, NL, NO, DE, ES)	1-Feb-2019 31-Jan-2022	http://www.action-euproject.eu/
COSMOS	€2,495,776	H2020-EU.1.1.	2 (FR, GB)	1-Jun-2019 31-May-2024	http://cosmos-h2020.eu/
NEXUS-DRR	€270,327.36	H2020-EU.1.3.2.	2 (GB, BR)	1-Aug-2019 31-Jul-2022	
CLEARING HOUSE	€4,986,463.75	H2020-EU.3.5.4. H2020-EU.3.5.1. H2020-EU.3.5.2.	11 (FI, CN, PO, BE, ES, FR, IT, AT, HR, CH, HK)	1-Sep-2019 31-Aug-2023	https://clearinghouse-oef.jrc.ec.europa.eu/
COS4CLOUD	€5,999,055.75	H2020-EU.1.4.1.3.	(ES, GB, FR, NL, DE, SE, GR, CO)	1-Nov-2019 28-Feb-2023	https://twitter.com/cos4cloud?lang=en

FoodE	€7,174,252.38	H2020-EU.3.2.2.1. H2020-EU.3.2.2.2.	8 (IT, FR, DE, NL, NO, RO, SI, ES)	1-Feb-2020 31-Jan-2024	
Socientize	€709,999	FP7-INFRASTRUCTURES	4 (ES, AT, BR, PT)	1-Oct-2012 30-Sep-2014	http://www.socientize.eu/
CrowdLand	€1,397,200	FP7-IDEAS-ERC	1 (AT)	1-Apr-2014 31-Mar-2020	
VECTORS	€12,484,835	FP7-KBBE	16 (GB, DE, ES, IT, IE, NL, EE, IL, FR, DK, GR, LU, BE, SI, PO, MC)	1-Feb-2011 31-Jan-2015	https://www.marine-vectors.eu/
Citizen Cyberlab	€3,400,000	FP7-ICT	3 (FR, CH, UK)	1-Oct-2012 30-Nov-2015	http://www.citizencyberlab.org/
INSEAME	€221,154.60	FP7-PEOPLE	1 (DK)	15-Apr-2014 14-Apr-2016	
GLORIA	€2,499,955	FP7-INFRASTRUCTURES	8 (ES, CZ, HR, IE, IT, PO, RU, GB)	1-Oct-2011 30-Sep-2014	https://gloria-project.eu/en/

13. Annex 3 Citizen Science Training Material Registration Form

This form went through six iterations prior to being used for this survey.

Form developed by:	
Checked by:	
Completion date:	
Version:	7

Name: Title of the training material	Title of the document, or if there is an official citation, include the preferred citation

Project name (ProjectName)	
Filename:	
Location - in folder or online	In the material folder / located online and can't be stored in the folder
URL - web address where the material is from	
Type	Video (online youtube, vimeo or video file), podcasts, transcripts of podcasts and videos, PDF files of instructions and guidelines, Word documents and forms, printed material that is worth digitising, recording of lectures and websites.
Language	FR / EN
Copyright?	Is the document free to copy/public domain or is it under some copyright protection?
Description (50 words)	
Project Contact	Email address of a contact
Name of the Partnerships	
Geographic area	Describe the geographical area that the material addresses - is it site-specific or generic and doesn't refer to a specific location? E.g. urban park, street, city
Publication date (estimated) https://web.archive.org/	
Date of the last update	
Time required	
Equipment needed to complete the training process (also apps and software)	
Is there a FAQ?	Yes / No
Connectivity	Internet needed or downloading available
Area of Science	

(https://en.wikipedia.org/wiki/Fields_of_Science_and_Technology)	
Audience:	practitioners, new participants, experienced participants, external bodies who support citizen science (funders), school teachers and educators.
EU-Cit.Sci Audience	Public, practitioners, academia, policy makers, journalist/media
Size of Audience	Individual, small group, large group
Audience Age / Life Stage (if defined in the material who is it for)	children, teenagers, families, adults, elderlies
Readability (french: http://www.scolarius.com/ or https://www.webfx.com/tools/read-able/ Eng)	Readability test score
Levels of education (inspired by ISCED 2011) https://en.wikipedia.org/wiki/International_Standard_Classification_of_Education#ISCED_2011_levels,_categories,_and_sub-categories	Level 0 to level 8
education purpose	Formal / informal
Specific / Generic training material	Specific / Generic
The Five C	contractual, contributory, collaborative, co-created, collegial, general
Aesthetic quality	need work / decent / excellent
Accessibility (check guidelines http://www.acessibilidade.gov.pt/accessmonitor/ For pdf : https://www.access-for-all.ch/en/pdf-lab/pdf-accessibility-checker-pac.html.)	need work / decent / excellent

Tags	
Content quality, problems, other notes	Comments on the variety, help, methodology, concepts, examples, practice
Popularity statistics (optional)	

Annex 4 List of training materials examined for the detailed analysis

This is the list of the 30 resources examined with links to the detailed analysis.

Week 1: Introduction / UCL Course / Introduction to Citizen Science & Scientific Crowdsourcing	https://docs.google.com/document/d/1VR7NUIKn4Q6jO5YhSEuQzuwamiyvYn_EfFsYmabXZzg/edit?usp=sharing
Week 2 : Scientific crowdsourcing principles and practice /UCL Course / Introduction to Citizen Science & Scientific Crowdsourcing	https://docs.google.com/document/d/1xsTATeoCH0kmsyvL0hiyMWoc4fNn4hHxTJdf93rXcrc/edit
Open Citizen Science Handbook	https://docs.google.com/document/d/1FnNju4zcMJdtLbYNkm6MkZ_ZXCpNSuRfQeI28fE5Q8o/edit?usp=sharing
GS-24 - Citizen Science with GIS&T	https://docs.google.com/document/d/1TRLcUCr6KoButpsJ3Xh21JVLpuqaHtVZy30fffoBzeg/edit#heading=h.6nsljuho3r9f
Guide to citizen science: developing, implementing and evaluating citizen science to study biodiversity and the environment in the UK.	https://docs.google.com/document/d/1zR091Z-3aTQg1OKoqcOotwL_1mExzE1ktdUr2xh36M8/edit?usp=sharing
Citizen Science Central Toolkit	https://docs.google.com/document/d/1zsAvpQbhDjkE-DlcmXxiCwLRF5q43cjYjZ7z5kotE0w/edit?usp=sharing
Citizen Science Toolkit	https://docs.google.com/document/d/1Tu8mnLUkmrwznb9RR11SJ4kx1dcWDIGHtOIKf5LIG0o/edit#
Bioblitz-guide	https://docs.google.com/document/d/1HTPy8OlIrapwJyZC4bgriasVUBNk3-NtXH1DC-8CPO0/edit?usp=sharing
Les Sciences participatives en France	https://docs.google.com/document/d/1JdIWRnBDajJ_HCYRNq2gfezTTyByXlc9TWG7Qa9Xa-4/edit
Birdlab	https://docs.google.com/document/d/1aygWeS1wdvJ0rL__6lbXhEe2udKXtCiFHCxDGO7XVs/edit?usp=sharing
Teacher course: Citizen science in school	https://docs.google.com/document/d/1Uk2ywM9MatM8NI1HKnOrQVsfd2qE6dzUkVtddM_0PzA/edit#
Observatoire des saisons	https://docs.google.com/document/d/1LLBJ-HBq-iDjs66ZEXCcfANZ8cX1FlxWeNApSHwlDEQ/edit?usp=sharing
Participatory plant breeding	https://docs.google.com/document/d/1U_RpWiYFqF96id_vM7NHSQf538HH2DIM6Pu5_B8t-fg/edit?usp=sharing

Science Camp	https://drive.google.com/file/d/1-WI6rUN5goLNoLFdFRN-jTTFK_mcEPrG/view?usp=sharing
Teach Earth	https://drive.google.com/file/d/1LRhfPf_ovBLLcJPxVTDTvZOq2gufKeuZ/view?usp=sharing
Pl@ntnet	https://docs.google.com/document/d/1EpoDtynR-jRG4fxvil9q4qo1BC-O-6GTg7KnMr9I_vQ/edit
Sauvages de ma rue	https://docs.google.com/document/d/10Wds5DGZ_QAOEQHcx1Nb1sVNyJNOrduNjNZkpPVtaKE/edit#
Mission Monarch	https://docs.google.com/document/d/1OXIgaghk_qJD9YA_yNAVo3SNujGRlp1EPILHtwBe5TI/edit?usp=sharing
Observatoire Agricole de la Biodiversité	https://docs.google.com/document/d/1Cd0_VBYXi8gCZx72PeKaUWLNtVNXkGiL9bKWfl8F_aY/edit
Phénoclim, les sciences participatives en montagne	https://docs.google.com/document/d/1nhd4A-QBxgmyYGJwr4yKfULw-pDYW9oc-iligSEM1AY/edit#
Sciences Participatives et biodiversité	https://docs.google.com/document/d/1OdvO6BGvF0V9uDEvq5CJvgDnDiTAkfKbTBT01nvms4I/edit
FLOAT Beijing	https://docs.google.com/document/d/1e6wm2HT1RudYkPggui3CjtPzlCpnfyFQ/edit#heading=h.gjdgxs
Environment China	https://docs.google.com/document/d/1BeNq-etUKdQeE6XisALTeIUZzHYiyxrX/edit#heading=h.gjdgxs
Citizen Science Podcast	https://docs.google.com/document/d/16JZkskZVKyFczsouvFW7oXlXtPGkc5pv/edit
Phenomer	https://docs.google.com/document/d/1LEWgS4Ll7AcIj-Yk97IkpKCxOT4c55z9QKkslJSl6aU/edit?usp=sharing
Sciences participatives et biodiversité	https://docs.google.com/document/d/1tOYUZs4PA6THgjp92rGCDR6G2IzIOUr4Kjv8j-nz-8Q/edit
Secchi DIsk study	https://docs.google.com/document/d/1Tdy7_2khKXlM3SVYiLtA-NLKaLXABn3W9SCt_Q_M6wo/edit?usp=sharing
Vigie flore	https://docs.google.com/document/d/1mInNN_UkICiSfKixEOyZMAADyg95hUd8gh_iAZm-r-0/edit
Vigie ciel	https://docs.google.com/document/d/1C-GIdQJhm9nwuWQnP7_c2bB912ty0ptkdtD8f4asbtA/edit
Planet Hunters Educators	https://docs.google.com/document/d/1LI5fTQKdKrj2Uz9dfwAEvUfAbz-9mEohynl98vqXoVI/edit?usp=sharing