eu-citizen.science

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

Deliverable 3.3

Review of Framework Implementation Defined in D3.1

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Abstract	The aim of the EU-Citizen.Science project is to build a sustainable platform as a mutual learning space for citizen science in Europe through an inclusive and transparent approach. To achieve this aim, the project supports the development of a framework to identify, collect and share good quality citizen science resources and best practices. This deliverable (D3.3) "Review of Framework Implementation" provides a review report on the implementation of the "Quality Criteria Framework for Resources" in practice, as developed in D3.1 "Framework describing criteria and rationale for sharing and selecting state of the art citizen science resources",

	which described the set of criteria and actions for identifying good quality citizen science resources for the EU-Citizen.Science platform. The Quality Criteria Framework, which has been implemented for more than a year, is designed as an inclusive exercise that actively involves the community in decision-making. The framework ensures that a living and sustainable repository for high quality citizen science resources is made available on the platform for the community. After a careful review of the implementation of the criteria framework for resources, the EU-Citizen.Science consortium has come to the conclusion that the criteria and their moderation will continue to be implemented by ECSA, who will take ownership of the platform after the end of the EU-Citizen.Science project.
Keywords	Citizen science, Citizen science resources, Citizen science projects, Training resources, Moderation

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0.2	23 April 2021	Dilek Fraisl	Second Draft
0.3	30 April 2021	Margaret Gold	Response to Comments
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Definitions and Acronyms

CC	Creative Commons
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, survey results, etc. (European Commission, 2016).
Data Set	A grouping of data
Digital Curation	Selection, preservation, maintenance and archiving of electronically stored data
DMP	Data Management Plan
EC	European Commission
ECSA	European Citizen Science Association
FAIR	Findable, Accessible, Interoperable and Reusable
GA	Grant Agreement
GDPR	General Data Protection Regulation
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
SWAfS	The Science with and for Society programme under Horizon 2020
TGM	Tools, Guidelines, Materials

Executive Summary

The aim of the EU-Citizen.Science project is to build a sustainable platform as a mutual learning space for citizen science in Europe through an inclusive and transparent approach. To achieve this aim, the project supports the development of a framework to identify, collect and share good quality citizen science resources and best practices.

This deliverable (D3.3) "Review of Framework Implementation" provides a review report on the implementation of the "Quality Criteria Framework for Resources" in practice, as developed in D3.1 "Framework describing criteria and rationale for sharing and selecting state of the art citizen science resources", which described the set of criteria and actions for identifying good quality citizen science resources for the EU-Citizen.Science platform.

The Quality Criteria Framework, which has been implemented for more than a year, is designed as an inclusive exercise that actively involves the community in decision-making. The framework ensures that a living and sustainable repository for high quality citizen science resources is made available on the platform for the community.

After a careful review of the implementation of the criteria framework for resources, the EU-Citizen.Science consortium has come to the conclusion that the criteria and their moderation will continue to be implemented by ECSA, who will take ownership of the platform after the end of the EU-Citizen.Science project.

1. Introduction

The aim of the EU-Citizen.Science project is to build a sustainable platform and mutual learning space to mainstream citizen science as a means to address societal challenges of our time and for the future. The platform will be the space where (i) initiatives, (ii) resources and (iii) outcomes that are relevant to citizen science are collected, curated, and made accessible to everyone, including volunteers, policy makers, media and academic institutions, among others.

This ambitious agenda is being pursued through the following complementary activities:

- coordination of citizen science actions and leveraging of existing resources in the presently fragmented landscape of citizen science in Europe;
- engagement of quadruple helix stakeholders at all levels (local, national and European); and
- creation of a platform that serves as a mutual learning space and a set of comprehensive training programs for different target audiences addressing their needs.

To achieve this, the EU-Citizen.Science consortium of 14 partners and 9 third parties from 14 European countries has adopted a transparent and inclusive approach to realizing these objectives and promoting interdisciplinary, cross-border, cross-sector collaboration. By consolidating activities, integrating knowledge and outputs, and increasing capacities at the local, national and global level, the EU-Citizen.Science platform aims to be 'the' knowledge hub for citizen science in Europe and beyond.

1.1 The Context of this Deliverable

The main purpose of Work Package 3 "Content - Framework, Quality Assurance and Curation" (WP3) within the EU-Citizen.Science work plan has been to develop a framework to identify and facilitate the collection and sharing of good-quality resources for citizen science as a practice, and then to apply this framework in gathering such resources for sharing on the platform, highlighting best practice and state of the art where possible. These resources include tools, guidelines, and materials that range from written texts, publications and guidelines, to toolkits, websites, videos, and software.

The main objectives of WP3 have thus been to:

- deliver a set of quality criteria and a living practical roadmap that help stakeholders define and identify:
    - citizen science resources and best practices, and
    - the quality of the aforementioned materials for selecting them in the frame of the EU-Citizen.Science portal; and
- curate resources that could be useful to facilitate engagement with citizen science among a broad range of actors – from inexperienced users to professionals, or from policy makers to career scientists; and
- identify gaps and needs in citizen science resources on the EU-Citizen.Science platform and recommend pathways on how to close those gaps.

The work of WP3 has been broken down into three essential tasks:

- Task 3.1 Criteria definition for collecting and sharing best practices in citizen science
- Task 3.2 Collating state of the art in citizen science resources (tools, guidelines and materials - TGMs)
- Task 3.3 Resources (TGMs) gap analysis and opportunity identification

The purpose of Task 3.1 "Criteria definition for collecting and sharing best practices in citizen science" was to develop a set of criteria and actions for defining and sharing state-of-the-art resources for conducting citizen science projects and initiatives in practice. This task culminated in the development of the "Quality Criteria Framework for Resources" described in Appendix 1, and the "Deliverable 3.1: Framework report describing criteria and rationale for sharing and selecting state of the art citizen science resources" (Fraisl et al., 2020).

This framework has provided a basis for the whole project, as the criteria for gathering and sharing resources on the EU-Citizen.Science platform, informing the gathering and sharing of citizen science projects, and feeding into the work of WP2 to design the platform, and the work of WP5 to design the training modules, as well as WP1 to establish close ties with other SwafS and RIA projects on citizen science.

After the submission of D3.1, the "Quality Criteria Framework for Resources" ('the Framework') was implemented with the launch of the EU-Citizen.Science platform, and has been put into practice across three releases of the platform:

- **The first release** of the EU-Citizen.Science platform was launched in **April 2020** with "starter content" that was selected by the Consortium partners (see: https://eu-citizen.science/blog/2020/07/17/starter-set-of-resources-and-our-selection/ for a description of this process), and members of the European citizen science community were invited to register on the platform, and start sharing their own citizen science projects and resources (see https://eu-citizen.science/blog/2020/05/12/our-first-month-behind/ for a description of this first launch phase).

- **The second release** of the platform in **September 2020** was timed to coincide with the ECSA2020 Conference to maximise awareness and interest in the platform, and to encourage more citizen science practitioners to share their citizen science projects and resources (see: https://eu-citizen.science/blog/2020/09/14/eu-citizenscience-video-teaser/ for a description of the new features in that release).

- **The third release** of the platform in **January 2021** introduced a newly integrated section for supporting and hosting citizen science training modules (see: https://eu-citizen.science/blog/2021/01/20/eu-citizenscience-evolving/ for a description of the new features in that release).

1.2 The Purpose of this Deliverable

The purpose of this deliverable is to report on the experience of implementing the Framework in practice, describe the activities within WP3 related to this implementation, and to report on any subsequent updates to the Framework as a result of this practical experience.

More specifically, this deliverable discusses:

- Whether the implementation of the Framework, which includes specific and supporting criteria, should still be handled within the project consortium, and how the sustainability of this "moderation" process will be ensured; and
- Whether the community could be mobilized and engaged in implementation of this moderation process (e.g., by providing feedback on resources already available on the platform, etc.).

2. Implementing the Quality Criteria Framework with the 'Starter' Content

As we prepared for the launch of the alpha version of the platform, we also wanted to have a comprehensive starter set of resources available for the wider citizen science community. This would contribute to fulfilling our aims for the platform, and also serve as a good example of the types of resources and projects we ask the community of citizen science practitioners and researchers to profile and share.

In collecting this "starter set" of content we took the opportunity to test the Framework by creating an input form in Google Forms that captured all of the mandatory metadata for describing the resource, but also implemented a checklist for the nine "specific criteria" as described in the deliverable D3.1 "Framework Report Describing Criteria and Rationale for Sharing and Selecting State of the art Citizen Science Resources" (Fraisl et al, 2020).

Starting with the resources that were suggested by the consortium members during our project kick-off meeting in Berlin and that were collected through the WP5 "Training Needs Survey", we asked each partner to use the Google Form (as illustrated in Table 1 below) to enter the descriptive information for the profile and evaluate the nine specific criteria for the resource on a five-point scale from 'strongly agree' to 'strongly disagree'. A simple macro built into the resulting spreadsheet allowed us to calculate whether the total rating exceeds the threshold for inclusion on the platform as a good quality resource (50% of the total highest points that a given resource could achieve based on the relevant questions that are applied to it).

Table 1: Data Entry Form & Quality Criteria Evaluation for Starter set of Resource Content

Step 1: Overarching Criteria
Criterion 1 (Required)**:** The resource is about citizen science or relevant to citizen science
Criterion 2 (Required)**:** The resource has the following metadata: • Title of the Resource • URL • Abstract • Resource category (i.e., guideline, tool, training resource, etc) • Resource audience • Keywords • Author (or project, or leading institution) • Language • Theme (i.e., engagement, communication, data quality, etc)
Criterion 3 (Suggested)**:** The resource engages with the 10 Principles of Citizen Science

Step 2: Specific Criteria	
Access to the resource	**1) The resource is easy to access** (e.g., registration process) **a.** Strongly Agree (e.g., completely open, no registration, such as a youtube video) **b.** Agree (e.g., optional registration or one click access to the resource through a social media registration) **c.** Neutral (e.g., average, undecided) **d.** Disagree (e.g., filling in a registration form) **e.** Strongly Disagree (e.g., complex registration process such as multiple steps to register or paid registration)
Readability and Legibility	**2) The resource is clearly structured according to the type of the resource** (e.g., if a scientific paper or a report, it includes an introduction, methodology, results, discussion and/or conclusions; or if a methodology document, it includes an introduction, audience description, step by step methodology, and an example, etc.) **a.** Strongly Agree **b.** Agree (e.g., clearly structured but the discussion doesn't reflect the introduction, etc.) **c.** Neutral **d.** Disagree **e.** Strongly Disagree (not clearly structured, very difficult to follow) **3) The resource has a clear language** (e.g., it is easy to read and understand for the intended target audience and it is concise – for example, if the intended user is a general audience, it is free from ambiguity, rare words and jargon; and when they need to be used, their meanings are explained clearly) **a.** Strongly Agree **b.** Agree **c.** Neutral **d.** Disagree **e.** Strongly Disagree **4) The resource pays attention to basic formatting** (e.g., titles, paragraphs and references are easy to capture; grammar and spelling is correct; legible font and sufficient font size is used) **a.** Strongly Agree **b.** Agree **c.** Neutral **d.** Disagree **e.** Strongly Disagree
Content	**5) The resource clearly describes its aims, goals and methods** **a.** Strongly Agree **b.** Agree **c.** Neutral **d.** Disagree **e.** Strongly Disagree

Applicability	**6) The resource is easy to implement** (it touches on how the resource could be implemented and the context in which it could be useful, and it provides recommendations for its further use) **a.** Strongly Agree **b.** Agree **c.** Neutral **d.** Disagree **e.** Strongly Disagree **7) The resource is easy to adapt to different cases** (it explains the limitations of the resource and the context in which it could be useful, and it provides guidelines or recommendations for its adaptation to different cases) **a.** Strongly Agree **b.** Agree **c.** Neutral **d.** Disagree **e.** Strongly Disagree
Object	**8) If the resource is an audio object, it is clearly audible** (no interruption, no background noise, etc.) **a.** Strongly Agree **b.** Agree **c.** Neutral **d.** Disagree **e.** Strongly Disagree **9) If the resource is a video, an image or illustration, the quality is good enough** (e.g. clear and sharp) **a.** Strongly Agree **b.** Agree **c.** Neutral **d.** Disagree **e.** Strongly Disagree
Step 3 - Supporting Criteria	

Evaluation	10. Was the resource used or is it currently being used in the context of citizen science or in a relevant initiative? (This could be answered based on the knowledge of the moderator/s and if the resource itself mentions this.) **a.** Yes, used with positive outcomes **b.** Yes, used with negative outcomes **c.** Yes, but the outcomes are not available or not known **d.** No, the resource has not yet been used in practice **e.** Don't know 11. Has the resource been evaluated before in terms of the content, methods and results? (This could be answered based on the knowledge of the moderator/s and if the resource itself mentions this.) **a.** Yes, evaluated with positive results **b.** Yes, evaluated with negative results **c.** Yes, evaluated with mixed results **d.** Yes, the results are not available or not known (no score - supporting argument) **e.** No, not evaluated **f.** Don't know
Impact	12. Does the resource refer to an impact (e.g., on science, policy, society, etc.) it had in the past and/or is currently having and/or it could have in the future? **a.** Yes, (reason to support the inclusion decision, if the result is good) **b.** No, (reason to exclude as this is a supporting criterion, but is just for info) **c.** Don't know 13. If the resource refers to an impact, has this been measured somehow? **a.** Yes, (reason to support the inclusion decision, if the result is good) **b.** No, (reason to exclude as this is a supporting criterion, but is just for info) **c.** Don't know
Step 4 - Our Selection	
Gold Star	Would you like to give this resource a gold star, for inclusion in the Curated List on the platform? ● Yes - this is a Gold Star resource, that should definitely be featured ● No - this is a good quality resource, but no gold star

The final question on our Google Form asked our consortium partners to indicate if the resource should be highlighted in the "Gold Star Resources" selection on the platform, thus allowing us to curate a short list of particularly useful or high-quality resources for citizen science practitioners.

This approach allowed us to both process a large number of resource evaluations in a reasonably short period of time, while also performing our first test of the Framework in practice. As the consortium partners are well established in the field of citizen science, they

were already familiar with (and able to identify) good quality citizen science resources that would easily meet our Quality Criteria. The first operational test of the Framework subsequently took place as we moderated the content submitted by the community after the first launch of the platform, as described further in Section 3.2 below.

3 Applying the Quality Criteria Framework in Practice

The central challenges faced in developing the Framework were:

- to identify "good quality citizen science resources" without attempting to create a set of universal rules or standards for inclusion or exclusion, which could risk limiting the development of new ideas and concepts in the field,
- to implement a well-defined and transparent moderation process, and a standardized methodology for that process to ensure that the resources being shared on the platform would be considered to be "good quality",
- to address the diverse needs and expectations of different target groups of the platform throughout the process,
- to integrate top-down and bottom-up approaches to defining quality that are both expert- and community driven, that empowers the community to take ownership of the process of identifying good quality citizen science resources, and
- to produce a sustainable framework that guides and influences how and in which areas new citizen science resources are developed.

The nature of the first challenge led us to defining 'good-quality citizen science resources' as: "*resources that are easy to access, implement and adapt; well structured; clearly described; written with a clear language and ideally have an impact (e.g., on science, policy or society, etc.); and therefore, useful to the citizen science community and beyond*" (Fraisl et al, 2020).

In order to describe these quality factors more accurately, we broke the wider category of "Resources" down into the subcategories of (i) tools, (ii) guidelines, (iii) training resources and (iv) other materials. 'Other materials' was then broken down further into (a) libraries, (b) scientific publications, (c) websites, (d) reports, (e) audio (f) visuals, and (g) miscellaneous. (See Appendix 2 for the definitions of these categories). These categories were built into the mandatory data fields for describing citizen science resources on the platform.

When applying these categories in practice, we discovered that they were not exactly aligned with the underlying information architecture of the platform, which was designed to be interoperable with other platforms by implementing open and shared metadata standards. The resulting update of the resource categories is described in Section 3.1 below.
The nature of other challenges led us to develop a light-touch moderation process that could be thorough without being too labour-intensive, to ensure good quality while also being

practical to implement. Such a light-touch process also ensures that moderation is sustainable over the anticipated long-term life of the platform. We describe the moderation process that was developed and revised based on our experience in Section 3.2, and describe a few of the other challenges experienced in practice in Section 3.3.

3.1 Updates to the Mandatory Data Fields for describing Citizen Science Resources

The information architecture of the EU-Citizen.Science platform describes the metadata structure, ontologies, and controlled vocabularies (see Table 1) that are implemented throughout in order to aid the organisation of content on the Platform, support the ability to search for and find relevant resources, and to ensure that the Platform is compatible and interoperable with other citizen science platforms, and thus able to share data across platforms via the application programming interfaces (APIs) described in Table 2.

Table 2: Definition of Metadata, Ontology, Controlled Vocabulary, and APIs

METADATA
Metadata is information that describes other data. Metadata is crucial to aiding the discovery and identification of content on the Platform. Descriptive metadata is information about a resource, including title, author and vocabulary to describe the content (e.g., the resource categories, etc.)
ONTOLOGY
Similarly, an ontology provides categories and concepts in a field in order to show properties and relations between the concepts, data and entities that are the subject of the metadata, i.e., the citizen science resources and tools to be shared on the Platform. The goal of having ontologies is to reduce complexity and organize information into a system of categories according to terminology that has been agreed upon within that field, so that data and knowledge are more easily shared.
CONTROLLED VOCABULARY
A controlled vocabulary is a list of terms that have been enumerated explicitly for use in a specific data field. This list is controlled by, and is available from, a controlled vocabulary registration authority such as Schema.org, PPSR, or Dublin Core. All terms in a controlled vocabulary should have an unambiguous, non-redundant definition. A controlled vocabulary may have no meaning specified, it can also just be a set of terms that people agree to use, and their meaning is understood, or it may have very detailed definitions for each term.
API
The term API stands for “application programming interface” and is a computing interface (usually a software programme) that defines and enables different websites, platforms or databases to interact with each other by sharing data. The API describes the kinds of data requests that can be

made, how to make them, and the data formats that should be used (such as which metadata schema and vocabularies to follow). The EU-Citizen.Science platform API (https://eu-citizen.science/swagger) allows other citizen science platforms to *pull* the featured project and resources descriptions into their own platforms, or to *push* their project and resource descriptions into the EU-Citizen.Science platform.

The EU-Citizen.Science platform information architecture implements the PPSR-Core metadata schema (https://core.citizenscience.org/), a set of data and metadata standards for **P**ublic **P**articipation in **S**cientific **R**esearch, for the mandatory data fields to describe the citizen science *projects* profiled on the Platform. For the mandatory data fields that describe the profiled *resources*, the Platform implements the Schema.org (https://schema.org) and Dublin Core (http://dublincore.org/specifications/dublin-core/dcmi-terms/) metadata schemas.

The Dublin Core schema is particularly well suited for describing both digital resources (such as video, images, web pages, etc.), and physical resources such as books or CDs. Dublin Core metadata is also very flexible, and may be used for multiple purposes, from simple resource description to combining metadata vocabularies of different metadata standards, to providing interoperability for metadata vocabularies in the linked data cloud and Semantic Web implementations. The Dublin Core Metadata Initiative (DCMI) Type Vocabulary provides a general, cross-domain list of approved terms that may be used as values for the Resource Type element to identify the genre of a resource; we have used this vocabulary to update the "Citizen Science Resource categories" described on the EU-Citizen.Science platform, namely:

- Collection
- Dataset
- Event
- Image
- Interactive Resource (Website)
- Moving Image (Video)
- Physical Object (Hardware)
- Service
- Software
- Sound
- Still Image
- Text

The definitions of these resource categories are provided in Appendix 2 of this report.

The 'Image' type includes both "Moving Image" and "Still Image" types, which is "a visual representation other than text". Examples include images and photographs of physical objects, paintings, prints, drawings, other images and graphics, animations; and moving pictures, film, diagrams, maps, musical notation. Note that Image may include both electronic

and physical representations (https://www.dublincore.org/specifications/dublin-core/dcmi-terms/).

Instead of requiring our users to first select 'Image', and then 'Still' or 'Moving', we exclude the overarching type of 'Image' and simply list 'Moving Image' and 'Still Image', to avoid confusion and an unnecessary step. Having both levels would not aid search results and having only the lower level will not hinder interoperability.

The resource types currently being used on the website map well against this new resource type vocabulary, allowing the Quality Criteria that have been developed to continue to be applied to the new vocabulary. The updated definitions are listed in Appendix 2 of this deliverable.

The one category of resources that will not be continued in the new vocabulary is "Training Resources", which are *"instructional materials about how to complete a citizen science task, or how to initiate and run a citizen science project and can include massive open online courses (MOOCs), workshops, webinars, gamified training, and quizzes"* (Fraisl et al, 2020). This is because Training Resources are now listed on the EU-Citizen.Science platform in their own content section, alongside Citizen Science Projects, Citizen Science Resources, and Citizen Science Training Materials. The resource type vocabulary will be applied identically to both Resources and Training Materials.

For the purposes of citizen science related resources on the platform, the "Text" category can be broken down further into a range of typical types of text within the context of this field, namely:

- Report
- Project Deliverable
- Guideline
- Policy Brief
- Scientific Publication
- White Paper / Green Paper
- Book
- Other

Definitions of this category and types are listed in Appendix 2.

3.2 The Moderation Process

In developing the Quality Criteria Framework, it was crucial to have a mechanism for ensuring that the resources profiled on the platform are of good quality. This led us to establishing (1) a set of *mandatory data fields* (e.g., author, year, title, abstract, etc.) for each resource profile to ensure that the descriptions are complete, and (2) a *moderation process* for all submissions to maintain oversight on the overall characteristics and quality of the resource content.

Thus, after a registered user of the platform has completed the mandatory data fields for the profile of their citizen science resource to be shared on the platform, the submitted profile is sent for moderation to the moderator, who is also the Community Manager of the EU-Citizen.Science platform. The Community Manager is a staff member of ECSA, one of the EU-Citizen.Science project partners, leading the Task 3.2 of the project, among others. Task 3.2 is about curating and maintaining the citizen science resources on the platform. ECSA will take over the platform and run it actively beyond the end of the project including the community management tasks and resources moderation process.

Until the moderator has reviewed the resource against the criteria, it will be marked as "not yet moderated" on the platform and will not be automatically visible in search results. Once moderated and found to be of good quality, it will be listed under the "moderated" category. Any conflict or inconsistency that may arise during the moderation process will be clarified with the submitter of the resource and the moderator. A joint decision will then be made on the inclusion of the resource in the EU-Citizen.Science platform.

The implementation steps of the Quality Criteria Framework presented in Table 1 are described in detail below.

3.2.1 STEP 1 - Overarching Criteria

The overarching criteria are the criteria that are applicable to all categories of resources. They include two required criteria and one suggested criterion that are described below.

3.2.1.1 Required Criteria

The first criterion that the moderator will look for, is that the resource is *about* citizen science or *relevant* to citizen science. Although there is no agreed definition of citizen science (citizen science remains a broad concept and a constantly developing field), we turn to the recent work conducted by the EU-Citizen.Science consortium with wider participation from the global citizen science community on the "Characteristics of Citizen Science" as guidance (Haklay et al., 2020). Users are requested to consult these characteristics if they are uncertain whether the resource really does relate to citizen science. If the moderator has concerns or clarifying questions, the user will be contacted directly.

3.2.1.2 Suggested Criteria

The moderator of a submitted resource will also consider whether it is in alignment with the 10 Principles of Citizen Science. This is a suggested criterion, which means that the moderator is encouraged to use it, if the type and the characteristic of the resource allows a meaningful evaluation. This means, based on the type or the complexity of a particular resource submitted, the moderator will decide if this suggested criterion will be applied during the

moderation process or not. For example, a water quality monitoring equipment does not necessarily need to engage with the 10 principles, but it is still a resource, or tool to be more precise, that could be useful in a water quality related citizen science project.

3.2.2 STEP 2 - Specific Criteria

For the resources to be shared on the platform, the EU-Citizen.Science project has developed a specific set of further criteria described below, which are assessed during the moderation process.

We consider good quality citizen science resources to be those that are easy to access, implement and adapt, are well structured, are clearly described and written in clear language, and ideally improve or support the desired impact of the initiative (e.g., on science, policy, society, etc.). The quality consideration, and thus the definition of "good quality citizen science resources", is developed based on the needs and expectations of the citizen science community presented in two of the WP2 deliverables of the project, namely (i) D2.1 Stakeholders, Network & Community Mapping Report, and (ii) D2.2 Multi-level Platform Engagement & Community Building Plan.

For this purpose, we have developed a range of criteria that the moderator will assess against a 5-point scale, from 'Strongly Disagree' (1 point) to 'Strongly Agree' (5 points):

- **Easy access to the resource:**
  - The resource should be easy to access, i.e., it doesn't require registration, and is not behind a paywall.
- **Readability and Legibility:**
  - The resource should be clearly structured according to the type of the resource. For example, a scientific paper or report should include an introduction, methodology, results, discussion and/or conclusions, and methodology documents should include an introduction, audience description, step by step methodology, and an example.
  - The resource should be written in clear language that is easy to read and understand for the intended target audience, and should be concise, unambiguous, and avoid the use of unusual words and jargon. Where technical terms are used, their meaning should be explained clearly.
  - The resource should pay attention to basic formatting, such as clear titles and paragraphs, correct grammar and spelling, a legible font of large enough size, and clearly marked references.
- **Clarity of Content:**
  - The resource should clearly describe its aims, goals and methods, so that it is easy for readers to understand how to apply the resource in their own context.

- **Applicability**:
  - The resource should be easy to implement, ideally with descriptions of how it can be implemented, the contexts that it is useful for, and recommendations for further use or development.
  - The resource should be easy to adapt to different cases, ideally with an explanation of any limitations of the resource and the context in which it could be useful, and with guidelines or recommendations for its adaptation to different cases.
- **Object Quality:**
  - If the resource is an audio object, it should be clearly audible, with no interruptions or background noise.
  - If the resource is a video, an image or illustration, the quality should be good enough to see clearly, with a sharp focus.

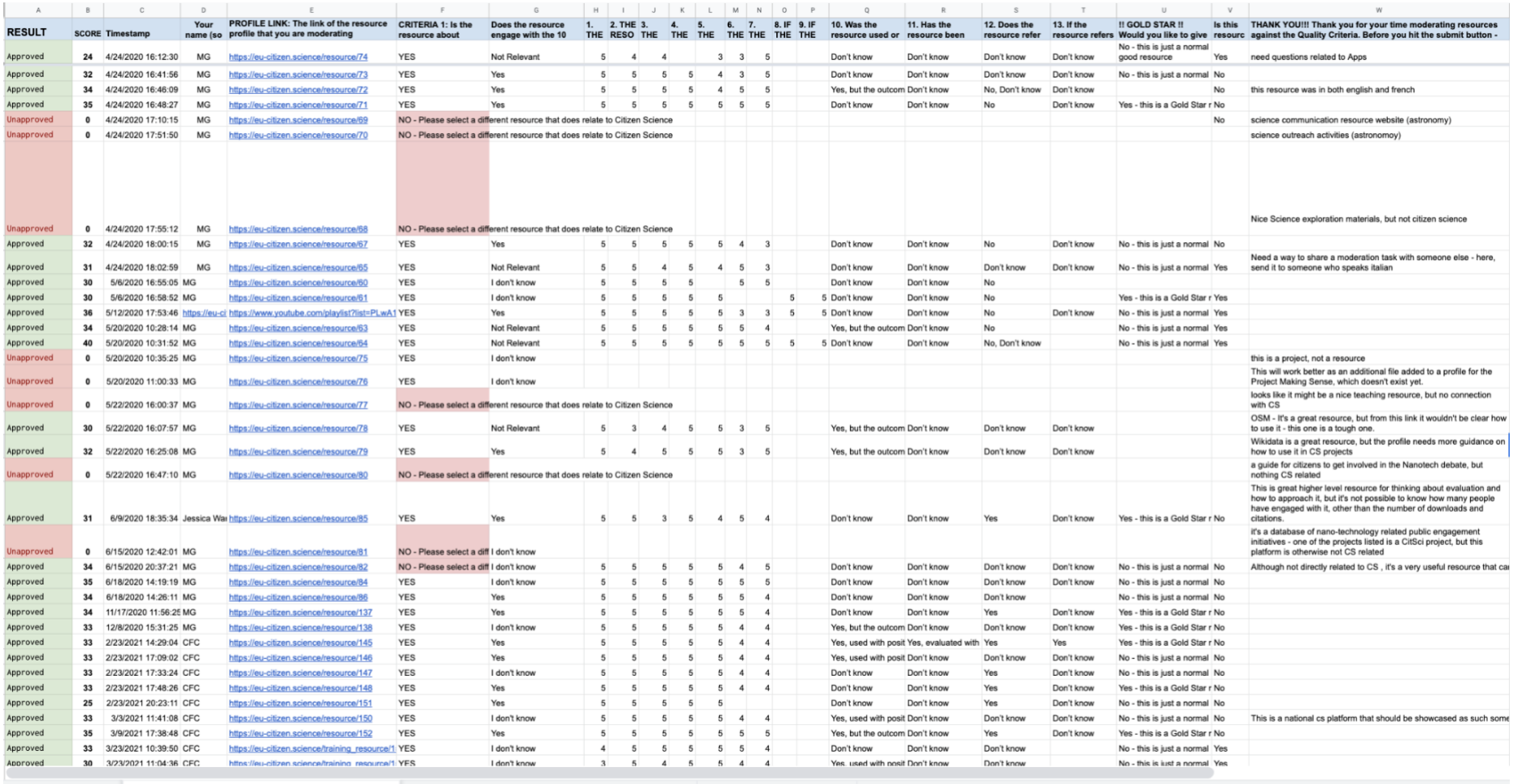
The highest possible score is 40 points, if all criteria are applicable. But in most cases, only a selection of the above criteria is applicable as the resources vary in type and content greatly. The moderator will look to see that a resource exceeds a score of 50% of the total possible points for that type of resource; this is the threshold for being listed on the platform as a good quality resource.

Figure 1 below shows the resource moderation checklist including the automatically calculated score and final decision as “approved” or “unapproved” on whether a resource will be featured on the platform as “good quality”.

For resources that have not met the Quality Criteria, the macro built into the moderation form shows that the calculation of the score falls short of the requirement and is marked as red instead of green. An additional space is provided in the moderation overview spreadsheet to indicate that the submitter of the Resource has been contacted to either request further information, or to explain in what way the Resource did not meet the Criteria, so that this can be addressed and the resource potentially resubmitted. A summary of this email contact is maintained in the far-right column.

Among the resources submitted to the platform, most have been approved. As of June 17, there are 126 resources submitted to be included in the platform, and 118 have met the quality criteria and thus been made available on the platform as good quality resources. The most common reason for not accepting a resource has been because it is a “project” according to our definition but indicated as a “resource” by the submitter; or is related to teaching on a scientific topic but does not include a citizen science element. In such cases, the moderator has contacted the submitter and explained why their submission has failed the moderation process, and then jointly worked on a solution depending on the context, e.g., if the submission is actually a “project” and thus belongs to the “projects” pages of the platform rather than the “resources” page, the moderation process for “projects” is applied.

It is important to highlight that the “projects” on the EU-Citizen.Science platform have a different moderation process than the “resources”, as the content and the concept of “quality” differ greatly in both categories. Additionally, the aim of WP3 and relevant tasks is to identify quality criteria for “resources”, and not for “projects”. However, the projects moderation process is influenced by and built on the resources moderation process, as the moderation process for resources has proved to be very effective in providing the community with the means to engage with the moderation process in an inclusive way, while at the same time allowing an expert-based review to ensure consistency and implementation of a standardized, yet flexible methodology that can address various needs and expectations of the community.



A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
RESULT	SCORE	Timestamp	Your name (so	PROFILE LINK: The link of the resource profile that you are moderating	CRITERIA 1: Is the resource about	Does the resource engage with the 10	1. THE	2. THE RESO	3. THE	4. THE	5. THE	6. THE	7. THE	8. IF THE	9. IF THE	10. Was the resource used or	11. Has the resource been	12. Does the resource refer	13. If the resource refers	!! GOLD STAR !! Would you like to give	Is this resourc	THANK YOU!!! Thank you for your time moderating resources against the Quality Criteria. Before you hit the submit button -
Approved	24	4/24/2020 16:12:30	MG	https://eu-citizen.science/resource/74	YES	Not Relevant	5	4	4		3	3	5			Don't know	Don't know	Don't know	Don't know	No - this is just a normal good resource	Yes	need questions related to Apps
Approved	32	4/24/2020 16:41:56	MG	https://eu-citizen.science/resource/73	YES	Yes	5	5	5	5	4	3	5			Don't know	Don't know	Don't know	Don't know	No - this is just a normal	No	
Approved	34	4/24/2020 16:46:09	MG	https://eu-citizen.science/resource/72	YES	Yes	5	5	5	5	4	5	5			Yes, but the outcom	Don't know	No, Don't know	Don't know		No	this resource was in both english and french
Approved	35	4/24/2020 16:48:27	MG	https://eu-citizen.science/resource/71	YES	Yes	5	5	5	5	5	5	5			Don't know	Don't know	No	Don't know	Yes - this is a Gold Star r	No	
Unapproved	0	4/24/2020 17:10:15	MG	https://eu-citizen.science/resource/69	NO - Please select a different resource that does relate to Citizen Science																No	science communication resource website (astronomy)
Unapproved	0	4/24/2020 17:51:50	MG	https://eu-citizen.science/resource/70	NO - Please select a different resource that does relate to Citizen Science																	science outreach activities (astronomoy)
Unapproved	0	4/24/2020 17:55:12	MG	https://eu-citizen.science/resource/68	NO - Please select a different resource that does relate to Citizen Science																	Nice Science exploration materials, but not citizen science
Approved	32	4/24/2020 18:00:15	MG	https://eu-citizen.science/resource/67	YES	Yes	5	5	5	5	5	4	3			Don't know	Don't know	No	Don't know	No - this is just a normal	No	
Approved	31	4/24/2020 18:02:59	MG	https://eu-citizen.science/resource/65	YES	Not Relevant	5	5	4	5	4	5	3			Don't know	Don't know	Don't know	Don't know	No - this is just a normal	Yes	Need a way to share a moderation task with someone else - here, send it to someone who speaks italian
Approved	30	5/6/2020 16:55:05	MG	https://eu-citizen.science/resource/60	YES	I don't know	5	5	5	5		5	5			Don't know	Don't know	No				
Approved	30	5/6/2020 16:58:52	MG	https://eu-citizen.science/resource/61	YES	I don't know	5	5	5	5	5			5	5	Don't know	Don't know	No		Yes - this is a Gold Star r	Yes	
Approved	36	5/12/2020 17:53:46	https://eu-ci	https://www.youtube.com/playlist?list=PLwA1	YES	Yes	5	5	5	5	5	3	3	5	5	Don't know	Don't know	No	Don't know	No - this is just a normal	Yes	
Approved	34	5/20/2020 10:28:14	MG	https://eu-citizen.science/resource/63	YES	Not Relevant	5	5	5	5	5	5	4			Yes, but the outcom	Don't know	No		No - this is just a normal	Yes	
Approved	40	5/20/2020 10:31:52	MG	https://eu-citizen.science/resource/64	YES	Not Relevant	5	5	5	5	5	5	5	5	5	Don't know	Don't know	No, Don't know		No - this is just a normal	Yes	
Unapproved	0	5/20/2020 10:35:25	MG	https://eu-citizen.science/resource/75	YES	I don't know																this is a project, not a resource
Unapproved	0	5/20/2020 11:00:33	MG	https://eu-citizen.science/resource/76	YES	I don't know																This will work better as an additional file added to a profile for the Project Making Sense, which doesn't exist yet.
Unapproved	0	5/22/2020 16:00:37	MG	https://eu-citizen.science/resource/77	NO - Please select a different resource that does relate to Citizen Science																	looks like it might be a nice teaching resource, but no connection with CS
Approved	30	5/22/2020 16:07:57	MG	https://eu-citizen.science/resource/78	YES	Not Relevant	5	3	4	5	5	3	5			Yes, but the outcom	Don't know	Don't know	Don't know			OSM - It's a great resource, but from this link it wouldn't be clear how to use it - this one is a tough one.
Approved	32	5/22/2020 16:25:08	MG	https://eu-citizen.science/resource/79	YES	Yes	5	4	5	5	5	3	5			Yes, but the outcom	Don't know	Don't know	Don't know			Wikidata is a great resource, but the profile needs more guidance on how to use it in CS projects
Unapproved	0	5/22/2020 16:47:10	MG	https://eu-citizen.science/resource/80	NO - Please select a different resource that does relate to Citizen Science																	a guide for citizens to get involved in the Nanotech debate, but nothing CS related
Approved	31	6/9/2020 18:35:34	Jessica Wa	https://eu-citizen.science/resource/85	YES	Yes	5	5	3	5	4	5	4			Don't know	Don't know	Yes	Don't know	Yes - this is a Gold Star r	No	This is great higher level resource for thinking about evaluation and how to approach it, but it's not possible to know how many people have engaged with it, other than the number of downloads and citations.
Unapproved	0	6/15/2020 12:42:01	MG	https://eu-citizen.science/resource/81	NO - Please select a diff	I don't know																it's a database of nano-technology related public engagement initiatives - one of the projects listed is a CitSci project, but this platform is otherwise not CS related
Approved	34	6/15/2020 20:37:21	MG	https://eu-citizen.science/resource/82	NO - Please select a diff	I don't know	5	5	5	5	5	4	5			Don't know	Don't know	Don't know	Don't know	No - this is just a normal	No	Although not directly related to CS , it's a very useful resource that ca
Approved	35	6/18/2020 14:19:19	MG	https://eu-citizen.science/resource/84	YES	I don't know	5	5	5	5	5	5	5			Don't know	Don't know	Don't know	Don't know	No - this is just a normal	No	
Approved	34	6/18/2020 14:26:11	MG	https://eu-citizen.science/resource/86	YES	Yes	5	5	5	5	5	5	4			Don't know	Don't know	Don't know		No - this is just a normal	No	
Approved	34	11/17/2020 11:56:25	MG	https://eu-citizen.science/resource/137	YES	Yes	5	5	5	5	5	5	4			Don't know	Don't know	Yes	Don't know	Yes - this is a Gold Star r	No	
Approved	33	12/8/2020 15:31:25	MG	https://eu-citizen.science/resource/138	YES	I don't know	5	5	5	5	5	4	4			Yes, but the outcom	Don't know	Don't know	Don't know	Yes - this is a Gold Star r	No	
Approved	33	2/23/2021 14:29:04	CFC	https://eu-citizen.science/resource/145	YES	Yes	5	5	5	5	5	4	4			Yes, used with posit	Yes, evaluated with	Yes	Yes	Yes - this is a Gold Star r	No	
Approved	33	2/23/2021 17:09:02	CFC	https://eu-citizen.science/resource/146	YES	Yes	5	5	5	5	5	4	4			Yes, used with posit	Don't know	Don't know	Don't know	No - this is just a normal	No	
Approved	33	2/23/2021 17:33:24	CFC	https://eu-citizen.science/resource/147	YES	I don't know	5	5	5	5	5	4	4			Don't know	Don't know	Yes	Don't know	No - this is just a normal	No	
Approved	33	2/23/2021 17:48:26	CFC	https://eu-citizen.science/resource/148	YES	Yes	5	5	5	5	5	4	4			Don't know	Don't know	Yes	Don't know	Yes - this is a Gold Star r	No	
Approved	25	2/23/2021 20:23:11	CFC	https://eu-citizen.science/resource/151	YES	Yes	5	5	5	5	5					Don't know	Don't know	Yes	Don't know	No - this is just a normal	No	
Approved	33	3/3/2021 11:41:08	CFC	https://eu-citizen.science/resource/150	YES	I don't know	5	5	5	5	5	4	4			Yes, used with posit	Don't know	Don't know	Don't know	No - this is just a normal	No	This is a national cs platform that should be showcased as such some
Approved	35	3/9/2021 17:38:48	CFC	https://eu-citizen.science/resource/152	YES	Yes	5	5	5	5	5	5	5			Yes, but the outcom	Don't know	Don't know	Don't know	Yes - this is a Gold Star r	No	
Approved	33	3/23/2021 10:39:50	CFC	https://eu-citizen.science/training_resource/1	YES	I don't know	4	5	5	5	5	5	4			Don't know	Don't know	Don't know		No - this is just a normal	Yes	
Approved	30	3/23/2021 11:04:36	CFC	https://eu-citizen.science/training_resource/1	YES	I don't know	3	5	4	5	5	4	4			Yes, used with posit	Don't know	Don't know		No - this is just a normal	Yes	

Figure 1: Screenshot showing the Structure of the Resource Moderation Checklist

As it is the EU-Citizen.Science approach to resources, projects and other related content and aspects of citizen science to always be inclusive and community-oriented, we both *inform* a submitter of why a submission is not accepted and provide them with *guidance* on how to address this and resubmit. We thus seek a balance that keeps inclusiveness, transparency and the complex, constantly growing nature of the field of citizen science, as well as diverse needs of the community in focus. At the same time, we aim to produce a standardized approach and a workflow that helps us identify good quality citizen science resources in a transparent way. Through this approach, we can implement a framework that defines quality based on community needs *and* expectations from the EU-Citizen.Science platform.

3.2.3 STEP 3 - Supporting criteria

The supporting criteria are suggested to the moderator to implement while making a decision regarding whether a resource should be featured on the platform as good quality. The moderator is *encouraged to consider* them to strengthen their argument on whether the resource should be on the platform. In other words, supporting criteria will only be used to aid moderators in better evaluating the quality of a resource (particularly if/when in doubt).

The moderator takes these supporting criteria into consideration if there is evidence of these criteria being met, and the supporting criteria are not part of the threshold calculation of the specific criteria mentioned above. The reason for this is that not all resources may apply impact measurement or evaluation methods due to various reasons such as funding availability. However, an absence of evaluations/measurements should by no means be interpreted as the resource being of lesser quality. For example, measuring impact is an area that is currently being explored in the field of citizen science, and thus not very common yet. However, if there are resources that have already measured impact and found positive results, this is an important point to consider while making a decision on their quality.

3.2.3.1 Evaluation

The resource has been used in the context of citizen science, or it is currently being used in a citizen science initiative, and the outcome of this has been shared. The resource has been evaluated in terms of the quality of the content, or the methods, or the results of the method, and the outcomes of these evaluations have been shared.

3.2.3.2 Impact

The resource refers to any impact that it could have (or has had) on science, policy, society, etc. The impact of the resource has been measured and is shared in the resource.

Figure 2 illustrates the workflow that is described above, and a more detailed description of this workflow is presented in D3.1 (Fraisl et al., 2020).

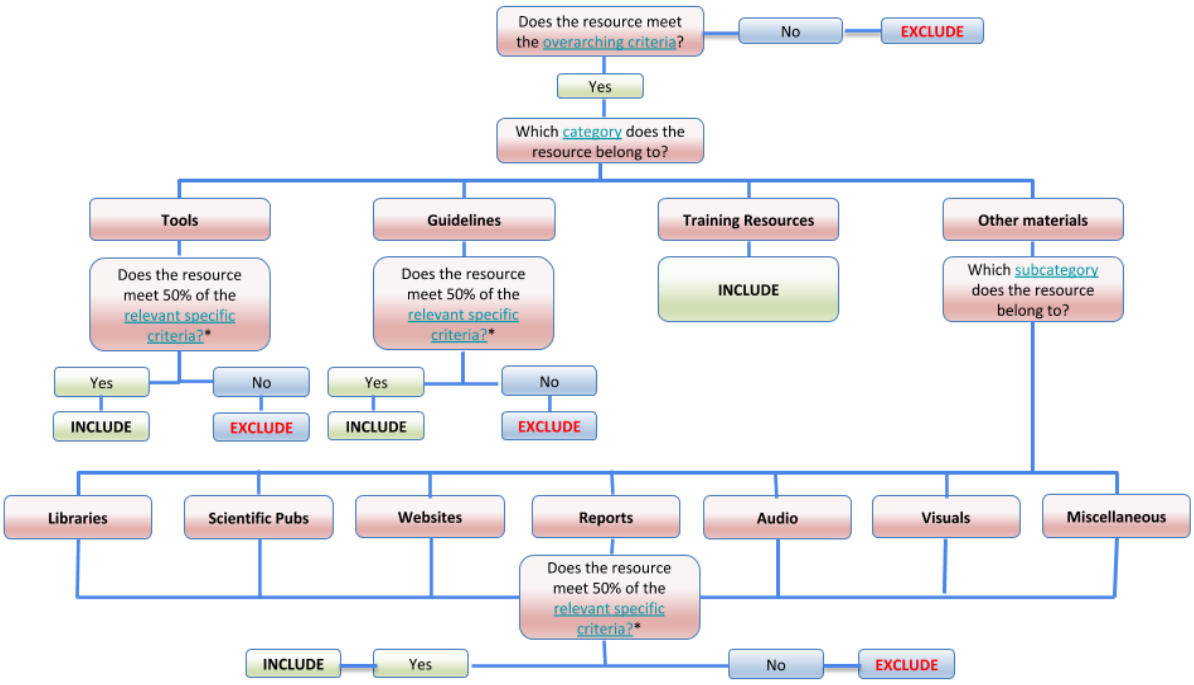


Figure 2: Quality criteria framework workflow

3.2.4 STEP 4 - Gold Star Selection

The final step of the moderation process is to flag whether or not a resource should be featured in the "Gold Star" section of the platform, which is the short list of exceptionally high-quality resources that is curated by the EU-Citizen.Science consortium as 'Our Selection'.

3.2.5 Applying the Quality Criteria to Projects and Training

Although the Quality Criteria were developed specifically for moderating the "Resources" shared on the platform, a moderation process was also required for Projects and Training Materials submitted to the platform. The process described above also informed the moderation process for other submissions to the platform by implementing the same "**Required Criteria"** that the Projects profiled be citizen science projects, and the Training profiled be related and relevant to citizen science.

Thus, the first criterion that the moderator will look for, is that the project or training being submitted is *about* citizen science or *relevant* to citizen science. The guidance for determining what citizen science is, continues to be based on the ECSA Characteristics of Citizen Science (Haklay et al., 2020). Similarly, users are requested to consult these characteristics if they are uncertain whether the project or training, they would like to share really does relate to citizen science. If the moderator has concerns or clarifying questions, they will contact the submitter directly.

We similarly applied the same **Suggested Criteria** to the moderation process for Projects and Training, so that the moderator considers whether a submitted project or training is in alignment with the 10 Principles of Citizen Science (ECSA, 2015).

The **Specific Criteria** for submitted Projects and Training, relate to a minimum set of information being provided (the required metadata). No further Quality Criteria are applied in the case of Projects or Training submitted to the Platform.

3.3 Challenges in applying the Quality Criteria

Challenges highlighted in Section 3 led us to developing different 'layers' to the Quality Framework including (i) "required" criteria that are applicable to all categories of resources, (ii) a set of "specific" and "supporting" criteria to provide guidelines for how to decide what "good quality" is, and finally (iii) a rating system and a feedback tool that allows the community to decide which resources are most useful for them.

This approach was considered to be the best way to address the diverse needs and expectations of different target groups of the platform, as well as being easier to apply and implement during the EU-Citizen.Science project lifetime and beyond. It empowers the community to have a say in the process in an inclusive way through submitting resources and providing feedback for the available resources on the platform, which makes it more sustainable and dynamic.

While implementing the criteria framework, various challenges have emerged. Some of these challenges have already been addressed as described in Section 3.1, including the need for aligning the process with the underlying architecture of the platform, which was designed to be interoperable with other platforms to implement open and shared metadata standards. Other challenges are currently being addressed by the developer team, and their testing is expected to be finalized in month 30 of the project (around the same time that this deliverable is submitted). These additional challenges and how they are being addressed is briefly described below:

- For resources submitted to the platform by the community in languages other than English, the moderation process currently takes place after the translation of the resource submission form to English using Google Translate, which takes additional time for the moderator. Google Translate can be quite accurate, and based on experience, it is sufficient to translate the most important parts of a resource to help implement the criteria framework and identify the quality of a resource, such as the abstract, introduction, methodology, conclusions, etc. However, this translation process needs to be automated and included in the moderation form. In future developments of the platform, it is planned to add an automated translation of the resource form submitted by users to make the moderation process quicker in case the moderator does not speak the language in which the resource profile has been

submitted. We believe this will help improve efficiency and productivity in the moderation process. There are currently (on 17 June 2021) 118 resources on the platform, 86 of which are in English and 32 in other languages. The expectation of the community on resources being available in different languages on the platform is also growing. Addressing the needs of the community, while at the same time being consistent in applying the Quality Criteria to all types of resources aligns with the inclusive nature of the EU-Citizen.Science project and the platform.

- Currently, the link between the resource and citizen science, as one of the required criteria, is being evaluated based on the knowledge and expertise of the moderator. When in doubt, the moderator discusses the resource with the submitter via email. However, due to the inclusive and community-led approach of the platform, we invite the opinion of the submitter on how they make the link between citizen science and the resource right at the start, while they are in the process of submitting the resource using the resource submission form. This will also help the moderator reduce the time needed to identify that link in order to evaluate the resource's quality based on the criteria framework. To address this challenge, a question and an open text field was added to the resource submission form that asks the user to describe the link between citizen science and the resource they are uploading. For guidance on making the link between citizen science and the uploaded resource, the user is recommended to consult the ECSA Characteristics of Citizen Science (Haklay et al., 2020), as well as the ECSA 10 Principles of Citizen Science (ECSA, 2015). This functionality in the moderation form is currently being tested and will be operational in month 30 of the project.

To summarize, all the challenges mentioned in Section 3 regarding the implementation of the criteria framework for resources have either already been addressed since the submission of the D3.1 on the Criteria Framework in March 2020 or are currently being addressed and tested.

4 Sustainability of the Resources Moderation Process

In D3.1, we highlighted that the use of the moderation process after the project ends will be assessed based on the number of resources uploaded by the community to the platform, as well as how well the community is engaged with the platform through the end of the project. We also mentioned that we would evaluate (i) if the implementation could be continued within the project consortium, (ii) if the community could be engaged in the implementation of the moderation process, and (iii) if we could still ensure good quality resources on the platform in case the criteria questions would be made optional for uploading a resource.

The application of the criteria framework has already proved to be a useful and efficient process in addressing the community needs and identifying the quality of citizen science resources using a simple, standardized, and yet flexible methodology that could be adapted to different contexts, needs and types of resources.

After carefully reviewing the current situation concerning the existing resources on the platform, the number and content of uploads by the community and how much time it requires to apply the moderation process, the EU-Citizen.Science consortium would like to continue using the criteria framework as described above under ECSA's leadership as the new "host" of the platform after the end of the project. ECSA has been leading the efforts within the consortium in implementing the criteria framework, and the consortium sees the need to continue using the moderation process after the project ends.

In terms of mobilizing the community and engaging them in implementing the criteria framework, this is already addressed through involving the user in the decision-making process on how the resource they submit is linked to citizen science. This information provided by the user is considered by the moderator during the moderation process. For the rest of the moderation, the community-building efforts around the platform are still ongoing. At this stage, a full community engagement is not yet established, and the platform is still under development. Hence, it is too early to make the decision on fully engaging with the community in the moderation process, which might jeopardize the intended use of the criteria framework, and its successful implementation due to insufficient community interest.

As the purpose of the EU-Citizen.Science project is to present high-quality citizen science resources on the platform to serve the needs of the community, full implementation of the criteria framework is of utmost importance to the project consortium. Therefore, ECSA will ensure that the quality assessment remains a priority of platform management as part of the legacy of the EU-Citizen.Science project. At a later stage, once community-building efforts result in active user engagement, the idea of involving the community fully in the application of the criteria framework will be reconsidered.

5 Conclusion

This deliverable presents a review of the application of the "Quality Criteria Framework for Resources", developed in D3.1 "Framework describing criteria and rationale for sharing and selecting state of the art citizen science resources", which described the criteria for identifying high quality citizen science resources for the EU-Citizen.Science platform.

Identifying quality criteria for resources in the field of citizen science, which is constantly developing, was a quite challenging, yet valuable process for addressing the needs and expectations of the community from the EU-Citizen.Science platform. Both the identification

and implementation processes that have been used for over a year now are designed as inclusive exercises that actively involve the community in decision-making. The process integrates top-down and bottom-up perspectives of both experts and the community to ensure that high quality resources are shared, and a living and sustainable repository for citizen science resources is made available on the platform for the community. At the same time, the approach has been to empower the community to take ownership of the process and be an active part in identifying and producing good quality resources.

After a careful review of the implementation of the criteria framework for resources for more than a year, the EU-Citizen.Science consortium has come to the conclusion that the criteria and their moderation will continue to be implemented by ECSA, who will take ownership of the platform after the end of the EU-Citizen.Science project. ECSA has already made resources available for the full implementation of the criteria framework and the moderation process, as described above. This will not only ensure the sustainability of the platform, but also empower the community in participating in the efforts to define and identify high quality resources, promote high quality content in existing and future citizen science resources and throughout the whole platform.

References

ECSA (2015). Ten principles of citizen science. European Citizen Science Association. Available at: https://osf.io/xpr2n/

Fraisl, D., Hager, G., See, L. (2020). Framework report describing criteria and rationale for sharing and selecting state of the art citizen science Resources. D3.1 of the EU-Citizen.Science project funded under the European Union's Horizon 2020 research and innovation programme GA No: 824580. Available at: https://zenodo.org/record/3716236#.YJJbcX0zY6A

Haklay, Muki, Motion, Alice, Balázs, Bálint, Kieslinger, Barbara, Greshake Tzovaras, Bastian, Nold, Christian, et al. (2020). ECSA's Characteristics of Citizen Science. Zenodo. http://doi.org/10.5281/zenodo.3758668

APPENDIX 1 - The Quality Criteria Framework for Resources

Our ambitious goal is to become the place to share useful resources about planning and running citizen science initiatives, including tools and guidelines, best practices and training modules. We hope to make practical citizen science project guidance findable and accessible to all and enable people to initiate their own activities wherever they are. It is therefore very important to us, and the community of practitioners, that we have a way of ensuring that the resources shared and profiled on the platform are indeed of good quality, and valuable to the community.

What are citizen science resources?

They are resources and practices that could be used for help and support in the context of citizen science - they can help individuals, projects or organizations to understand, plan, implement and evaluate citizen science and citizen science practices, and demonstrate the value of citizen science to different audiences. Resources can include documents such as how-to guides, publications, reports, policy briefs, and protocols; technical tools such as software or hardware; other file formats such as videos, podcasts, and diagrams; and even websites or webpages.

What are good-quality citizen science resources?

They are resources that are easy to access, implement and adapt; well structured; clearly described; written with a clear language and ideally have an impact (e.g., on science, policy or society, etc.); and therefore, useful to the citizen science community and beyond.

We have developed the following set of required and suggested quality criteria as a way of ensuring that the resources that you can find on this platform are indeed of good quality. You can read more about how we developed these in the blog post 'How we developed the quality criteria for resources'.

When you are creating a profile for a resource to share on the platform, please ensure that it meets all of the mandatory criteria, and as many of the suggested criteria as possible.

The overarching criteria

Required criteria for all resources

1. The resource must be about citizen science or relevant to citizen science

Although there are no hard and fast definitions of what citizen science is and is not (nor should there be - citizen science should always remain a broad and inclusive concept), we can turn to the recent work conducted by the citizen science practitioner community on the Characteristics of Citizen Science as guidance. If you are uncertain whether the resource you would like to share really does relate to citizen science, please consult these Characteristics.

2. The mandatory information fields in the resource profile must all be completed.

The purpose of this requirement is to ensure that all resources have sufficient information provided about them to enable users of the platform to see whether it is useful or relevant to them. It will not be possible to submit your profile without this information. The mandatory data fields are:

- Title of the Resource
- URL
- Abstract
- Description of Citizen Science Aspects (as of May 2021)
- Resource category (i.e., guideline, tool, training resource, etc)
- Resource audience
- Keywords
- Author (or project, or leading institution)
- Language
- Theme (i.e., engagement, communication, data quality, etc)

Suggested criteria for all resources

3. The resource engages with the 10 Principles of Citizen Science

A great source of guidance on what can determine the quality of a resource are the 10 Principles of Citizen Science, but we recognise that it is not possible to treat those as a checklist of requirements to meet, as sometimes they simply won't apply. We therefore ask that you ensure that the resource you are sharing does reasonably 'engage' or 'align' with the 10 Principles and is in keeping with the ethos of the principles.

Specific criteria

We consider good quality citizen science resources to be those that are easy to access, implement and adapt, are well structured, are clearly described and written in clear language, and ideally improve or support the desired impact of the initiative (e.g., on science, policy or society, etc).

When submitting a resource please ensure that it meets as many of these criteria as possible:

- **Easy access to the resource:** the resource should be easy to access, i.e., it doesn't require registration, and is not behind a paywall.

- **Readability and Legibility:**
  - The resource should be **clearly structured** according to the type of the resource. For example, a scientific paper or report should include an introduction, methodology, results, discussion and/or conclusions, and methodology documents should include an introduction, audience description, step by step methodology, and an example.
  - The resource should be written in **clear language** that is easy to read and understand for the intended target audience, and should be concise, unambiguous, and avoid the use of unusual words and jargon. Where technical terms are used, their meaning should be explained clearly.
  - The resource should pay attention to **basic formatting**, such as clear titles and paragraphs, correct grammar and spelling, a legible font of large enough size to read, and clearly marked references.

- **Clarity of Content:** The resource should clearly describe its aims, goals and methods, so that it is easy for readers to understand how to apply the resource in their own context.

- **Applicability:**
  - The resource should be **easy to implement**, ideally with descriptions of how it can be implemented, the contexts that it is useful for, and recommendations for further use or development.
  - The resource should be **easy to adapt** to different cases, ideally with an explanation of any limitations of the resource and the contexto in which it could be useful, and with guidelines or recommendations for its adaptation to different cases.

- **Object Quality:**
  - If the resource is an audio object, it should be **clearly audible**, with no interruptions or background noise.

- If the resource is a video, an image or illustration, the quality should be good enough to **see clearly**, with a sharp focus.

When you submit a resource profile to the platform, a moderator from the EU-Citizen.Science team will check the relevant aspects of your resource against these criteria, to ensure that the majority of these criteria have been met. Until these have been checked, it will be marked as 'not yet moderated' on the platform and will not automatically be visible in search results.

Supporting criteria

It really enhances the value and quality of your resources when you can say something about how it has been used and developed further in practice, and whether or not it has been evaluated for usefulness and applicability in practice. The moderator will also take it into positive consideration if there is evidence of the following criteria being met (but these are not part of the threshold calculation mentioned above):

- **Evaluation**:
  - The resource has been used in the context of citizen science or is currently being used in a citizen science initiative, and the outcome of this has been shared.
  - The resource has been evaluated in terms of the quality of the content, or the methods, or the results of the method, and the outcomes of these evaluations have been shared.

- **Impact**
  - The resource refers to any impact that it could have (or has had) on science, policy, society, etc.
  - The impact of the resource has been measured and is shared in the resource.

APPENDIX 2 - Relevant Definitions and Categories

The first step in identifying quality criteria for citizen science resources was to agree on what is meant by "citizen science resources" and "good quality citizen science resources'' in the context of the EU-Citizen.Science project.

We defined ***citizen science resources*** as "*resources and practices that could be used for help and support in the context of citizen science*". Citizen science resources can help an individual, a project or an organization to understand, implement and evaluate citizen science and citizen science practices, and demonstrate the value of citizen science to different audiences.

G*ood-quality citizen science resources* are "*resources that are easy to access, implement and adapt; well structured; clearly described; written with a clear language and ideally have an impact (e.g., on science, policy or society, etc.); and therefore, useful to the citizen science community and beyond".*

Once we agreed on the definitions, the next step was to identify the categories of these resources. As the concept of resources is quite broad, a classification was required. Based on the EU-Citizen.Science project description and the needs and expectations of the community presented in the WP2 deliverables summarized in section 2.4 above, (i) tools, (ii) guidelines, (iii) training resources and (iv) other materials were selected as categories of resources in the context of the project. The definitions of these categories are described below:

> ***Tools*** are *"any software or hardware to help perform a particular task or work in citizen science initiatives (e.g., water quality equipment, air quality sensors, etc.)"*.
>
> ***Guidelines*** are *"a set of rules and instructions that could be helpful in designing, implementing or evaluating citizen science or initiatives relevant to citizen science. Guidelines are* ***written texts*** *such as reports, deliverables, briefings, etc.".*
>
> ***Training resources*** *are "some form of instructional material in relation to citizen science often related to 'how to do' citizen science. Some examples include MOOCs, (online) workshops, webinars, gamified training, quizzes, etc.".*
>
> ***Other Materials*** are *"resources other than "tools", "guidelines" and "training resources" that are about or relevant to citizen science".*

As other materials address a broad spectrum of resources, it would be difficult to identify how the overarching criteria could be applied and which specific and supporting criteria would be relevant to them. Therefore, the project partners agreed to classify other materials in seven categories described below:

> ***Libraries:*** *An organized set of resources such as databases, repositories, toolkits and toolboxes that bring together relevant documents for a particular purpose in citizen science initiatives.*
>
> ***Scientific publications:*** *Publications where scientific knowledge on citizen science is shared.*
>
> ***Websites:*** *Websites, platforms, webpages where citizen science related content is published.*
>
> ***Reports:*** *A document that presents information on citizen science or on topics relevant to citizen science.*
>
> ***Audio:*** *Any resource with sound that includes citizen science related content such as podcasts, audio books, radio broadcasts, etc.*
>
> ***Visuals:*** *Any resource that includes visual content such as videos, diagrams, figures, illustrations, etc.*
>
> ***Miscellaneous:*** *Any resource that does not fit the definitions of the first 6 subcategories under "other materials".*

Note that these definitions are not designed to be exclusive, but just as guidance to help moderators to decide on the category for each resource, as one resource may fall under different categories and terms.

Additional consideration is that we agreed to handle citizen science projects differently than the citizen science resources within the platform. This is because these projects will not follow the same quality criteria structure as the categories of resources defined above due to their diverse and unique nature. Instead, citizen science characteristics described in section 3.2.1 will be used as a basis for selecting citizen science projects that will be listed on the platform.

Following the step where we identified the appropriate classifications and definitions for the platform, we defined the overall approach to determine the processes of implementation. We agreed on a combination of two methods: (i) a top-down approach to establish criteria to build a repository of resources and (ii) a more democratic, bottom-up approach to allow users to

collaborate in the process of resource selection and inclusion. These steps are described in the following sections.

Updated Resource Type Definitions

TYPE	Dublin Core definition	EU-Citizen.Science definition
Collection	An aggregation of resources. A collection is described as a group; its parts may also be separately described.	Collections can include organized sets of technical resources such as databases, repositories, libraries, toolkits and toolboxes that bring together relevant resources for a particular purpose in citizen science initiatives.
Dataset	Data encoded in a defined structure. Examples include lists, tables, and databases. A dataset may be useful for direct machine processing.	Same definition will be adopted for EU-Cizien.Science.
Event	A non-persistent, time-based occurrence. Metadata for an event provides descriptive information that is the basis for discovery of the purpose, location, duration, and responsible agents associated with an event. Examples include an exhibition, webcast, conference, workshop, open day, performance, battle, trial, wedding, tea party, conflagration.	Same definition will be adopted for EU-Cizien.Science.
Image	A visual representation other than text. Examples include images and photographs of physical objects, paintings, prints, drawings, other images and graphics, animations and moving pictures, film, diagrams, maps, musical notation. Note that Image may include both electronic and physical representations	Visual resources are visual content related to citizen science such as videos, diagrams, figures, illustrations, etc.
Interactive Resource (Website)	A resource requiring interaction from the user to be understood, executed, or experienced. Examples include forms on Web pages, applets, multimedia learning objects, chat services, or virtual reality environments.	Websites and webpages are online sites where citizen science related guidance, experience, and knowledge is published and shared.

Moving Image (Video)	A series of visual representations imparting an impression of motion when shown in succession. Examples include animations, movies, television programs, videos, zoetropes, or visual output from a simulation. Instances of the type Moving Image must also be describable as instances of the broader type Image.	Same definition will be adopted for EU-Cizien.Science (this is a subcategory of "image").
Physical Object (Hardware)	An inanimate, three-dimensional object or substance. Note that digital representations of, or surrogates for, these objects should use Image, Text or one of the other types.	Physical objects can include hardware and equipment that support a particular task in citizen science initiatives, such as water quality equipment, air quality sensors, etc.
Service	A system that provides one or more functions. Examples include a photocopying service, a banking service, an authentication service, interlibrary loans, a Z39.50 or Web server.	Same definition will be adopted for EU-Cizien.Science.
Software	A computer program in source or compiled form. Examples include a C source file, MS-Windows .exe executable, or Perl script.	Software can include mobile applications that support a particular task in citizen science initiatives, or data analysis tools that enable the processing of citizen science data.
Sound	A resource primarily intended to be heard. Examples include a music playback file format, an audio compact disc, and recorded speech or sounds.	Audio resources are sound files with citizen science related content such as podcasts, audio books, radio broadcasts, etc.
Still Image	A static visual representation. Examples include paintings, drawings, graphic designs, plans and maps. Recommended best practice is to assign the type Text to images of textual materials. Instances of the type Still Image must also be describable as instances of the broader type Image.	Same definition will be adopted for EU-Cizien.Science (this is a subcategory of "image").
Text	A resource consisting primarily of words for reading. Examples include books, letters, dissertations, poems, newspapers, articles, archives of mailing lists. Note that facsimiles or images of texts are still of the genre Text.	A resource consisting primarily of words for reading. Text will have the following subcategories: guideline, report, book, scientific publication, policy brief, project deliverable, white or green paper, working paper and other.

Report	n/a	Reports are documents that present information on citizen science or on topics relevant to citizen science
Project Deliverable	n/a	Deliverables are reports prepared as part of a project on citizen science and related topics.
Guideline	n/a	Guidelines are written texts such as reports, deliverables, or briefings that describe best practices or provide instructions that can be helpful in designing, implementing or evaluating citizen science or initiatives relevant to citizen science.
Policy Brief	n/a	Policy brief is a short document regarding citizen science that describes an issue and provides recommendations on how to address it including the policy options for non-specialized audiences.
Scientific Publication	n/a	Scientific publications are peer-reviewed texts about citizen science, ideally sharing practical experience, knowledge, and recommendations for initiating or running citizen science projects.
White or Green Paper	n/a	Documents issued by the government as policy proposals or statements on citizen science or topics related to citizen science.
Book	n/a	Books are bound and printed text resources, or equivalent digital versions. Book is written content in a set of printed pages or online on topics relevant to citizen science.
Other	n/a	Any written material that does not fit any of the definitions of the 7 subcategories under “text”.