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## Capacity building in citizen science

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### Highlights

- Strategic capacity-building programmes have been initiated at the European and national scale leading to the development of the Societize Green and White Paper for Citizen Science in Europe and the *Greenpaper Citizen Science Strategy 2020 for Germany*.
- These programmes have broader relevance in informing national and supranational programmes elsewhere in the world.
- Capacity building involves five main steps: (1) identifying and engaging different actors, (2) assessing capacities and needs for citizen science in the setting under focus, (3) developing a vision, missions and action plans, (4) developing resources such as websites and guidance, as well as (5) implementation and evaluation of citizen science programmes.
- Capacity building is an iterative and adaptive process that needs a sound engagement of all involved actors from society, science and policy.

## Introduction

Citizen science builds on long traditions as well as on new developments. Collaboration between professional scientists and volunteers committed to research is not new and has been practised in various forms for centuries (Silvertown 2009). Clubs, expert associations, museums and universities have always played a pivotal role in this collaboration (Miller-Rushing, Primack & Bonney 2012; Ballard et al. 2017). In recent decades, however, the increased specialisation of science and reduced social recognition of expertise can be understood as having led to a gap between the ideas and activities of citizens and the practice of scientific research (Gibbons 1999). As a result, the ambition to open science to citizens (again) has developed both in civil society and among scientists, fuelled by technical advances (e.g., Mazumdar et al., in this volume) and calls for stronger participation in research itself (e.g., Danielsen et al.; Haklay, both in this volume; Silvertown 2009; Bonney et al. 2014).

Today, voluntary participation in science is undergoing a revival and the field of citizen science is rapidly growing (Kullenberg & Kasperowski 2016). This has been aided by new means of technology, online communication tools, social media and accessible databases and repositories (Williams et al., in this volume). The recent trend towards professionalisation of citizen science has resulted in the almost simultaneous establishment of national and international citizen science associations in the United States, Australia and Europe (Göbel et al. 2016) to support and advance citizen science through communication, co-ordination, knowledge sharing and education (Haklay 2015). Aligned with this, the American government has established infrastructures to monitor and collect inputs from citizen science for environmental policies ([www.citizenscience.gov](http://www.citizenscience.gov)). The European Commission has also reinforced citizen science by promoting it through their research and innovation programme (Horizon 2020; and see Nascimento et al.; Smallman, both in this volume) and developing and supporting targeted citizen science activities and capacity-building programmes (e.g., citizens' observatories, Societize). In addition, several landmark reviews and guides aiding practitioners in the establishment of citizen science have been released, often led by UK scientists (Roy et al. 2012, Unit 2013, Pocock et al. 2014b). As citizen science is becoming more formalised and widely accepted in both science and society, capacity building paired with political commitment is now required to support its potential (Newman et al. 2012). Capacity building refers to a framework for individuals and organ-

isations, which focuses on process-orientated goals to strengthen and maintain the capabilities to set and achieve their own development objectives over time (Eade 1997; UNDP 2009).

This chapter presents key findings from capacity-building programmes at the European level and in Austria and Germany. It showcases capacity development for citizen science in various settings and synthesises key experiences and outputs of strategic citizen science development. The chapter therefore distils the principles of citizen science capacity building to inform capacity building elsewhere, illustrating the current political dimensions of citizen science in Europe to draw out key lessons that could also be applied in other contexts beyond Europe.

## **Socientize: White Paper on Citizen Science for Europe**

Socientize (2012–2014) was a consortium project initiated by the European Commission under the Directorate General for Communications Networks, Content & Technology (DG CONNECT) and co-ordinated by the University of Zaragoza with other institutions from Spain, Portugal, Austria and Brazil. It was influential in increasing recognition and appreciation of citizen science research experiments. The main aim of Socientize was to co-ordinate actors involved in citizen science to set the basis for a new open science paradigm in the framework of current citizen science development in Europe. Socientize presented the added value of collaboration and knowledge sharing through digital tools by involving some 12,000 citizens in a range of science projects from mapping flu outbreaks and labelling images of cancer cells to collective music creation (Lanza et al. 2014). Socientize created a multi-channel platform for discussion and developed Green and White Papers on Citizen Science for Europe, applying an open, iterative and inclusive approach. Within its first year, the Green Paper (Socientize 2013) presented an analysis and mapping of citizen science projects, and identified ongoing programmes and initiatives paying special attention to researchers outside academia. These trends were analysed, best case studies were promoted, and cross-cutting concerns and draft policy options addressed key areas in need of change. A wide audience was reached through common digital technologies such as YouTube, Google Hangouts and WordPress forums as well as more specific collective intelligence tools such as allourideas, Thinkhub or LimeSurvey. Socientize also ran a number of virtual workshops, moderated open consultations with questionnaires and facilitated online discussions.

The later White Paper ([Socientize 2015](#)) included proposed actions and measures to address the key challenges of science-society-policy interactions. Arranged at the macro-, meso- and micro-levels, these correspond to strategies for policymakers and science funders, and recommend plans for citizen science mediators and facilitators as well as actions for citizen science practitioners ([table 19.1](#)).

**Table 19.1** Actions and measures of the *White Paper on Citizen Science for Europe*

| Actions                              | Measures  |
|--------------------------------------|---|
| <b>Targeted funding</b>              | Designing funding schemes and launching programmes specific to citizen science. Targeted calls will achieve a broader uptake and will keep established networks and systems going. Programmes should contribute to a deeper analysis of citizen science practices and outcomes.   |
| <b>Mainstreaming citizen science</b> | Embedding citizen science into existing funding schemes. Like science communication, citizen science should become an integral part of ongoing scientific activities. Research should be given greater credit for the inclusion of citizen science strands covering multiple disciplines, addressing the public's needs and concerns.   |
| <b>Education</b>                     | Updating educational programmes to promote and recognise new forms of community engagement and digital skills in the curriculum.  |
| <b>Evaluation and assessment</b>     | Expanding current academic reputation systems and evaluation criteria to account for social impact and engagement.  |
| <b>Access to technology</b>          | Broadening access to technology and improving the systems required to make the most of the power of networked communities, paying special attention to the digital divide in Europe.  |
| <b>Data policy</b>                   | Clear ethical guidelines are needed for EU-wide data policy. Stakeholders are asked to share public datasets and research data infrastructures (to promote quality, reliability, interoperability of data) as well as data handling tools and methods (such as algorithms, descriptive, predictive, visualisation, decision-making). This requires attention to intellectual property rights, |

**Table 19.1** (continued)

| Actions                          | Measures  |
|----------------------------------|---|
|                                  | fundamental personal data protection rights, ethical standards, legal requirements and scientific data quality. |
| <b>Dissemination and support</b> | All strategies and policy actions must be communicated by providing appropriate knowledge-based guidance.       |

Source: [Socientize 2015](#)

The White Paper recommendations led to the establishment of the European Citizen Science Association (ECSA, [www.ecsa.citizen-science.net](http://www.ecsa.citizen-science.net)) and were endorsed and embedded in ECSA policy development. High-level guidance and support on road mapping was presented to the European Commission, member states, local and regional authorities, and private actors. The White Paper provided the basis for several actions and policies related to public engagement in science directed by the European Commission (e.g., in the Science with and for Society programme 2018–2020). Currently, Socientize is run and supported by the Ibercivis Foundation, which is coordinating the Spanish national citizen science platform ([www.ciencia-ciudadana.es](http://www.ciencia-ciudadana.es)) and developing the co-creation of citizen science road mapping in Spain.

## ***Österreich forscht*: Development of citizen science in Austria**

In Austria, capacity building for citizen science is closely connected with two comprehensive citizen science initiatives: the establishment of the online platform *Österreich forscht* ([www.citizen-science.at](http://www.citizen-science.at)) and the Center for Citizen Science ([www.zentrumfuercitizenscience.at/en/citizen-science](http://www.zentrumfuercitizenscience.at/en/citizen-science)). Two national citizen science funding schemes were initiated, namely Sparkling Science by the Federal Ministry of Science, Research and Economy (BMWFV) and Top Citizen Science by the BMWFV together with the Austrian Science Fund. The platform *Österreich forscht* is an independent, bottom-up initiative managed by early career researchers at the University of Natural Resources and Life Sciences (BOKU), Vienna. It was launched in March 2014 to connect Austrian citizen science actors from different disciplines and institutions. Since 2016 the platform has

been financially supported by BOKU, which has led to the formation of the Citizen Science Network Austria (CSNA, [www.citizen-science.at/netzwerk](http://www.citizen-science.at/netzwerk)). Since summer 2017, Austrian institutions (NGOs, universities and companies) have now formally expressed their commitment to citizen science in a joint Memorandum of Understanding of the CSNA. The CSNA aims to further develop citizen science in Austria, secure and foster quality and method development, publicise projects to interested publics and enhance dialogue between different actors. The first Austrian citizen science conference was held in Vienna in 2015, organised by the team of the platform initiators. The conference is now an annual event and connects scientists working in, or about, citizen science and enables citizens to connect with project managers. Until 2016, most curation of the platform has been done on a volunteering basis by two people committed to spend a great amount of time into the curation. In 2016, it had 38 different citizen science project partners from more than 30 different institutions (Pettibone, Vohland & Ziegler 2017). As a bottom-up initiative, the partners meet annually to decide on tasks for the upcoming year in a democratic way to integrate all views. To do so, they use the following guidelines:

- Decisions on management and development of the platform are taken by all platform partners.
- Platform partners can participate in the creation of content on the platform, such as writing and publishing articles and news about their projects. This fosters cohesion and ownership of the platform.
- The annual Austrian citizen science conference is hosted by different platform partners each year. This helps to integrate and establish citizen science in the different host institutions by (a) raising awareness about participation in science with new stakeholders and (b) allowing the host institution to choose a special focus for the conference through which it becomes more involved in the platform development.

The Austrian Center for Citizen Science was initiated by the BMWFW as a top-down approach and was established at the Austrian Agency for International Cooperation in Education and Research (OEAD) in June 2015. It aims to be an information and service centre for researchers, citizens and experts from different disciplines, and to establish links with interested communities beyond Austria. Six Austrian universities now refer to citizen science as an important part in their service agreement with the BMWFW.

Thanks to these two initiatives, the term ‘citizen science’ is now established not only in Austrian science communities, but also in the media and research policy. Future steps for capacity building in citizen science in Austria could include funding long-term citizen science projects and networks, as well as fostering science awareness in the general public.

## GEWISS: Developing a citizen science strategy for Germany

The ‘Citizens Create Knowledge’ (GEWISS) capacity-building programme was funded by the German Federal Ministry of Education and Research (BMBF) aiming to strengthen citizen science capacity in Germany through a series of capacity-building activities. The objectives were to build a strong German citizen science community network, to assess the current state and needs of citizen science in Germany and – building on this – to develop the *Citizen Science Strategy 2020 for Germany* (Richter & Pettibone 2014; Bonn et al. 2016). GEWISS employed a modular programme with the following steps:

- Workshops for networking and capacity needs assessment: Organisation of more than 10 national dialogue forums hosted by different partners, including a high-profile think-tank, to identify the needs of citizens and researchers, connect diverse actors working or interested in citizen science and engage decision-makers and funders (Richter et al. 2017).
- Resource development: Development of technical and organisational resources to develop guidelines for citizen science (Schierenberg et al. 2016), three film clips (e.g., [www.youtube.com/watch?v=cE1kpXLkGbo](http://www.youtube.com/watch?v=cE1kpXLkGbo)) and three training workshops (for reports, see [www.buergerschaffenwissen.de](http://www.buergerschaffenwissen.de)).

- Online platform: Collaboration with projects to develop an online platform to increase their visibility, enhance public awareness and allow citizens to link with each other ([www.buergerschaftenwissen.de](http://www.buergerschaftenwissen.de)).
- Strategy development: Development of the *Greenpaper Citizen Science Strategy 2020 for Germany* through the GEWISS workshops, moderated online consultation with 1,000 online visits and over 50 formal position papers from civic society and science organisations (Bonn et al. 2016).
- International conference: Hosting the first European citizen science conference in Germany in collaboration with ECSA ([www.ecsa2016.eu](http://www.ecsa2016.eu)).

The development of the Citizen Science Strategy 2020 for Germany was the central strategic policy instrument of the GEWISS programme (Bonn et al. 2016). The core of the strategy development was the combined dialogue forum input from 10 workshops with over 700 participants from 350 organisations, including scientific institutions, environmental groups, informal science clubs, science shops, funding organisations, state and federal agencies, and local interest groups (Bonn et al. 2016; Richter et al. 2017). This was followed by a six-week online consultation with over 1,000 website visitors and over 400 comments submitted on the draft of the Green Paper as well as over 50 formal position papers from civic society and science organisations. The open, iterative and transparent consultation process was important to facilitate ownership of various stakeholder groups by including their perspectives directly both in the strategy development and implementation. The Green Paper presents aims, potentials and challenges of citizen science in Germany with five visions of citizen science (table 19.2). The strengthening, establishment and integration of citizen science into science, society and policy were identified as core fields, alongside potential actions for each. Next steps ideally include translation into action plans by the different interest groups (Bonn et al. 2016).



**Table 19.2** Priorities and visions for citizen science in Germany  
(Bonn et al. 2016)

| Priorities for citizen science in Germany | In the year 2020, citizen science in Germany is . . .   |
|---|---|
| <b>Integration</b>                        | . . . an integral part of social and scientific debates, and an approach that brings benefits for science, politics and society. At the same time, the various forms of participation – from co-operation to the active co-design and active co-production of research – are valued, recognised and lived in science, society and politics. |
| <b>Empowerment</b>                        | . . . an important part of citizens’ lives which enables individual, formal and informal learning, empowers citizens to participate in research processes and allows them to engage with science.   |
| <b>Recognition</b>                        | . . . a scientifically accepted, established and practised research approach which puts both participatory and transdisciplinary research into practice and unleashes innovative potential in research processes by including a wide range of knowledge sources and extensive participation.  |
| <b>Participation</b>                      | . . . a politically accepted process of citizen participation for the generation, quality assurance and dissemination of knowledge and an expression of participation and encounter between science and society that is supported and sponsored by policy.  |
| <b>Innovation</b>                         | . . . a participation format characterised by the use of web-based infrastructures which – as trustworthy environments that are in compliance with data protection regulations – promote knowledge exchange and co-operation in the context of citizen science projects.  |

The Green Paper was launched and presented to the German Ministry of Research and Education (BMBF) during a high-profile event in Berlin in March 2016. Based in part on its recommendations, the German Ministry launched a new funding scheme for citizen science projects in summer 2016. The call resulted in over 300 project proposals (BMBF 2017), which is one indicator of the growing capacity for citizen science in Germany as a result of the above initiatives.

## From experiences to principles of capacity building in citizen science

The examples of capacity-building processes for citizen science presented above demonstrate capacity building at both individual and organisational levels. Building on UNDP recommendations (UNDP 2009), five critical steps to capacity development in citizen science can be identified (figure 19.1), which are ideally consecutive and iterative.

### 1) Actor engagement

First, actors are identified to include diverse interests related to citizen science: scientific enquiry, education, public engagement and more. Actors are approached in different ways, for example, through online platforms, face-to-face meetings and networking opportunities. The goal is to build a setting where individuals and key groups can share their experiences, learn from each other and build a shared identity. The strength and breadth of actor engagement drives the quality of the subsequent discussions and outcomes.

### 2) Capacity and needs assessment

The actors assess each other's capacities, based on current activities, shared goals (see Robinson et al., this volume) and community needs.

### 3) Visions, missions and action plan(s)

Actors formulate visions for the development of citizen science. This can include defining the goals of citizen science within the community, establishing guidelines and developing a strategy or action plan, for example, in a Green Paper followed by a White Paper (Socientize 2015; Bonn et al. 2016; Pettibone et al. 2016; Richter et al. 2017).

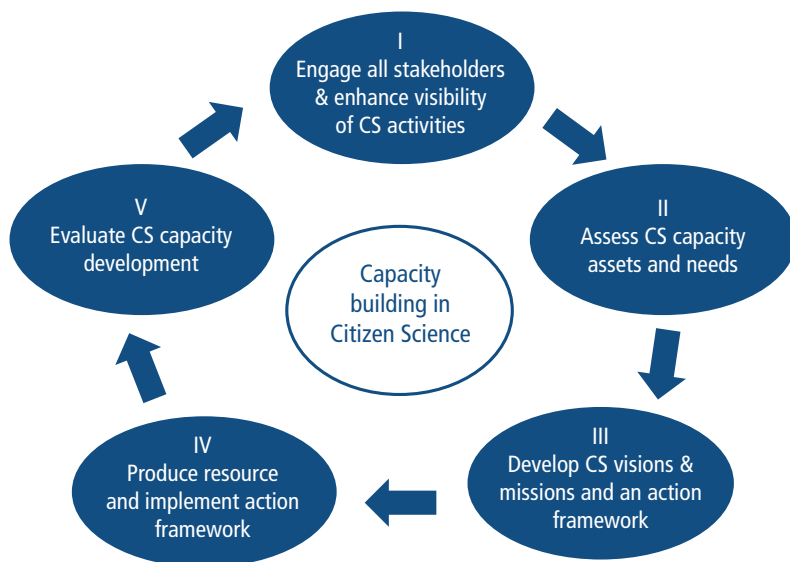
#### 4) Resource development

A response plan is implemented building on the action plan, including the creation of funding opportunities, the development of tools and guidelines, and provision of training and educational material to publicise and improve the quality of citizen science.

#### 5) Evaluation

Finally, the implementation is evaluated and reflected on to foster further development.

The nature of citizen science activities means that capacity building takes place at all geographical levels, from local to regional to national and international scales. Crucially, strategic capacity building comprises the development of policy instruments to frame citizen science in science and policy, and to further develop citizen science as an integral component of the science-society interface. In each setting, forums for discussions and other opportunities for participation are needed to bring perspectives from science, society and policy together. These discussions help to improve visibility of existing activities and assess the state and needs of citizen science actors corresponding to steps 1 and 2 of the



**Fig. 19.1** Steps towards capacity building in citizen science.

(Source: Adapted from [UNDP 2009](#))

**Table 19.3** Overview and links to selected outcomes of capacity-building programmes

| Step        | Capacity development                             | Country/region   | Measure  | Outcomes  | Resources   |
|-------------|--|------------------|--|---|---|
| <b>I.</b>   | Engage stakeholders and enhance visibility       | Europe – Austria | Platforms and community building   | > 100 citizen science (CS) projects now visible | <a href="http://www.socientize.eu">www.socientize.eu</a> , <a href="http://ecsa.citizen-science.net">ecsa.citizen-science.net</a><br><a href="http://www.citizen-science.at">www.citizen-science.at</a><br><a href="http://www.zentrumfuercitizenscience.at">www.zentrumfuercitizenscience.at</a><br><a href="http://www.buergerschaftenwissen.de">www.buergerschaftenwissen.de</a> |
|             |  | Germany          |  |   | <a href="http://www.ecsa2016.eu">www.ecsa2016.eu</a><br><a href="http://www.citizen-science.at/konferenz">www.citizen-science.at/konferenz</a>  |
| <b>II.</b>  | Assess CS capacity assets and needs              | Europe           | Conferences and accompanying research  | Workshop, conferences and public consultation   | <a href="http://www.socientize.eu/sites/default/files/SOCIENTIZE_D5.3.pdf">www.socientize.eu/sites/default/files/SOCIENTIZE_D5.3.pdf</a><br><a href="http://www.ecsa.citizen-science.net/documents">www.ecsa.citizen-science.net/documents</a>  |
|             |  | Germany          |  |   | <a href="http://www.socientize.eu/sites/default/files/white-paper_0.pdf">www.socientize.eu/sites/default/files/white-paper_0.pdf</a><br><a href="http://www.buergerschaftenwissen.de/sites/default/files/assets/dokumente/gewiss_cs_strategy_englisch_0.pdf">www.buergerschaftenwissen.de/sites/default/files/assets/dokumente/gewiss_cs_strategy_englisch_0.pdf</a>                |
| <b>III.</b> | Develop citizen science                          | Europe           | Development of science policy documents and strategies                         | Green and White Papers                          | <a href="http://www.buergerschaftenwissen.de/citizen-science/ressourcen">www.buergerschaftenwissen.de/citizen-science/ressourcen</a><br>Citizens create knowledge <a href="http://www.youtube.com/watch?v=md2Lgg5D62E">www.youtube.com/watch?v=md2Lgg5D62E</a>  |
|             |  | Germany          |  |   | <a href="http://www.youtube.com/watch?v=Z_fw5MAAtM64">www.youtube.com/watch?v=Z_fw5MAAtM64</a><br><a href="http://www.ec.europa.eu/programmes/horizon2020/en/h2020-section/science-and-society">www.ec.europa.eu/programmes/horizon2020/en/h2020-section/science-and-society</a>  |
| <b>IV.</b>  | Produce resources and implement action framework | Europe – Austria | Development of practical resources and establishment of new funding programmes | Guides and video clips                          | <a href="http://www.zentrumfuercitizenscience.at/en/ausschreibungen">www.zentrumfuercitizenscience.at/en/ausschreibungen</a><br><a href="http://www.sparklingscience.at">www.sparklingscience.at</a><br><a href="http://www.bmbf.de/foerderungen/bekanntmachung-1224.html">www.bmbf.de/foerderungen/bekanntmachung-1224.html</a>  |
|             |  | Germany          |  |   | <a href="http://www.cost.eu/COST_Actions/ca/CA15212">www.cost.eu/COST_Actions/ca/CA15212</a><br><a href="http://www.cs-eu.net">www.cs-eu.net</a>  |
| <b>V.</b>   | Evaluate CS capacity development                 | Europe           | Scientific integrative network   | Paper, workshops, guidelines, recommendations   |   |

capacity development cycle (figure 19.1). The developments of Green and White Papers in the policy area are instrumental in helping enhance governance structures and developing organisational structures and frameworks, corresponding to step 3. The implementation and development of practical resources such as guidelines was accomplished by supporting the development of new citizen science–funding schemes, both nationally and internationally, corresponding to steps 4 and 5 (figure 19.1). The first criteria for assessing citizen science projects and aid funding scheme development have recently been suggested (Kieslinger et al. 2017). However, the true evaluation of capacity-building programmes can probably only take place in a few years so that it can assess the sustainability of measures undertaken and the long-term implementation of action frameworks as outlined (table 19.3). The facilitators of capacity-building programmes either obtain their mandates from the ‘top’ (programmes which are therefore attached to overarching policy goals) or they are developed as a result of vision from the ‘bottom’ via volunteer teams, existing project members or a consortium of institutions (reflecting the shared needs of a community). Both approaches are appropriate depending on the context, and the case studies presented show that either approach can engage citizen science projects, non-governmental organisations and governmental authorities, local, regional and international organisations, as well as interested individuals in developing and advancing citizen science. This in itself can be considered an important milestone for achieving steps 1 and 2 of the capacity development cycle (table 19.3).

## Lessons learned from capacity building in citizen science in Europe

The most important lesson from capacity-building programmes is the need for in-depth understanding of prospective stakeholders and important actors in citizen science. Citizen science is a broad field and actors share different goals and approaches. This heterogeneity is seen by some as incompatible with understandings of citizen science; by others, this is welcomed as a rich diversity of citizen science. Sensitivity is therefore required within emerging communities as they develop more concrete plans and strategies, to ensure that the diversity of approaches is accurately represented and supported. Scientific actors are often the easiest to reach, as they can participate in capacity-building efforts as part of their paid work. Other stakeholders might be reached consistently, but to a

lesser extent. For example, educational actors, who engage in citizen science projects in curricular or extracurricular activities (Richter et al. 2016; Makuch et al. this volume) or policy actors whose statutory monitoring requirements are fulfilled by citizen science data (Nascimento et al; Parker et al., both in this volume), have only recently coalesced into identifiable stakeholder groups.

Other groups and entities that bridge science and society, such as science communicators, environmental groups or science jobs, that is, independent and participatory research support taking up concerns of the society ([www.livingknowledge.org](http://www.livingknowledge.org)), might be reached through attendance at conferences. Participants can rarely be engaged in centrally organised daytime meetings, but possibilities to engage them can be harnessed through online tools, consultations and open discussions at science shops, museum events or via exhibition stands at public events.

Individuals who live in deprived communities or people with a different cultural background as well as unemployed individuals and/or individuals with formal education have yet to be included more specifically as stakeholders in most capacity-building programmes, and steps are needed in this direction to foster even broader societal integration. Citizen science should also harness the opportunity to learn from, and build on, experiences in other networks, such as participatory health research or science shops, which have gone through the same capacity-building processes. Capacity building for citizen science is a highly political process enabled by participants from science, society and policy communities. Therefore, strong, integrative capacity-building processes can foster the development of appropriate policies and support schemes for citizen science in the future.

## Final remarks

The chapter presented the functionality and mode of operations of capacity building for citizen science and provided insights into the practice of the processes involved in capacity building in Europe and at the national level (Austria and Germany). Steps and activities established and implemented showcased how people, governments, international organisations and non-governmental organisations are needed as partners and actors for the development of capacities for citizen science. The capacity building as presented in the case studies improved governance structures and developed organisational structures and frameworks to strengthen and

enhance citizen science, and hopefully encourages other initiatives at local, regional or national level to foster engagement in policy-making related to citizen science.

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