CITIZEN SCIENCE:
NEW WAYS FOR RESEARCH

POLICY ADVICE PAPER

Version dating 10th November 2016

proposed for discussion during a workshop on 17th November 2016 in Zurich

Important questions to be discussed during the workshop concern:

- Does this paper provide for the best examples and practices of citizens science projects?
- Does this paper adequately cover the current issues and challenges of citizens science projects?
- Are the recommendations to research institutions, governments and research funding organisations pertinent and exhaustive?
- Is the cross-referencing to the `Standards for Citizens Science` useful?
- What additional literature is relevant and should be included in the paper and the reference list?
- What additional projects should be added in the annex?

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Acknowledgements and authors

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Executive summary

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Introduction and motivation

Amateur scientists have contributed to science for a long time[1], but the establishment of universities and other research institutions moved research questions away from every day experience. However, the need to maintain expensive and complicated equipment limited the participation of citizens and research is conducted largely without the participation and influence of citizens. This situation is changing as the new communication technologies lead to growing availability of scientific results for everyone, and scientific activities become more reachable. The involvement of citizen in the scientific process has increased and will become more prominent with the emergence of a well informed knowledge society. Therefore, 'citizen science' will become an important part of research activities in future and research institutions need to prepare for it.

Citizen science generally refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources. Citizen science may also contribute to advances in (educational) Information and Communication Technologies (ICT).

In recent years, organisations coordinating best practices for citizen science programmes have been established, e.g. the European Citizen Science Association (ECSA) or the Citizen Science Association (CSA) in the United States. Through the wide range of activities of those who participate in such organisations, interested citizens are given the possibility to participate in scientific projects or contribute to education and awareness of people. The research themes are often guided by issues of general interest and concern, like environmental monitoring. Such projects involve non-professional scientists only (or professional scientists who particpate outside their official role) and thus are detached from mainstream academic research. However, they may lead to novel research questions and tap on the natural interest of citizen in science.

On the one side, citizen science projects carried out at research institutions involve both academic scientists ('researchers'[2]) and citizen scientists. The latter are generally recruited by the researchers through Internet campaigns, public announcements etc. Mostly, researchers initiate these projects. As public organisations[3] receiving public funding[4], their work must be governed by the highest standards of quality, transparency and ethics.

Well known examples of citizen science include projects such as Zooniverse or Foldit. They have led to high quality scientific outputs, which would not have been possible without the involvement of the citizens. Involving citizens adds creativity and capacity and at the same time deepens the public's understanding of science and fosters the general interest in it. Citizen science is in fact an important part of the European agenda for open science; it is a most efficient way to democratise science which is one of the goals of the initiative of the European Commission (EC). Indeed, surveys among citizens show that they consider contributing to science a good use of their volunteering time.

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[1] Rick Bonnex, Jennifer L. Shirk, Tina B. Philipps, Andrea Wiggins, Heidi L- Ballard, Abraham J. Miller-Rushing, Julia K. Parrish, "Next step for Citizen Science," *Science* 28 March 2014 / Vol 343 no. 6178, 1436.

[2] See Frascati Manual for a definition of researcher.

[3] See Frascati Manual for a definition of research institution.

[4] See Frascati Manual for a definition of funders.

However, there is also widespread scepticism among researchers and research institutions towards citizen science, in particular about the setup of the projects, their output and their quality. The purpose of this paper is thus to provide information on existing succesful citizen science activities in an academic setting and to formulate the necessary conditions and recommendations to include, when appropriate, citizen science into the procedures of research institutions. Standards are particularly important as "a wide range of heterogeneous stakeholders with different motivations and objectives tend to challenge the fundamental mechanisms of scientific evaluation systems."[5] The paper therefore addresses researchers (by providing them with principles and guidelines), research institutions (by providing succesful examples and principles for projects), at funding agencies (by encouraging them to fund citizen science projects) and at policy makers (by encouraging them to include citizen science explicitely in their research agendas and to recognise the high value of citizen science for society).

This initiative is fully in line with the European Commission who is advocating an 'open science' agenda for a society whose citizens are in many ways part of science and research. The EC launched the project SOCIENTIZE which conducted a public consultation and a debate about the potential role of citizen science in and for Europe. The results were published in a Green Paper presenting the major themes of discussion and setting the ground for the White Paper on Citizen Science[6] where general recommendations are spelled out. Recently it was argued that citizen science is part of the human right to science. This right ensures the participation of everyone in the making of valuable scientific knowledge.[7] This policy advice paper presents the necessary considerations to citizen science projects involving research institutions building on the white paper. It intends to help facing the "challenge […] to disconnect from traditional ways of conducting science and thinking about new opportunities for innovation and insights that lies at the interface of science and society and in the links between disciplines."[8]

It recognises the role played by other players and addresses citizen science projects in various settings, including for-profit projects involving many citizens facilitated by a research institution. An example is drug discovery, where there are millions of people who help to identify targets, but only the researchers secure a patent (in contrast to open source drug discovery where it is all open).

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[5] Socientize (2013) Green Paper, S. 33.

[6] Socientize (2014) White Paper on Citizen Science

[7] Vayena E, Tasioulas J. (2015) 28(3): 479-485 The right to science has been dormant for many years, but has lately attracted the attention of academic and UN bodies and its importance has been re-emphasised.

[8] Socientize (2013) Green Paper, S. 31.

Citizen science at research institutions

Universities and other research institutions are committed to highest scientific standards and ethics which are essential to receive competitive funding from public agencies and to attract the best researchers and students. Although in some areas, research questions have generally moved away from every day experience, the potential offered by the digital knowledge is leading to an increase in citizens science projects. Most of them are initiated by researchers at research institutions which provide the basis for carrying out the research. Various citizen science projects are in progress (see appendix) and many have led to novel scientific results. Why should a renowned research institution engage in citizen science projects? What are the experiences with the existing projects?

In `Zooniverse` - the world's largest platform for people-powered research - over a million volunteers have made unexpected and scientifically significant discoveries thanks to the superior human ability to recognise patterns, for instance of galaxies or identifying species in the Serengeti. In `Foldit`[9] - designed to solve the longstanding problem of protein folding - a computer game-like tool attracted a thousands of dedicated players who in several cases found significantly better solutions than the elaborate computer simulations. Thus the inclusion of participating citizens can lead in many cases to superior research results. In more complex examples such as a `Healthy aging project at the University of Zurich` - which also includes stakeholders (patients, relatives, health care personnel) as test persons - academic scientists typically profit from a larger variety of ideas, more meaningful interpretations of data and much faster recruitment of test persons (patients and generally stakeholders). In such projects, the test persons themselves are often act as citizen scientists.

Another opportunity offered by citizen science projects is the possibility to use hand-on experience to make citizens understand and value science. The `Extreme Citizen Science`[10] (ExCiteS) at the University College London for example is a bottom-up practice, that aims at providing any user, regardless of background or literacy level, with a set of methodologies and tools that can be used to collect, analyse and act on information in line with agreed upon scientific methods. In particular the `Citizen Cyberlab`[11] will set up two pilot projects based on the ExCiteS approach. The pilot projects will allow the assessment of the development of hard and soft skills such as statistical literacy, online community governance, virtual network building, teamwork and communication with strangers.

Many citizen science projects involve citizens in research, but citizen scientists come in only very late in the research process. Participatory citizen science should involve citizens in all phases of the research in all disciplines. In this case, academic scientists worry about laypersons having a say in deciding about methods, data collection, or data interpretation. However, individuals involved in such projects have an inherent interest to participate in excellent research. Academic scientists typically profit from a larger variety of ideas, different and possibly novel interpretations of data, and much faster recruitment of test persons. The involvement of such differing groups of people make the organisation and working procedures of such a project quite demanding.

[9] https://fold.it/portal/

[10] https://www.ucl.ac.uk/excites

[11] http://citizencyberlab.eu/founding-partners/university-college-london/

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However, research institutions lack the structures and procedures to sustainably ensure the originality and excellence of participatory citizen science projects. The existing procedures in terms of developing grant ideas, applying for and managing of research funding, reviewing of applications and publications, or ethics approval do not match the needs of participatory citizen science. For example, citizen scientists hardly have access to resources to develop research ideas (be it academic papers that are locked behind paywalls, or access to 'wet' laboratory space), can typically not apply for research funding, publication reviews from citizen scientists are hardly considered as peer review, and research ethics committees are legally not responsible for citizen science projects. Providing these procedures and resources puts citizen science in a starting position that would be equal to academic science and should demonstrate the added and complementary creativity, originality and excellence of participatory citizen science.

Involving Citizens is clearly not always possible. In 'regular' science projects, researchers usually possess an extreme high professionalisation acquired over many years. This applies in particular to specialised laboratory work. Citizens may lack such in-depth training and thus not all research projects are suitable as citizen science projects. Therefore the topic and research goals have to be chosen carefully. However it is not excluded that only a part of a research project is 'citizen science'.

In order to ensure excellence of research, the following four important aspects of citizen science projects are identified where particular care is required: recruitment, participation, organisation and rewards.

Recruitment

In succesful projects like Zooniverse, citizens are asked to participate through suitable Internet platforms. Launching a new project via a press release can lead to coverage across various web platforms, which connect new citizen scientists with the project. There are mechanisms in place that may screen and select citizens according to their contributions. In health related projects, where the test persons themselves act as citizens scientists the selection is rather by the topic of the investigation. While there is often an evident selection on the academic researchers, the project organisation should also monitor the recruitment of the citizens. The procedure for this depends on the research goal. Research institutions should ensure high scientific quality (such as absence of a bias) and provide adequate training to citizens. The project should also be aware that without effort in recruitment, many groups in society will exclude themselves, and therefore project should dedicate clear effort for outreach and recruitment – especially to groups in society, which are excluded.

Participation

The degree of participation of the citizens can vary; it is important that there are procedures in the collaboration to discuss this where necessary. As a rule, a project should be as democratic as possible. Also the clarity and objectivity on research objectives, research protocol, quality and reliability of data, etc., is crucial to ensure the success of citizens' science projects. Project websites must be intuitive and simple to use as the project competes for user attention with the rest of the Internet. In Foldit, citizens participate through gaming, which is obviously attractive to many people. The participation is designed in a way that all participants of the research project can fully use their talents and motivation. This is not only fair, but it enhances the quality of research. In sensitive cases (e.g. personal data of patients) the signing of a confidentiality agreement should be considered and the

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citizen advised how to maintain their rights to the data (as in health related projects). Participants typically in the beginning worry about lay persons having a say in deciding about data collection.

However, individuals involved in such projects have usually an inherent interest to participate in excellent research or because they feel that their contribution is useful (to society)[12]. There can be restrictions in the participation of citizen scientist, such as limited acces to buildings or research facilities.

Organisation

Especially for larger and more complex projects, the structural set up important and critical to success. Health-related projects typically involve other stakeholders such as health services providers besides researchers and citizen scientists, which have to be recruited before the start of each sub project. In the health project in Zurich, a steering group discusses the research goals, the required skills for the participants and the selection process. Professional moderators set up and organise meetings of the research group and decide about inclusion and exclusion criteria for possible participants as well as the overall research agenda. Methods and theory training meetings are completed before deciding on specifics of the research design and procedures. Long term aspects are particularly important in citizen science projects: one cannot simply 'drop' a group of citizens. In comparison, projects of non-governmental organisations have typically a long term perspective. The stability of project funding therefore is an important element research institutions engaging in citizen science have bear in mind. Virtual and face-to-face discussion boards that allow volunteers to work together with each other and the research teams are therefore essential.

Rewards and incentives

In Zoouniverse, the participating citizen scientists are acknowledged in any publication using data generated by them. Where the classifications generated by the citizen scientists are used in aggregate, this may take the form of a website listing citizen scientists' names or usernames after their permission has been sought. In the case of individual discovery, citizen scientists are asked if they wish to be co-authors on the resulting publication. Well-known instances of citizen's rewards are names of objects like comets (thought this is a well established practice in astronomy). Other participants prefer to get recognition letters or occasional personalised thank you from the project coordinators. Finally, when working with citizen scientists who have limited financial resources the time they dedicate may be remunerated.

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[12] http://arxiv.org/abs/0909.2925 http://arxiv.org/abs/1303.6886

Citizen science and policy makers

More and more governments (agencies) at regional, national and supranational level are keen to promote citizen science projects. They examine and adjust current regulations and policies accordingly. Involving citizens may make the planned regulations more acceptable. In fact, using the results from apropriate citizen science projects, these regulations may be put on a more solid ground. Since the results from the citizen science projects can be decisive, they should be done with great care. A well-known example ist the outcome of climate-related research which gives rise to stringent environmental regulations.

Examples of governmental initiatives, where citizen science projects are promoted top-down, can be found e.g. at the European Environment Agency (EEA) and the EC. The latter encourages citizen science projects as part of `Open Science, and Responsible Research and Innovation` under its 'Science with and for Society' theme of the current EU Framework Programme for Research and Innovation (Horizon 2020). While EEA confines itself mentioning citizen science projects, Horizon 2020 also provides funding promoting the rise and importance of citizen science.

At national level, examples are found in the United Kingdom, the Netherlands and Germany. In Germany for example, the Ministry for Education and Research (BMBF) support a Citizen Science Platform[13], which brings together many initiatives and is currently collecting inputs to deliver its own Citizen Science Strategy 2020. The United States Office of Science and Technology Policy (OSTP) published its Second Open Government National Action Plan for the United States of America[14] in 2013 in which OSTP recognised the potential citizen sciences has to encourage people to contribute to large initiatives.

In the United Kingdom, the Scotish Environmental Protection Agency made a strong commitment towards citizen science in all its activities, while at the national level, Citizen Science is integrated in the strategy for tree health and invasive species.

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[13] http://www.buergerschaffenwissen.de/

[14] https://www.whitehouse.gov/sites/default/files/docs/us_national_action_plan_6p.pdf

Citizen science and research funding organisations

The funding of citizen science projects is often similar to other projects not involving citizens, although special incentives exist sometimes. Since citizen science projects are often complex and interdisciplinary, their assessment can be quite difficult and the rejection rate correspondingly high, partly because of lack of suitable tools to judge them.

However research funding organisations and certain government agencies may view cititzen science also from other angles. EEA for example pioneered many citizen science projects pertaining to biodiversity monitoring and also FP7 funded numerous citizen science activities. In the United Kingdom, the Open Air Laboratories have conducted a ten-year citizen science project, supported by a non-traditional funder (lottery) which led to the creation of ECSA. It was run from universities and had problems of lack of recognition by the universities involved. Often, funding comes from private donors (such as the Wellcome trust).

The literature shows that the United States are leading when it comes to provide funding to citizen science. Quite recently the National Science Foundation also funds citizen science projects in the form of grants for education and the Obama administration has even developed a toolkit for citizen science[15].

However, on a more global level, the Takagi Foundation in Japan established in 2001, provides research and training grants up to $5`000 to citizen scientists or organisations engaging in citizen science[16].

The funding of funding citizen science is also rising in Europe. For example, the Medical Research Council (MRC) in the United Kingdom had one citizen science project involving over 11'000 citizens globally. It is interesting to see that more 'traditional' research fundering organisations indirectly support citizen science activities by asking the grant-holders to undertake 'project-related science outreach'.

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[15] https://www.whitehouse.gov/blog/2014/12/02/designing-citizen-science-and-crowdsourcing-toolkit-federal-government

[16] http://www.takagifund.org/e/apply/

Citizen science and citizens

The idea to run a citizen science project does not always come from universities and other research institutions. Citizens might identity a need for a citizen science project because of personal and societal needs such as, for example, better understanding (and fighting) polluted air in their neighbourhood. In such cases, private initiatives and citizen science societies respond to these needs by organising and running projects, often with support from a government agency or crowdfunding.

To attract, but also retain persons who are willing to contribute with their skills, time, and effort for a scientific cause is an important pillar of citizen science work.[17] In this regard, crowdfunding has positive implications on citizen science projects. The mere fact that the funding comes from a crowd raises the overall level of commitment.

Nonetheless crowdfunding citizen science projects appears not to be without problems, as it was already stated in the Green Paper: "crowdfunding citizen science projects is currently considered as an alternative funding strategy. There is however a fear associated with this approach in terms of who is deciding on what research should be funded. Such an open approach might intervene too much in the scientific process. The challenge here is to find the balance between openness and involvement on the one hand and keeping the focus on the original aim of the research project on the other hand. Selling advertising space on citizen science websites is considered another funding model, but there is strong worry that this could devaluate the project."[18]

Examples for platforms enabling citizen science projects by crowdfunding are `Experiment.com`[19] and `Indiegogo`[20], the latter being one of the largest crowdfunding platform on the Internet. One of its projects called `uBiome`[21] tries to create a better understanding of health conditions related to the bacteria in the body, though it is run for profit, and encountered ethical issues. Citizens can be rather creative in finding opportunities for funding, because the personal interest contributes to a large extend to the will to find or provide funding. But as "only few projects have a clear policy about the ownership of the results […]. Volunteers are hardly informed about the intellectual property rights of projects they have been involved in".[22] Thus clear rules need to be formulated in advance and followed through with.

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[17] Socientize Project. Green Paper, S. 23.

[18] Socientize Project. Green Paper, S. 25.

[19] https://expe riment.com/

[20] https://www.indiegogo.com/

[21] http://ubiome.com/

[22] Socientize Project. Green Paper, S. 30.

Promoting citizen science

Citizen science offers a rich potential to advance science and at the same time enhance awareness for research in the public. Because of its wide scope of issues and possible participants, citizen science projects are pursued by many groups, ranging from traditional research institutions such as universities to scientific societies, interest groups, governements and individual citizens. Universities, longtime almost the only bearers of research have to respond to this new situation. Citizen Science should not be seen as only 'public engagement' element of research activities, but as an integral part of the open science agenda.

Over the years, standards have been developed for academic research in order to enable competitive funding, compliance with ethical and diversity rules and respect for public support. These standards are now widely used by funding bodies, medical and ethical boards, university boards and form the basis of modern scientific work. Citizen science is a relatively new practice to academic research. In view of its potential, both for science and education, citizen science must become part of the regular scientific research activities and enjoy the support that science and research already have. Therefore, one must attempt to embed citizen science projects into existing funding schemes by requiring correspondingly high standards. In an initial stage this may imply dedicated funding schemes and launching programmes specific to citizen science. This will encourage research organisations to carry out citizen science projects and thus gain both reputation and experience with such projects. In particular, current academic evaluation and reputation criteria must be expanded to account for characteristic citizen science features. Citizen science projects can also come from outside academia through interested and dedicated citizens (grassroots projects). Such projects may have great merits and lead to new research directions. However, they must satisfy the same criteria as those of academic research in order to be eligible for funding. Since citizen science involves people who do not have the means and background of academic scientists, there are several support measures that policy makers at all levels must invoke:

- update educational programmes in order improve the interest of citizens in science;
- improve citizen's access to technology, data, publications;
- develop a data policy that allows to store large amounts of data in confidential ways;
- secure storage for personal data.

Five principles[23]24 are essential for citizen science:

1. mutual respect and recognition of all stakeholders involved;
2. support of motivation throughout the project;
3. adaptation to the temporalities specific to the different stakeholders (e.g. duration of funding);
4. good management of available resources;
5. adapted governance and organisation.

[23] http://www.sciences-participatives.com/Presentation-de-la-mission. Une mission sur les sciences participatives a été confiée par le ministère de l'Education Nationale, de l'Enseignement Supérieur et de la Recherche à François Houllier, PDG de l'INRA et Président de l'Alliance nationale de recherche pour l'environnement (AllEnvi) afin d'en favoriser le développement.

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In order to make citizen science projects fundable, the current academic reputation systems have to be expanded. On the one hand, the inclusion of citizens who usually do not have a measurable track record must be put on solid ground. On the other hand, citizen science projects are often multi-disciplinary; therefore a suitable reputation system must be developed. In the mentioned White Paper, a metric and incentives that recognise social engagement is advocated. Although this is laudable, it is not clear to what degree this should be implemented. Another open question concerns to what extent citizens must be part of the evaluation procedure. For bottom up projects, this can be recommended. However for academic research projects this must be discussed further. In any case, the results from citizen science projects should be disseminated and the contribution of citizens achknowledged.

Principles

In order to establish citizen science as a valid academic method it needs to satisfy both general principles for academic research and take into account the following eight principles derived from the `Standards for Citizens Science`:

1. Excellence all the way

Citizen science projects must adhere to general international standards of science, the relevant international standards specific for the academic discipline (-s) of the projects and these Standards for citizen science. This includes aspiring for objectivity and assessing it, transparency of methodology, proper citations and avoidance of wasteful repetitive studies.

2. Participation all the way

Citizen science projects should aim to develop an active and productive participation of citizens' scientists in all the different phases of the research project, by acknowledging a large variation in their participation. Citizens might possibly contribute to topic selection and development, research design, execution, dissemination of results and funding. Expertise of citizen science shall be used in the best possible way implying flat hierarchies and the possibility of citizen scientists to take over responsibilities if they wish, once encouraged.

3. Clear motivation

The goal of a citizen science project must be clearly and realistically stated. Citizen Science is often cross disciplinary and the governance of such project should take this into account. The projects must be designed to encompass in a wide way the various aspects of a research topic.

4. Openness and diversity

Citizen science projects should be open to anyone. Projects may not discriminate on any personal grounds. In fact, cross-cultural approaches and diversity are often needed for optimal and unbiased scientific quality. Project should not just opt for passive diversity (not stopping anyone from joining) but have a clear engagement strategy that is suitable for the context of the research.

5. Transparency

Citizen science projects must operate in a fully transparent way. Either all data etc. are open to all members of a team or there shall be an agreement reached to why this is impossible.

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6. Maintaining public and personal interest

Research institutions should ensure the public investments into citizen science are spent effectively and efficiently and empower citizens and institutions to explore new ways for science.

7. Sustainability

Research institutions and their researchers should provide access to citizens to their research projects, including to e-infrastructures. The research institutions and researchers should ensure the continuity in project support and the dissemination of knowledge and support participants who want to continue and develop their knowledge.. The development and maintenance of the community of citizen scientists should have high priority.

8. Education and training

Citizen science projects shall contribute to education and training of scholars and citizens alike. Importantly, researchers must properly instruct and train citizen scientist concerning all standards and ethics involved in the respective research project. It is recommended to work closely with science communicators, to make the information clear and suitable for a wide range of participants.

Recommendations to research institutions

Universities and other research institutions are encouraged to comply with the `Standards for Citizens Science` providing guidedines to realise many of the conditions formulated in the European White Paper and in the ECSA Principles. Moreover, research institutions are proposed to:

- adopt the `Standards for Citizens Science` and apply them in order to ensure that the participative research they conduct respond to their highest scientific standards and ethical criteria;
- establish ways to attract and maintain a well-informed citizen science community and make sure that they have the means to properly instruct citizens scientists, among others on all quality standards and research ethics involved in the research project;
- raise awareness amongst researchers to perform citizen science highlighting the importance of involving different stakeholders and ensuring mutual respect and recognition between them;
- make sure that the funding available for citizen science projects is sustainable with long-term commitment for infrastructures and data repositories;
- reform research evaluation and reputation systems and provide incentives for interaction with citizens such as recognition in appraisal and tenures;
- establish a citizen science advisory board of promotion, coordination, monitoring evaluation and collaboration;
- establish a citizen science platform to promote projects with the necessary infrastructure and (internal) funding;
- promote data archives and conferences;
- establish connections to bottom-up initiatives and scientific societies.

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Recommendations to governments

Governments play an important role in funding citizen science projects. In view of the diverse advantages of citizen science, governments are recommended to:

- fund citizen science projects, especially those that can help formulating better policies and regulations;
- adhere to the `Standards for Citizen Science` when funding citizen science projects in order to ensure quality and compliance and state clear rules on the sharing of benefits resulting from the citizen science projects fom the very beginning;
- support citizen science as an increasingly reliable and evidence-based method to collect data and information.

Recommendations to research funding organisations

Research funding organisations are advised to:

- raise awareness of citizen sciences amongst researchers, as funded projects should also involve more knowledge exchange and public interaction with different stakeholders such as civil society organisations;
- promote dissemination activities in the projects and ensure that best practices are shared;
- rethink the evaluation of proposals and the reputation systems they use, for example by considering the interaction with citizen as an award criterion;
- promote the use of open data practices and provide enough funding for the maintenance of open data repositories;
- adopt open access policies for publications and data in order to allow the public to access, interact and question research findings.

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Examples of citizen science projects

Zooniverse is the world's largest platform for people-powered research, providing opportunities for citizens around the world to contribute to discoveries from astronomy to zoology. Hundreds of thousands of volunteers around the world, assist professional researchers in analysing the massive flood of information. The human ability for pattern accelerates the analysis significantly; in some cases, Zooniverse volunteers have made unexpected and scientifically significant discoveries.

Foldit: Biologists have long sought to understand how the long chains of amino acids that make up each protein fold into their specific configurations. In May 2008, researchers at the University of Washington made a protein-folding video game called Foldit[25], which was freely available via the Internet. The game, which was competitive and offered the puzzle-solving qualities of a game like Rubik's Cube, quickly attracted a dedicated following of thousands of players. According to the scientists, the results delivered by the video game players matched in comparison to the results generated by elaborate software solutions in three cases, outperformed them in five and found significantly better solutions in two others,.

Healthy aging project at Zurich University: In participatory citizen science projects on healthy aging, stakeholders for each project are recruited before the start of each project. After jointly defining the goals, a steering group consisting of academic scientists and stakeholders, e.g., old adults, relatives, health services providers, academic scientists, recruiters, identify stakeholders and suggest whom to recruit for the project lead and project participation. Professional moderators set up and organize meetings of the research group and that jointly takes decisions on all phases of the research project. In the first meetings, the necessary information for researchers and citizens, the required methodological skills and theoretical concepts are developed. Methods and theory training meetings are completed before deciding on specifics of research design and procedure. At this point, there are no specific rewards for citizen scientists besides becoming part of serious research and learning about how excellent research is conducted. Decisions within the project are strictly taken on equal terms basis.

Extreme Citizen Science[26] (ExCiteS) is a bottom-up practice that brings together scholars from diverse fields to develop and contribute to the guiding theories, tools and methodologies that will enable any community to start a citizen science project that takes local needs, practices and culture into account. The interdisciplinary research approach aims at providing any user, regardless of their background or literacy level, with a set of tools that can be used to collect, analyse and act on information according to agreed upon scientific methods.

[25] https://fold.it/portal/

[26] https://www.ucl.ac.uk/excites

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Citizen Cyberlab[27]: Citizen Cyberlab will set up two pilot projects based on the ExCiteS approach. Using consistent and verifiable scientific methods to explore, collect and systematically analyse data, citizens will take on the role of researchers themselves. From an analysis point of view, activities in the pilot project will focus on the understanding of consensual decision-making, the motivation behind participation and its incentives, identifying patterns of data collection, and dealing with the uncertainty and validity of data collected in this way. The pilot projects will allow the assessment of the development of hard and soft skills such as statistical literacy, online community governance, virtual network building, teamwork and communication with strangers.

The**UCL Interaction Centre (UCLIC)[28]** is an internationally leading Centre of Excellence in Human-Computer Interaction teaching and research. There are currently 8 faculty members, 12 post-docs and 15 PhD students. The focus is on studying interactions between people and technology, drawing on the best scientific traditions in Computer Science and Human Sciences, and working collaboratively with the research community and industry. UCLIC was founded in 2001 and is jointly supported by the Department of Computer Science and the Division of Psychology and Language Sciences. Its current research is in the areas of developing theoretical and conceptual frameworks for applications such as emotions or creativity, but also ageing or behavioural change.

OpenSystems[29] is a multidisciplinary group attached to the University of Barcelona (UB) that focuses on the arts and public participation as core elements of the way of doing science. Our methodology is based on community processes that seek to make the city and urban environments an open permanent science lab, although constantly evolving. Often thanks to new technologies, we are committed to multidisciplinary and horizontal research, innovation and public engagement.

The **Community Collaborative Rain, Hail and Snow Network** (CoCoRaHS) founded at Colorado State University is a more society oriented project. Organised as a volunteer network of backyard weather observers working together to measure and map precipitation in their local communities, CoCoRaHS could establish itself as the largest provider of daily precipitation observations in the United States. By using low-cost measurement tools, **stressing training and education**, and utilizing an interactive website, CoCoRaHS aims at providing high quality data for engineers, climate scientists etc.

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[27] http://citizencyberlab.eu/founding-partners/university-college-london/

[28] http://www.ucl.ac.uk/uclic/

[29] http://www.ub.edu/opensystems/