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Change – The transformative power of citizen science

Showcasing citizen science to promote changes and engagement in your community

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Abstract

Result dissemination in Citizen Science is pivotal for raising awareness of pressing challenges. By witnessing their contributions' impact, citizens become empowered scientific agents, prompting shifts in habits and attitudes.

The Citizen Science Office of Barcelona promotes various dissemination actions, from talks, workshops, and exhibitions at community centres, libraries, or city events, to cultural proposals that combine citizen science and artistic languages. Since 2016, the Office's programs have engaged nearly 14,000 neighbours and schoolchildren who have collected over 10,000 measurements. These actions have motivated citizens to tackle environmental and social challenges. In the process, they develop critical thinking and can propose changes and take action.

Sharing results beyond the research community underscores that Citizen Science transcends mere evidence collection—it's integral to project success. Enhancing research-society interaction is crucial for magnifying research impact and societal change.

Keywords: citizen science, results dissemination, awareness, community engagement, showcasing experiences.

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Introduction

Addressing environmental, social, and economic challenges is urgent. Recognizing the crucial role of science, technology, and innovation in responding to these challenges is a priority. UNESCO's open science principles state that new scientific knowledge should be accessible, inclusive, equitable, and sustainable. They recommend innovative, participatory methods engaging diverse social agents beyond traditional science, particularly through citizen science and other participatory forms (UNESCO 2021).

Citizen science is a methodology with great potential for opening up research to societal participation, from idea generation and planning to conducting research and disseminating results (Hecker et al. 2018).

Fostering connections between research and society raises awareness and commitment to current challenges. Since 2012, Barcelona City Council has supported a Citizen Science Office to bridge research and society. It offers guidance to pilot projects, reaching new audiences, and disseminating information at city events. Partnering with civic, cultural, and educational entities, it cultivates a Community of Practice with 20 active projects spanning environmental, health, and social concerns (Escobar and Bröll 2023).

Table 1. Active Citizen Science projects that collaborate with the Office.

Name	Description	Website
CoAct for Mental Health	Social support networks in mental health.	https://web.ub.edu/en/web/ciencia-ciutadana/coactuem-per-la-salut-mental
Floodup	Awareness regarding floods and intense rainfall and their impacts, as well as increasing the information available to the scientific community.	http://www.floodup.ub.edu/
I-CHANGE	Showing that behavioural change of single citizens is possible through citizen science initiatives which are using sensors and that this has an impact of their environmental footprint.	https://ichange-project.eu/
Lichens of Barcelona	Mapping of Barcelona's lichens by working with experts to identify the species, recognise them and interpret them	https://www.barcelona.cat/barcelonaciencia/en/science-city/science-and-citizenship/citizen-science/lichens-barcelona
Sound Map of Barcelona	Characterization of different public spaces in order to be able to understand analytically and scientifically those sounds that build the acoustic realities of the streets, squares and parks where we live.	https://www.bitlab.cat/projectes/mapa-sonor-de-barcelona/
Mosquito Alert	Investigate and control disease-carrying mosquitoes through an app.	https://www.mosquitoalert.com/en/
Observadores del Mar	Website by which people in contact with the sea can share their observations and experience regarding changing phenomena in this environment, which is useful for various marine research projects.	https://www.observadoresdelmar.es/

Name	Description	Website
Urban Butterfly Monitor Scheme (uBMS)	Collaborative network of volunteers who join forces to obtain data on butterfly populations in the cities of Barcelona and Madrid.	https://ubms.creaf.cat/en/
Observatori Metropolità de Papallones (mBMS)	Monitor the butterflies metropolitan areas and, at the same time, to be a laboratory for testing strategies to improve the abundance and diversity of this group of insects.	https://mbms.creaf.cat/
OdourCollect	Report odours to communities affected by odour nuisance with the aim of creating joint solutions with all stakeholders to improve the quality of life of the community.	https://odourcollect.eu/map
Plant*tes	Citizens report the presence of allergenic plants and their phenological status	https://www.planttes.com/
RitmeNatura	Citizens collaborate with observations to help the scientific team study the impacts of climate change on plants, animals and living beings in general.	https://www.ritmenatura.cat/
RiuNet	Interactive educational tool that helps any person to assess the hydrological and ecological conditions of a river.	https://www.ub.edu/fem/index.php/en/inici-riunet-en
TrackU	Validation of the community dimension of a tool for managing personnel at risk of SARS-COV-2 infection.	https://sites.google.com/view/estudi-tracku
WeCount	A project to count and measure mobility in cities.	https://www.wecountmovilidad.eu/
Network of Meteorological Observers	Network created to obtain meteorological data for Catalonia, based on manual observation by measuring the different variables.	https://www.meteo.cat/observacions/xom_observacio
Beepath	A project that allows us to study human mobility, recording it through mobile devices.	http://beepath.org/
BioBlitz Barris	Experts and citizens work hand in hand to identify as many species as possible in a given area.	https://www.barcelona.cat/barcelonaciencia/en/science-city/science-and-citizenship/citizen-science/bioblitz-barris
BioBlitzBcn	Biodiversity inventory of the city of Barcelona.	https://www.barcelona.cat/barcelonaciencia/en/science-city/science-and-citizenship/citizen-science/bioblitzbcn
Cities-Health	Citizens design and conduct experiments to explore how pollution in their environment is affecting their health.	https://www.citieshealthbcn.eu/

Disseminating Citizen Science in Barcelona

Figure 1. Citizen Science space at Barcelona Science Festival

From its inception, the Office has focused on disseminating citizen science. Actions include publishing a projects catalogue in 2015 "Citizen Science, 20 projects to make a city" (Oficina de Ciència Ciutadana de Barcelona 2015), organizing the Citizen Science Day, integrating projects into major city events like the "Riu Besós Day", hosting a dedicated space for citizen science at the annual Science Festival (see Figure 1), and incorporating participatory sessions and projects in the three editions of the City and Science Biennial.

As a public administration platform, the Office connects citizens with the research ecosystem, enhancing participation and visibility. It tackles significant challenges, contributes to the creation of common goods and shared resources, and facilitates knowledge transfer between science and society (DITOs consortium 2017). This is exemplified by two transversal programs:

- **Citizen Science in the Neighbourhoods**: developed in cultural centres and public libraries. 10 projects across 12 city areas have engaged approximately 12,000 participants.
- **Citizen Science in Schools:** in partnership with the Local Education Authority, seven editions of this program have been organized. 100 schools and 3,500 students who have participated in nine distinct research projects.

Showcasing experiences

Participation in citizen science projects can involve people from the formulation of the hypothesis and data collection, to the analysis and interpretation of results, as well as having a critical voice in the debate and

the proposal of actions. This entails the collective generation of knowledge, promoting both education and capacity-building, as well as inclusion and empowerment, which are fundamental principles of open science (DITOs consortium 2017).

At their final stage, projects aim to share and evaluate their results and impacts. The outputs can include datasets, reports, academic papers, maps, software, or policy recommendations, each with different impacts. The communication of results will vary depending on the project type and target audience, tailored to the specific needs of each case (ACTION programme 2022). Following the conviction that it is necessary to go beyond the dissemination of results (Hecker et al. 2018), some of the projects participating in the "Citizen Science in Schools" program organize dissemination activities that emphasize the active role of project participants. Some examples, are:

- **Sharing results with other schools:** RitmeNatura (see Table 1 for this and further mentioned projects) and Mosquito Alert have organized events involving participating schools to disseminate their findings to a wider educational community.
- **Presenting results to a committee of experts:** in the Plant*tes project, a school hosted a final session with experts to review project results and discuss technical and citizen science elements. Held at the local public library, students and families from the community were also invited.
- **Organizing a video contest:** OdourCollect proposed a video contest where students could share their results on odour sampling related to air pollution. Additionally, they could explore the social aspects of olfactory memory through the creation of "Noses Stories." The contest was also held in a public library.
- **Photo-Voice exhibition:** utilizing photography as a participatory methodology, TrackU (see Figure 2) held exhibitions with the materials generated in the research process. These exhibitions were showcased in various locations, and are designed to be itinerant, allowing schools to share them within their facilities and other cultural centres in their neighbourhoods.

Figure 2. Photo-Voice exhibition from the TrackU project.

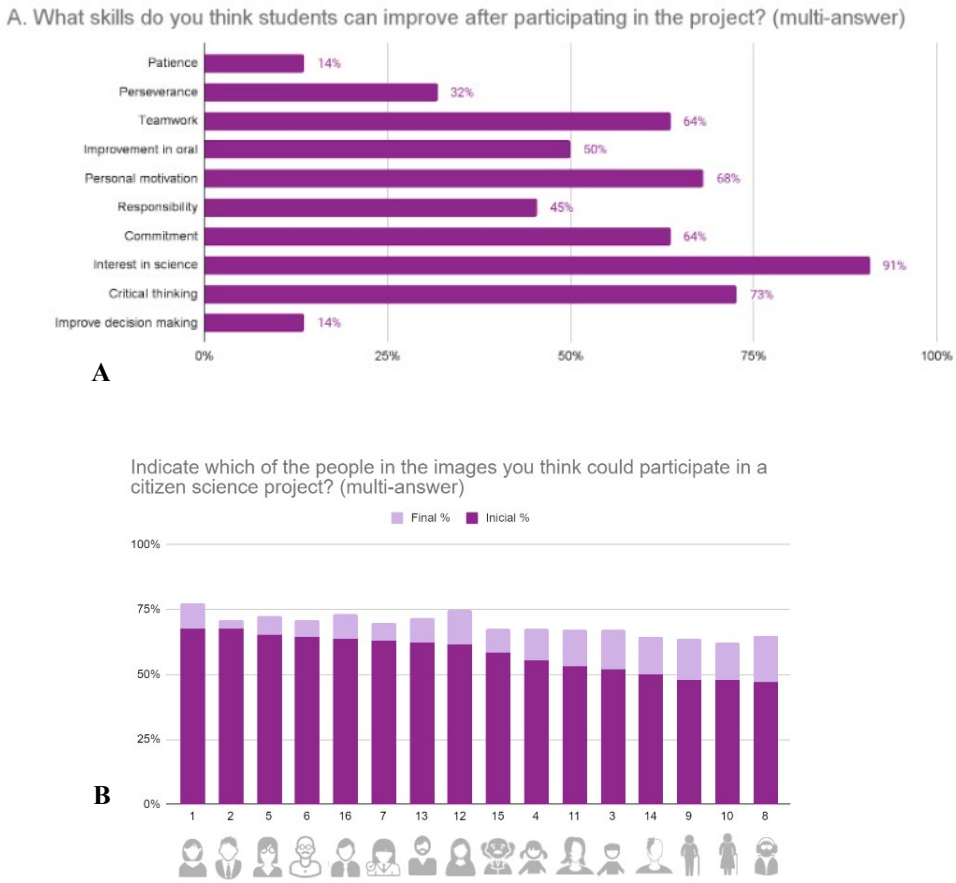

Figure 3. A Citizen Science in School 2022-23 Teacher's post-survey (23 responses). **B** Citizen Science in School 2022-23 Student's post-survey (260 responses). Survey's questions are included as additional material.

The Office conducts pre- and post-surveys with teachers and students, yielding 2,305 student responses and 131 teacher responses from 2019 to 2023. Feedback indicates improvements in teamwork, interest in science, critical thinking, and responsibility among students (Figure 3A). Additionally, involvement in research projects challenges preconceived notions about who can engage in scientific inquiry, inspiring scientific vocations among students (Figure 3B). According to a school director, that has participated in the program since the beginning, "We have noticed that now there are many more girls interested in science. These projects have a big impact".

A creative example of disseminating results among neighbourhood participants can be seen in the Barcelona Sound Map project. This project was originated from a citizen demand, and it has evolved to include the characterization of the soundscape in open public spaces. In each neighbourhood, Sound Map records the soundscapes reflecting the sonic heritage of the streets, squares, and parks. Citizens actively participate in different stages of the research process: they record sounds using professional equipment, analyse sound sources, and document the sensations, emotions, and cultural and social uses associated with these spaces.

As a way of sharing results, individuals contribute to the creation of sonic pieces that combine soundscapes with music. The connection with art plays a pivotal role in appealing to personal emotions and expressions, regardless of whether participants are actively involved in the creation process or are merely spectators.

Conclusion

Embracing creative approaches significantly enhance research result dissemination, especially in informal settings like festivals, broadening audience reach beyond engaged participants (Sánchez Vidal et al. 2023).

By participating in outreach activities, students learn that explaining the results is an important part of the research process, thus amplifying the effectiveness of Citizen Science as an educational tool.

Disseminating results in neighborhoods not only showcases research but also acknowledges citizens' active role, empowering them as community contributors. This recognition fosters active citizenship, improves critical thinking, promotes changes in attitudes and collaboration among various stakeholders.

It's essential to emphasize that sharing project results beyond participants or community strengthens the concept of citizen science as more than just a means of collecting evidence. It should be regarded as an essential component of any project. Finding innovative ways to encourage interaction between research and society is paramount to maximize the impact of its outcomes and drive meaningful societal changes.

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