

# THE CITIZEN SCIENCE APPRAISAL TOOL (CSAT)

## Contents

1. Introduction to the CSAT
2. CSAT Scoring System
3. Citizen Science Appraisal Tool
4. Background of CSAT Section Descriptors
5. CSAT Level of engagement
6. Example of CSAT evaluation

## 1. Introduction to the CSAT

The Citizen Science Appraisal Tool (CSAT) (Table 3) was developed to evaluate the quality of CS and other participatory approaches. Quality is defined here in relation to the levels of active engagement and partnerships utilised by CS studies. <sup>[1]</sup> These two factors of engagement and partnerships are evaluated through a lifecycle approach <sup>[2]</sup> starting with the aims of a study through to its outcomes and future impacts, and considers the scientific standards, participation, data quality, and dissemination, which are elements of good quality CS. <sup>[3, 4]</sup> The tool development was guided by the European Citizen Science Association (ECSA) 10 principles, <sup>[3]</sup> Critical Appraisal Skills Programme (CASP) tools <sup>[5, 6]</sup> and encompassed three levels of engagement: contributory (*for the people*); collaborative (*with the people*); or co-productive (*by the people*). <sup>[7]</sup>

The tool gives equal weight to all questions to encompass both CS engagement and scientific standards. Active engagement and developing real-world outcomes are crucial elements of CS <sup>[1, 8]</sup> alongside demonstrating validity, transparency and appropriateness of methods and data. <sup>[9-11]</sup> Providing equal weight enables the tool to assess the quality of CS engagement and scientific standards, which are elements of good quality CS. <sup>[3, 4]</sup>

## 2. CSAT Scoring System

A total of 16 questions are presented, scoring points based on the ability to meet the answer: Yes =2; Unsure =1, No = 2. Each question should be scored, with the scores added together to produce a final score. Using the low to high categories, the final score will indicate a study or projects quality.

### 3. Citizen Science Appraisal Tool

Section	Question	Y	N	?
A. Science & Research	1) Is there a clear statement of the aims, objectives or goals of the study?			
	2) Is it clear that the study used a citizen science approach?			
B. Leadership & Participation	3) Is the degree of active engagement or participation of citizens identified clearly by the study?			
	4) Are the roles, responsibilities and type of partnership between citizens, scientists and stakeholders identified and transparent?			
C. Delivery & Data	5) Is the extent to which citizen scientists are actively engaged or collaborate in the data collection, analysis, and use/dissemination clear?			
	6) Are citizen science data limitations or biases considered by the study?			
	7) Are the main findings of the study clearly described?			

<p>D. Outcome, evaluation &amp; open data</p>	<p>8) Are the study's outcomes a direct result from the data-driven strategies and solutions generated by the citizen scientists?</p>			
	<p>9) Do the outcomes of the study have 'real world' decision making implications or impact?</p>			
	<p>10) Does the study report intention to track and/or tracking of long-term impacts, changes or 'ripple effects' of the study?</p>			
	<p>11) Does the study report any evaluation of citizen knowledge, attitudes, actual and/or intended behaviours?</p>			
	<p>12) Does the publication report any accessible dissemination plans or intentional mechanism for sharing the study and its outcomes with citizens?</p>			
	<p>13) Are citizens invited to review or participate in the study's publication process?</p>			
	<p>14) Are the study's results and outcomes published in an open access format and/or shared in a publicly accessible format?</p>			
	<p>15) Are citizen scientists acknowledged in the study's results and publications?</p>			

	16) Does the publication provide any critical evaluation of the study, methods and/or examination of its limitations?			
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1. Scores will be categorised using the following scale system, adapted from Wijewardhana et al <sup>[12]</sup> checklist:

2.

<b>Low (0-6)</b>	<b>Low- Medium (7-12)</b>	<b>Medium (13-19)</b>	<b>Medium-High (20-26)</b>	<b>High (27-32)</b>
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## 4. Background of CSAT section descriptors

### *(1) Science & Research*

Section 1 identifies the aims, objectives, and/or goals of the study and clarifies that a CS approach has been used. This can demonstrate the validity and appropriateness of the research design and methods, <sup>[5, 10]</sup> and if studies have intentionally designed their approaches to demonstrate good quality CS. The presence of these aspects can strengthen CS and transition it towards being viewed as ‘genuine’ science in the traditional scientific community. <sup>[13]</sup>

### *(2) Leadership and Participation*

Section 2 demonstrates the degree of active engagement of citizens within the study and the presence of a partnership between citizens and scientists, which are both principles presented by ECSA. <sup>[1, 3]</sup> Clear and planned engagement of citizens, with engagement of citizens throughout the entire process preferential, can demonstrate good quality. <sup>[1, 13]</sup> A transparent partnership and expectations can further strengthen the level of CS engagement, as it can shift citizens from ‘participant’ to ‘active researcher’. <sup>[3]</sup>

### *(3) Data and delivery*

Section 3 identifies studies who have fully engaged citizens in the data collection, analysis and dissemination processes. This level of active engagement is encouraged in CS approaches and demonstrates good quality CS. <sup>[3, 7]</sup> This section also identifies if studies have considered the quality and reliability of data, as well as any biases, errors or limitations that may be present, which is important for CS findings to be integrated and trusted within the scientific community. <sup>[9, 11]</sup>

### *(4) Outcomes, evaluation, and open data*

Section 4 identifies the level of CS engagement throughout the study processes, the presence of sustainable or ‘real world’ outcomes, critical evaluations of citizens or the study processes, and intentional mechanisms for disseminating outcomes, which are all indicators of good quality CS. <sup>[1, 3, 13]</sup> Fully engaging and empowering citizens, such as through co-production,

aligns with ECSA CS values for preferred levels of engagement. <sup>[1, 3]</sup> The presence of ‘real world’ impacts or pathways can demonstrate sustainability of CS activities, such as through the continuation of community-engage CS activities, <sup>[7, 14-16]</sup> which are key for strengthening CS projects. <sup>[17]</sup> Providing a critical evaluation of a study’s processes can demonstrate quality, trustworthiness, and transparency, <sup>4</sup> and the evaluation of citizen knowledge or intended behaviours can indicate quality assurance of a project’s delivery and ensuring participant understanding or learning. <sup>[13]</sup> Lastly, having accessible and open dissemination of outcomes is good practice <sup>[3] 4</sup> and can provide the opportunity for citizens to ‘see’ their data, which can lead to long-term sustainability of CS studies. <sup>[1, 3, 13]</sup>

## 5. CSAT levels of engagement

The CSAT evaluates three different types of citizen science participation to guide the review identified by King et al. <sup>[18]</sup> These are:

- 1) **‘For the people’** – Contributory level of citizen science where citizens have limited engagement and are only involved to provide data (i.e. usually in the form of personal information or a biological sample). All other aspects of the research process are directed by the researchers.
- 2) **‘With The People’** - A type of collaborative citizen science where citizens actively and systematically collect data on a specific phenomenon (i.e. citizens involved in bird counts or online crowdsourcing). The data is then analysed, interpreted and disseminated by researchers and not citizen scientists.
- 3) **‘By the people’** – Produces a partnership or collaboration between citizen scientists and researchers in which citizens actively engage in the entire research process to drive and steer questions, objectives, collection, and interpretation of data, and developing and advocating outcomes and changes.

Studies may use the following methods, approaches or key words to describe this participation at any stage of design or methods to be included: (1) Citizen science (2) Citizen scientist/s or Citizen engagement; (3) Participatory (research, approaches, methods); (4) Participatory Action; (5) Collaborative/Collaboration; (6) Engagement; (7) Partnership; (8) Resident-engaged; (9) Community-Based Participatory Research (CBPR); (10) Advocacy/Advocate; (11) ‘Our Voice’; (12) Co-production; (13) For the people; (14) By the people; (15) With the people.

## 6. Example of CSAT Evaluation

The example provided below for Barrie et al. [19] was presented as part of the systematic scoping review (Wood et al., 2022). Each section provides a reason or justification for the score provided.

Author, Year	Question	Answer	Reason	Point
Barrie et al. (2019)	1	Yes	This pilot study aimed to test a new smart phone-based audit tool using an innovative methodology—citizen science—in order to explore how and why older people engage with public green spaces.	2
	2	Yes	A citizen science approach with a co-created model was used to evaluate public green spaces not based on researchers' valued judgement	2
	3	Yes	Co-created whereas citizen scientists, older people not only collected data but were also engaged in preliminary analysis of the data and, most importantly, contributed feedback and ideas on the methods, process, audit tool and the design of the proposed larger project.	2
	4	Yes	Clear that citizens have the role of being trained as citizen scientists, collect data using the data tool and preliminary analysis of data and feedback of the tool.	2
	5	Yes	Citizen Scientists were engaged in collecting data in their own chosen locations using an online tool (or paper-based tool) and were engaged in the interpretation of this data through interviews and preliminary analysis. No dissemination was discussed by the paper.	2

6	Yes	This pilot engaged a small, self-selected group of adults interested in participating in citizen science and may not represent the general older population. Further work needs to be done with wider groups of older adults, including those with reduced mobility, greater frailty and/or poorer health, and from different cultural backgrounds to test both the potential and reliability of the audit tool.	2
7	Yes	Broken down into use of tool, audit of data and participant reflection on senior citizen science.	2
8	Unclear	The main findings of the project are based on the data collected by citizen scientists using the online/paper tool in their chosen locations and provided an understanding of key design elements for these individuals. However, it was unclear if they were actively engaged in the development of the project and no solutions provided to this but instead the focus was on evaluating the citizen scientists' experiences in the study and the use of the tool.	1
9	Yes	The findings provide a pathway to real-world decision making in terms of the design elements citizens highlighted in green spaces, alongside information of technology and becoming comfortable with it.	2
10	Unclear	Although the article says 'Participants showed a keenness to be further engaged with future citizen science projects beyond just data collection, indicating that whenever possible they would like to be involved in all stages of future research projects' which shows a sustainable element of the citizen science process, it does not report any 'ripple-effects' or highlight any projects participants have been involved in since.	1
11	Yes	Citizens were involved in evaluating the tool and citizen science approach.	2
12	No	None reported.	0



	13	No	None reported.	0
	14	Yes	Open access	2
	15	Yes	Participants acknowledged in acknowledgements section.	2
	16	Yes	Citizens evaluated the project and the tool experience which were included in results and discussion.	2
<b>Total Score = 26 (Medium-High)</b>				

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