SI 1: Demographics of survey respondents

Table SI 1.1 Age, gender, education level, nationality and length of citizen science (CS) engagement. Results for the main CS stakeholder groups and for the total respondent sample are shown as means with interquartile range or as percentages. As respondents could chose up to three groups, the group sample sizes don't add up to 340

Stakeholder groups	**Citizen scientists (n=113)**	**CS project coordinators (n=79)**	**Researchers (n=75)**
Age	mean 53.2, sd=13.9 years	mean 44.9, sd=11.1 years	mean 42.2, sd=12.3 years
Gender	male 62%, female 38%, diverse 0%	male 47%, female 51%, diverse 1%	male 38%, female 63%, diverse 0%
Education	48% master degree, 21% doctoral degree, 14% vocational training, 6% bachelor's degree	45% master degree, 49% doctoral degree, 0% vocational training, 1% bachelor's degree	37% master degree, 57% doctoral degree, 2% vocational training, 2% bachelor's degree
Nationality	German 85.8%, Austrian 5.3%, Swiss 8.8%	German 74.7%, Austrian 13.9%, Swiss 11.4%	German 85.3%, Austrian 12.0%, Swiss 2.7%
Length of CS engagement	$\bar{x}$=9.6 years, sd=11.7, range: 0-55 years	$\bar{x}$=9.5 years, sd=10.3, range: 1-40 years	$\bar{x}$=4.3 years, sd=5.9, range: 0-30 years

Stakeholder groups	**Members of NGOs & the extra-curricular education sector (n=92)**	**Total sample (n=340, including four main groups plus teachers, CS funders and others)**
Age	mean 48.8, sd=13.2 years	$\bar{x}$= 48.8, sd=13.5 years
Gender	male 58%, female 40%, diverse 1%	male 51%, female 48%, diverse 1%
Education	43% master degree, 44% doctorate degree, 4% vocational training, 1% bachelor's degree	49% master degree, 33% doctoral degree, 6% vocational training, 5% bachelor's degree
Nationality	German 80.4%, Austrian 11.9%, Swiss 7.6%	German 84.4%, Austrian 7.4%, Swiss 8.2%
Length of CS engagement	$\bar{x}$=10.1 years, sd=10.9, range: 0-50 years	$\bar{x}$=7.4 years, sd=10.2, range: 0-63 years. Overall, 12% were active in CS for < 1 year; 35% for 1-3 years and 34% for 4-10 years; 19% were active in CS for >10 years.

Table SI 1.2 Percentage of respondents affiliated to environment-related CS projects. Unique discipline affiliations were determined from the multiple choice data (Table SI 1.3) in the order shown below

Research discipline	**Coordinators (n=79)**	**Citizen scientists (n=113)**	**Researchers (n=75)**	*Average percentage*
biology	53.16	50.44	41.33	48.31
environmental sciences	13.92	6.19	10.67	10.26
agricultural sciences	3.79	1.77	1.33	2.29
geography	1.27	0.88	4.00	2.05
sum	*72.14*	*59.28*	*57.33*	*62.91*

Table SI 1.3 Cumulative percentage distribution of research disciplines
Multiple-choice question with max. 3 answers to allow indication of inter-disciplinary projects. The percentage of respondents is shown for each discipline. Disciplines are ordered by the CS coordinators' response frequencies

Research discipline	Coordinators (n=79)	Citizen scientists (n=113)	Researchers (n=75)
biology	53.16	50.44	41.33
environmental sciences	30.38	28.32	21.22
agricultural sciences	12.66	4.42	10.67
health sciences	10.12	2.65	10.67
geography	6.33	1.77	6.67
history	5.06	15.04	5.33
informatics	5.06	2.65	2.67
educational sciences	5.06	0.00	5.33
architecture	3.78	3.54	1.33
astronomy	3.78	5.31	0.00
chemistry	2.53	0.88	4.00
genealogy	2.53	27.43	1.33
communication sciences	2.53	1.77	5.33
cultural sciences	2.53	2.65	1.33
arts	2.53	0.00	0.00
literature	2.53	0.00	1.33
psychology	2.53	2.65	5.33
sociology	2.53	2.65	6.67
linguistics	2.53	1.77	4.00
anthropology	1.27	0.00	0.00
media sciences	1.27	0.00	0.00
meteorology	1.27	0.00	1.33
philosophy	1.27	0.88	0.00
political sciences	1.27	0.00	1.33
economics	1.27	0.00	1.33
archaeology	0.00	0.00	0.00
mathematics	0.00	0.00	2.67
physics	0.00	0.00	4.00
engineering	0.00	1.77	4.00
information sciences	0.00	0.88	4.00
other discipline	15.19	6.19	10.67

Analysis of missing data

Nineteen percent (n=81) of the respondents who started the survey (n=421) dropped out before completing the first survey section containing the group specific questions. One possible reason for this could be that some of the very CS specific questions addressed at the stakeholder groups were not answerable for participants who had only recently become interested or involved in CS. The length of the survey (average completion time 18 minutes) is another possible reason for dropouts especially in the second part of the survey. The survey was slightly longer for those who assigned themselves to two or three stakeholder groups and thus also had two or three sections of group-specific questions to answer.
However, we found no significant difference regarding dropout numbers between…

- respondents who had been active in CS for less than a year, for 1-3 years, for 3-10 years, or for more than 10 years (Chi Square test p=0.74, n.s.)
- the surveyed CS project coordinators and other respondents (Chi Square test p=0.83, n.s.)
- the surveyed researchers and other respondents (Chi Square test p=0.28, n.s.)
- the surveyed NGO members and other respondents (Chi Square test p=1, n.s.)
- the surveyed citizen scientists and other respondents (Chi Square test p=0.99, n.s.)
- respondents who answered the group-specific questions for one, two or three CS stakeholder groups (Chi-Square test p=0.17, n.s.)
- respondents from Germany, Austria and Switzerland (Chi Square test p=0.53, n.s.)

Further, the gender distribution of respondents who answered the demographic items at the end of our survey is balanced. Based on these results, we assume that missing data have no relevant distorting effect on the overall survey results.

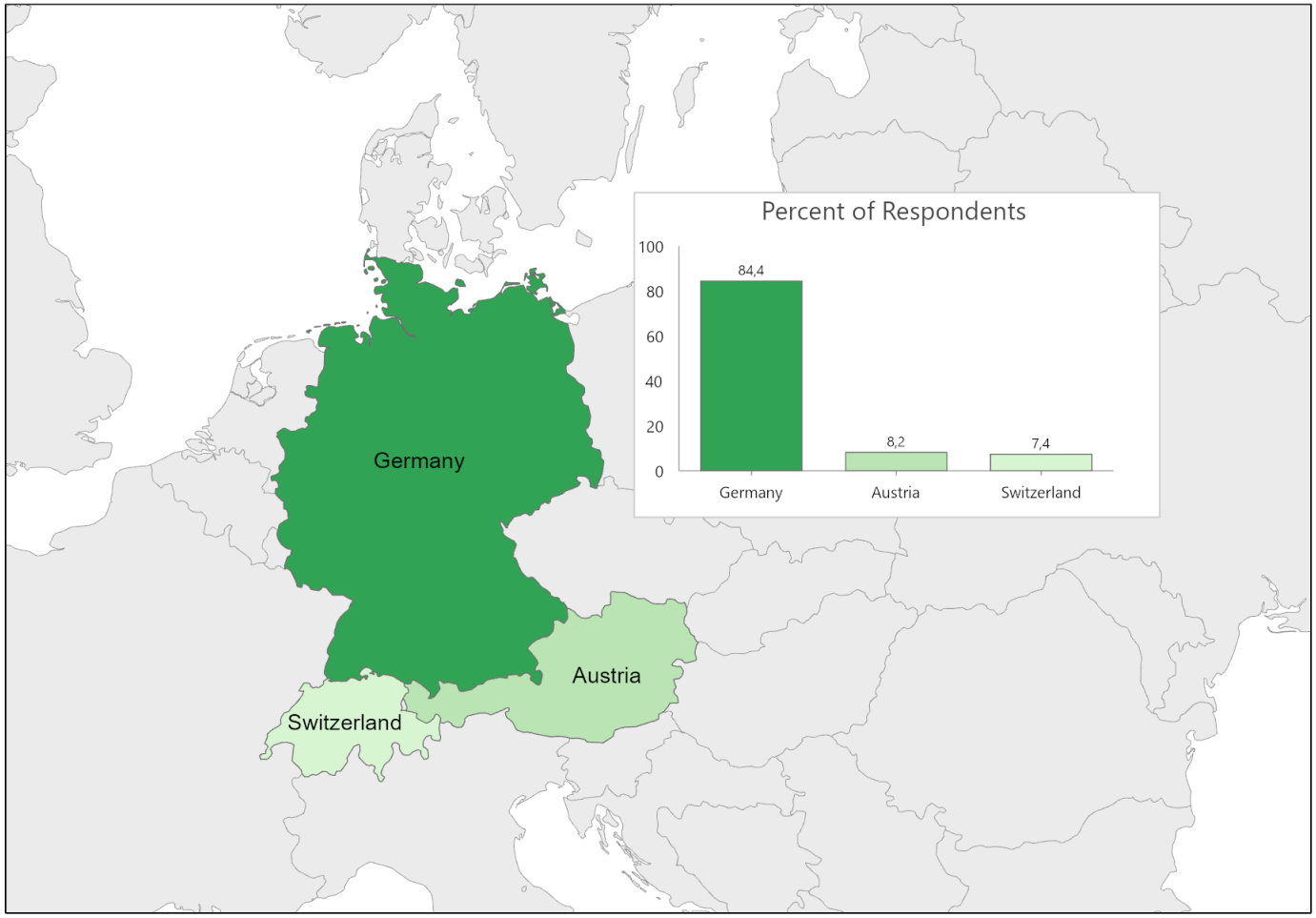


Fig. SI 1.1 Map of the survey study area Germany, Austria and Switzerland in Central Europe. Although we used the same recruitment approach in all three countries, and clearly indicated that the survey aimed to analyze the status quo of CS in all three countries, response rate was much higher in Germany than in Austria and Switzerland. Both the Citizen Science Green Paper (Bonn et al. 2016) and White Paper (Bonn et al. 2022) for Germany were developed jointly by the three countries and are also used as a strategic tool in Austria and Switzerland. Still, we assume that the German CS community in particular wanted to support the authors' goal to collect evidence for the White Paper Citizen Science Strategy 2030 for Germany.

SI 2: Scientific practices and outcomes of citizen science

Table SI 2.1A How is data quality ensured in the citizen science project you are involved in? *Multiple-choice question*. Response percentages for each of the items and the four main stakeholder groups are shown below. Differences between the group's absolute response frequencies were tested using Chi Square tests with Bonferroni Correction

Items	CS coordinators (n=77)	Researchers (n=67)	NGO members (n=81)	Citizen scientists (n=105)	Chi Square test and Bonferroni correction
Preparatory measures (before data collection)	51.95	34.33	41.98	29.52	χ^2= 10.32, df = 3, p<0.05* Bonf. correction n.s.
Accompanying measures (during data collection)	70.13	34.33	54.32	44.76	χ^2= 20.72, df = 3, p<0.001***. Bonf. correction: coordinators p<0.001***, researchers p<0.05*
Retrospective measures (after data collection)	66.23	44.78	58.02	44.76	χ^2=10.92, df = 3, p<0.05*. Bonf. correction n.s.
I don't know	0.065	0.343	0.209	0.314	χ^2=20.63, df = 3, p<0.001***. Bonf. correction: coordinators p<0.001***

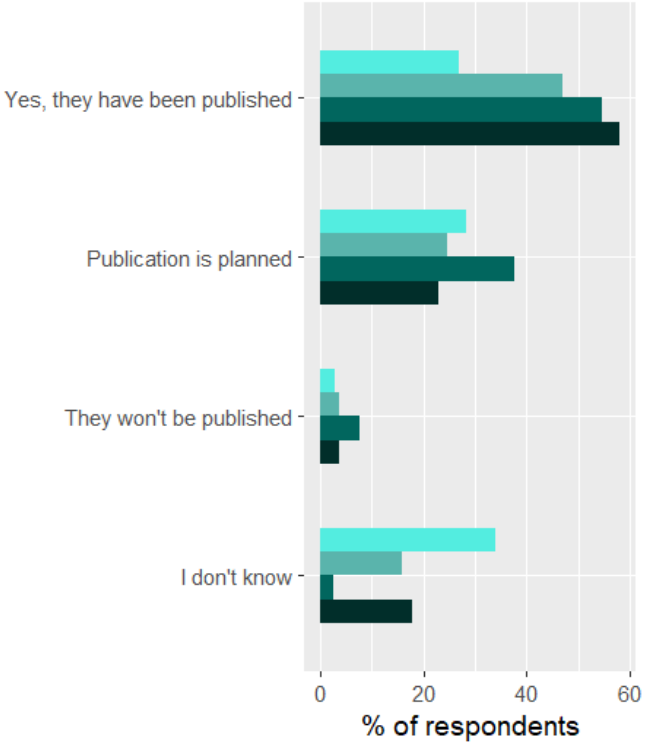
Table SI 2.1B Specific data quality assurance and control measures taken in the respondents' CS projects. *Multiple-choice question, subitems for items in Table 1A* Response percentages for each of the items and the four main stakeholder groups are shown below. 1-3: preparatory, 4-16: accompanying, and 17-28: retrospective measures

Items	CS coordinators (n=77)	Researchers (n=67)	NGO members (n=81)	Citizen scientists (n=105)	Chi Square test and Bonferroni correction
1. Project specific data quality guidelines	32.47	23.88	29.63	23.81	n.s.
2. Testing of the participants' knowledge and/or skills	9.09	10.45	4.94	5.71	n.s.
3. Training for participants	31.17	22.39	25.93	17.14	n.s.
There are no data quality assurances measures before data collection	3.9	0	1.23	2.86	NA
4. Accompanying and support of participants during data collection	35.06	16.42	33.33	20	χ^2=10.69, df = 3, p<0.05*, Bonf. correction n.s.
5. Automatic data filtering	7.79	4.48	8.64	1.9	n.s.
6. Automatic image, text or sound classification/recognition	2.6	2.99	3.7	4.76	n.s.
7. Automatic plausibility- & completeness control with data entry tool	9.09	7.46	9.88	10.48	n.s.

Items (Table SI 2.1B continued)	CS coordinators (n=77)	Researchers (n=67)	NGO members (n=81)	Citizen scientists (n=105)	Chi Square test and Bonferroni correction
8. Collection of evidence (e.g. photos, samples for re-examination)	35.06	20.9	29.63	20.95	n.s.
9. Collection of metadata	20.78	8.96	17.28	6.67	χ^2=10.11, df = 3, p <0.05*, Bonf. correction n.s.
10. Manual data filtering	23.38	11.94	13.58	11.43	n.s.
11. Self-assessment of data quality by participants	9.09	1.49	8.64	11.43	n.s.
12.Standardised monitoring e.g. through protocols	42.86	23.88	30.86	20	χ^2=12.35, df = 3, p<0.01** Bonf. correction coordinators p<0.05*
13. Standardisation via calibrated measuring devices	12.99	11.94	11.11	4.76	n.s.
14. Ranking of the participants' knowledge and/or skills	6.49	0	3.7	3.81	n.s.
15. Repeated sampling/measuring	19.48	13.43	8.64	10.48	n.s.
16. Testing of the participants' knowledge and/or skills	9.09	1.49	7.41	5.71	n.s.
There are no quality assurance measures during data collection	0	0	0	0.95	NA
17. Analysis of data together with participants	9.09	8.96	7.41	4.76	n.s.
18. Automatic data filtering	10.39	8.96	11.11	7.62	n.s.
19. Automatic image, text or sound classification/recognition	2.6	4.48	1.23	3.81	n.s.
20. Comparison of CS data with known, (measured) current status	16.88	13.43	17.28	6.67	n.s.
21. Comparison of CS and expert data	24.68	14.93	18.52	6.67	χ^2= 11.81, df = 3, p<0.01**, Bonf. correction citizen scientists p<0.05*
22. Examining of metadata	12.99	8.96	9.88	5.71	n.s.
23. Expert appraisal of CS data and samples	41.56	22.39	30.86	28.57	n.s.
24. Manual data filtering	36.36	22.39	20.99	14.29	χ^2=12.56, df = 3, p<0.01**, Bonf. correction coordinators p<0.01**
25. Normalisation of CS data	6.49	8.96	3.7	0	χ^2= 9.33, df = 3, p= 0.03, Fishers p=0.01** Bonf. correction n.s.

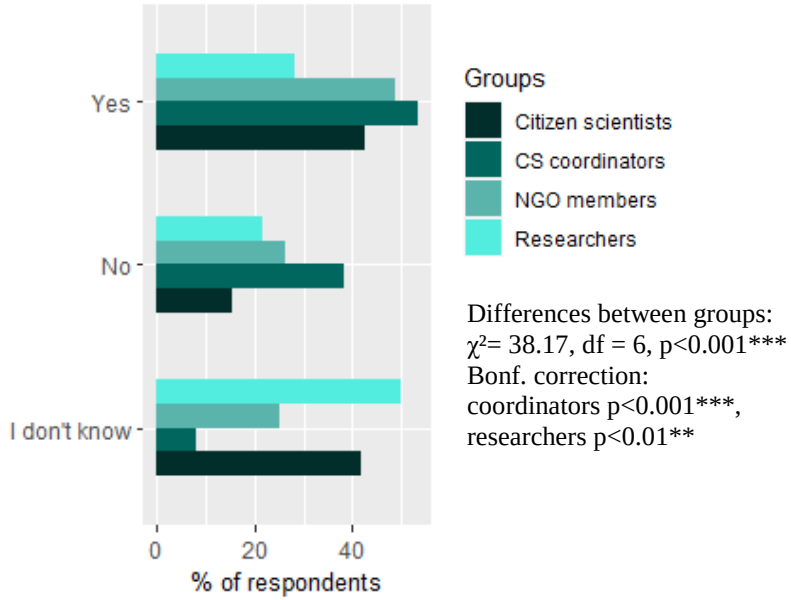
Items (Table SI 2.1B continued)	CS coordinators (n=77)	Researchers (n=67)	NGO members (n=81)	Citizen scientists (n=105)	Chi Square test and Bonferroni correction
26. Ranking of the participants' experience/performance	6.49	1.49	3.7	3.81	n.s.
27. Systematic data storage and archiving	31.17	13.43	23.46	15.24	χ^2=9.61, df = 3, p<0.05*, Bonf. correction n.s.
28. Triangulation of CS data	5.19	4.48	6.17	1.9	n.s.
There are no quality control measures after data collection	0	0	0	0.95	NA

Fig. SI 2.1 Have the data and results from your citizen science (CS) project already been published? N=77 coordinators, 67 researchers, 81 NGO members, 105 citizen scientists



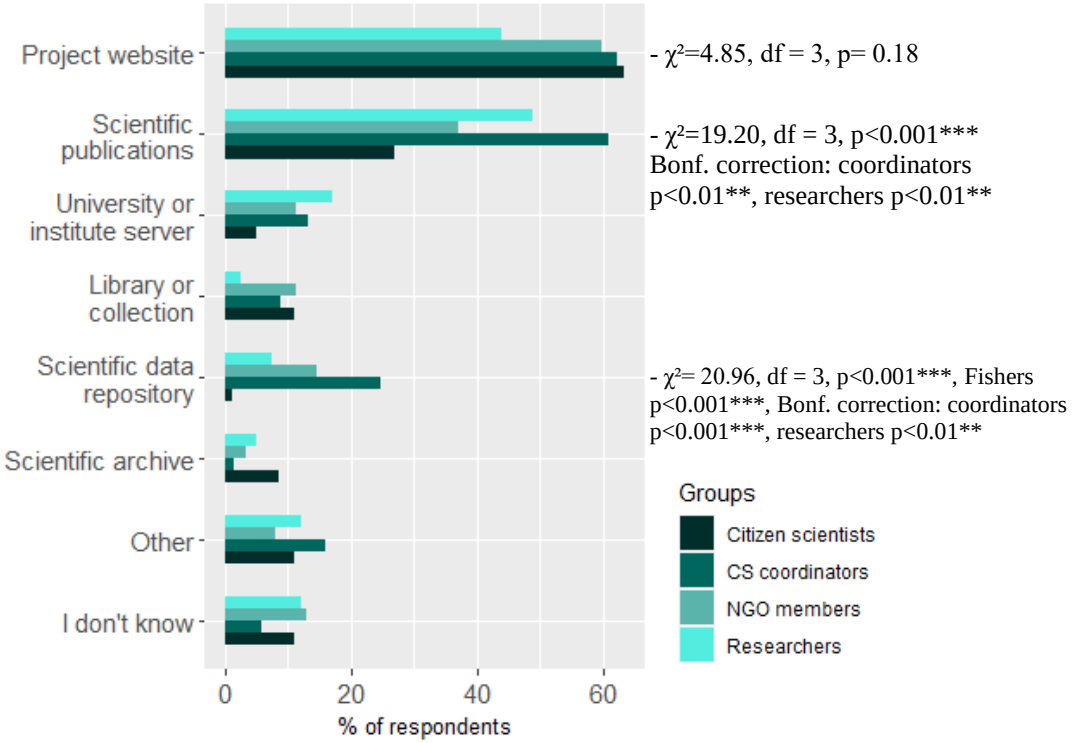
Differences between groups:
χ^2= 35.66, df = 9, p < 0.001***,
Fisher's Test p < 0.001***,
Bonf. correction: researchers p<0.01**

Fig. SI 2.2 Does your CS project have an official regulation for handling data, such as a data management plan, which regulates the storage, processing, publication and archiving of data? Single-choice question. N=75 coordinators, 63 researchers, 77 NGO members, 104 citizen scientists



Differences between groups:
χ^2= 38.17, df = 6, p<0.001***
Bonf. correction:
coordinators p<0.001***,
researchers p<0.01**

Fig. SI 2.3 Where have the data and results from your CS project been published? Multiple-choice question. N= 69 coordinators, 41 researchers, 62 NGO members, 82 citizen scientists



- χ^2=4.85, df = 3, p= 0.18

- χ^2=19.20, df = 3, p<0.001*** Bonf. correction: coordinators p<0.01**, researchers p<0.01**

- χ^2= 20.96, df = 3, p<0.001***, Fishers p<0.001***, Bonf. correction: coordinators p<0.001***, researchers p<0.01**

Fig. SI 2.4 Where is the data from your CS project archived? Multiple-choice question, n=98 data managers

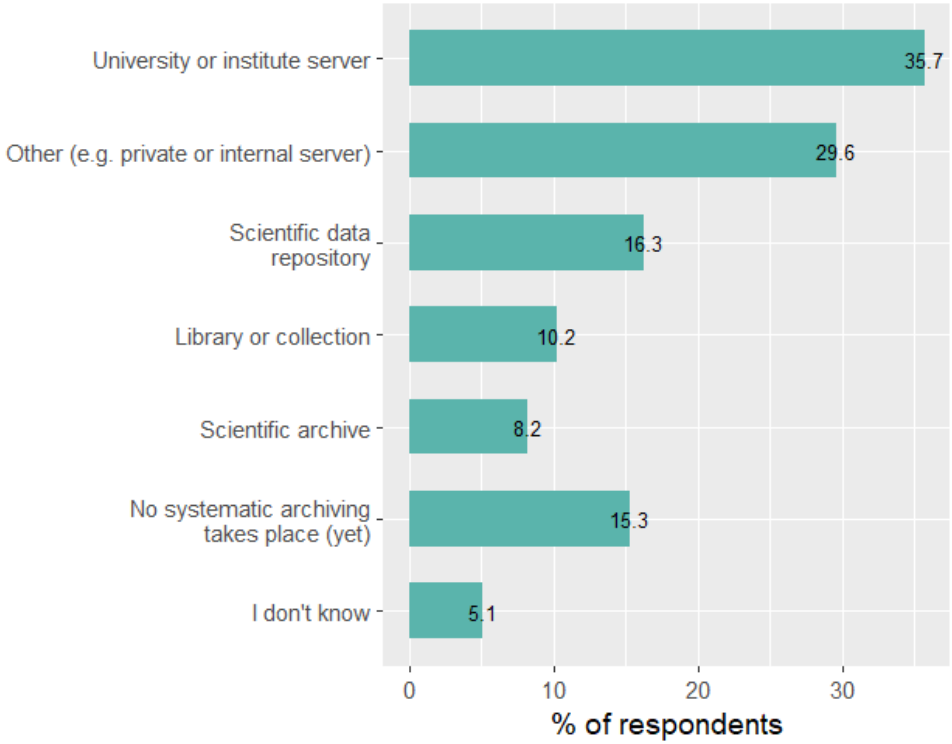


Fig. SI 2.5 What kind of support would be helpful for you to collect and archive your CS data? 7-point Likert scale, n=81 respondents who stated wishing for more advice on implementing CS projects

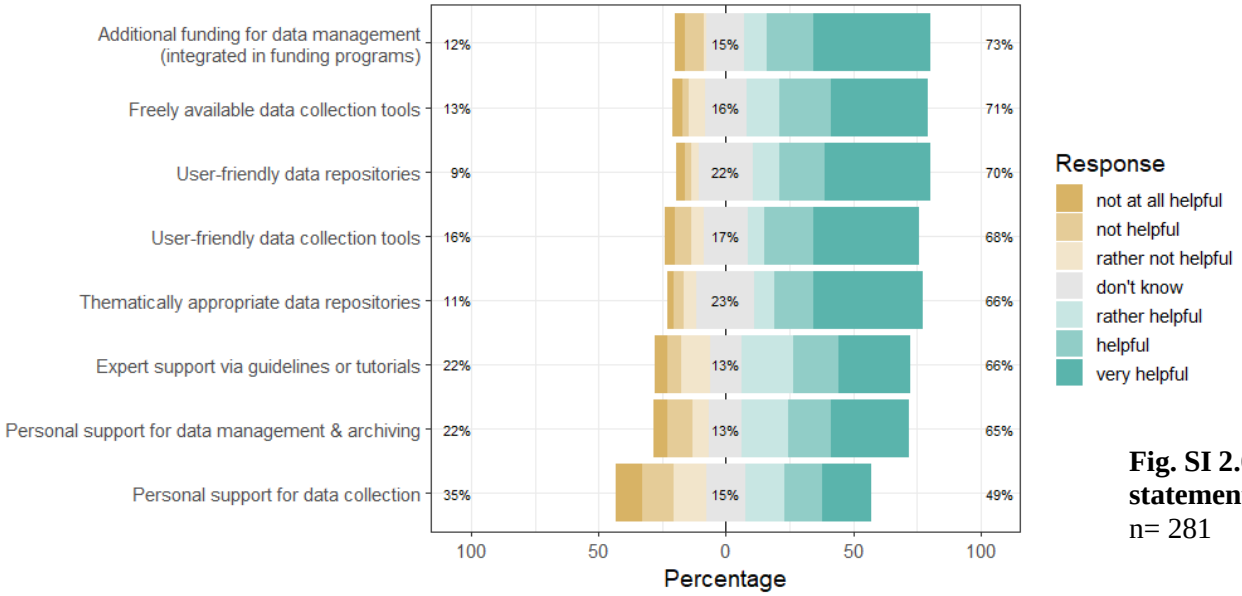
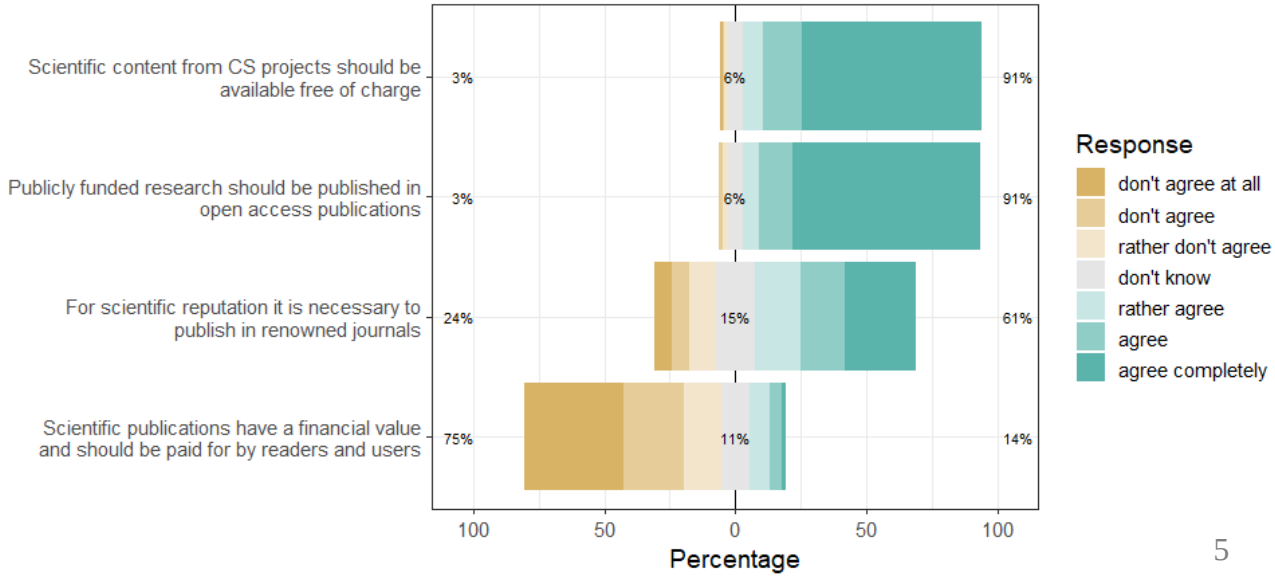


Fig. SI 2.6 Please specify to what extent you agree or disagree with the following statements about Open Access publishing in the field of CS. 7-point Likert scale, n= 281



SI 3: Citizen science impact on participant learning

Table SI 3.1 Which forms of learning support have you used during your citizen science activity? (Multiple-choice question to citizen scientists)
Which forms of learning support does your project offer to citizen scientists? (Multiple-choice question to CS project coordinators)

Forms of learning support	Citizen scientists (n=113)	CS project coordinators (n=79)
Written information material	48.3 %	70.9 %
Systematic feedback on project activities	44.7 %	37.9 %
Mentoring by fellow citizen scientists	25.4 %	27.9 %
Opportunity to take responsibility for important project tasks	21.1 %	25.3 %
Onsite training with experts	19.3 %	58.2 %
Interactive media	17.5 %	31.7%
Online training	13.2 %	31.7 %

Fig. SI 3.1 To which project type does your citizen science (CS) project belong? Single-choice question, n=112 citizen scientists and n=76 coordinators

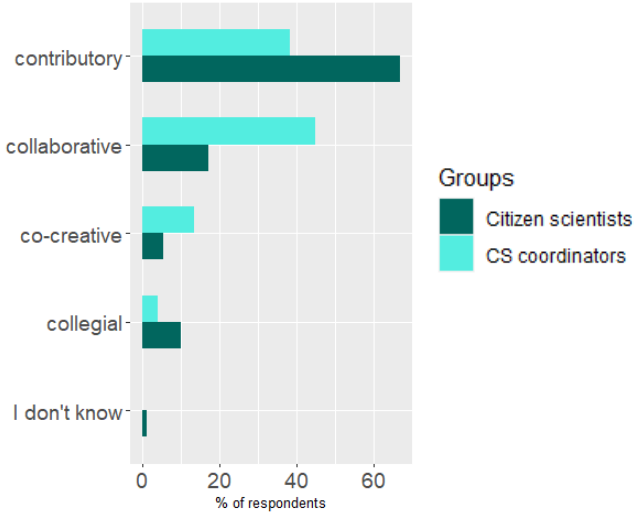


Fig. SI 3.2 What is the spatial scope of your CS project? Single-choice question, n=111 citizen scientists, n=74 coordinators

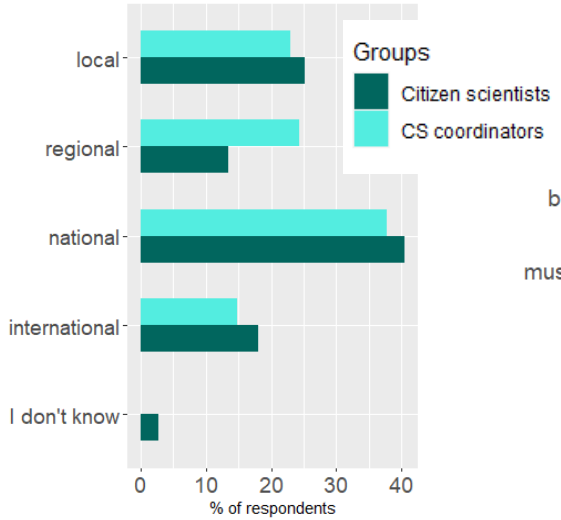


Fig. SI 3.3 Where does the research in your CS project take place? Multiple-choice question with max. 3 answers, n=113 citizen scientists, 79 coordinators

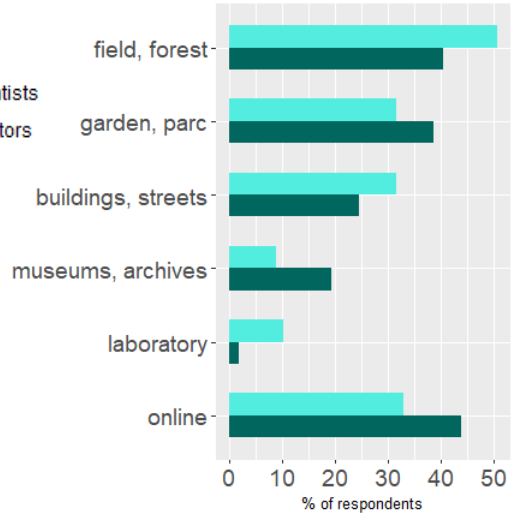
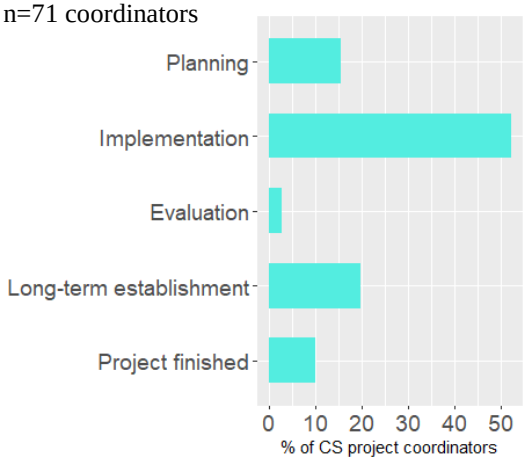


Fig. SI 3.4 At the moment, which project phase is your CS project in? Single-choice question, n=71 coordinators



Effects of different forms of learning support on the citizen scientists learning outcomes: Ordinal logistic regression models

First, for each learning outcome (Tables SI 3.2.1-8), relationships between the citizen scientists Likert rating of the respective outcome and each of the listed predictor variables were analyzed separately with ordinal logistic regression models. Then, predictors with $p \leq 0.1$ were fitted into multiple ordinal regressions for each learning outcome. The least significant predictors were removed step by step until a significant model for each learning outcome was reached. For significant predictors, 95% confidence intervals are shown square brackets.

Table SI 3.2.1 Content knowledge

	Predictor variable	significance/ test results
Demo-graphics	Gender (female, male)	n.s.
	Age (numeric)	n.s.
	Education (sec. school, vocational training, bachelor, master, PhD)	n.s.
	Length of CS engagement (numeric)	n.s.
	CS project type ('contri-butory', 'collaborative/co-creative/collegial')	n.s.
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	coeff= 0.90, SE 0.38, t= 2.37, p<0.05*, CI [0.15,1.65]
	Mentoring by fellow citizen scientists	n.s.
	Taking responsibility for important project tasks	n.s.
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	coeff= 1.48, SE 0.59, t=2.51, p<0.05*, CI [0.32,2.63]
	Interactive Media	n.s.

Content knowledge- multiple ordinal logistic regression

Predictor	Significance/ test results	Residual Deviance	AIC
Feedback on project activities	coeff= 0.77, SE 0.39, t=1.98, p=0.05*, CI [0.009,1.54]	240.15	252.15
Audiovisual Media	coeff= 1.34, SE 0.59, t=2.24, p=0.03*, CI [0.16,2.51]		

Table SI 3.2.2 Scientific skills

	Predictor variable	significance/ test results
Demo-graphics	Gender (female, male)	n.s.
	Age (numeric)	coeff=0.03, SE 0.01, t=2.09, p<0.05*, CI [0.002,0.06]
	Education (sec. school, vocational training, bachelor, master, PhD)	n.s.
	Length of CS engagement (numeric)	n.s.
	CS project type ('contri-butory', 'collaborative/co-creative/collegial')	n.s.
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	coeff=0.95, SE 0.35, t=2.68, p<0.01**, CI [0.25,1.64]
	Mentoring by fellow citizen scientists	coeff=1.14, SE 0.409, t=2.77, p<0.01**, CI [0.33,1.94]
	Taking responsibility for important project tasks	coeff=1.30, SE 0.44, t=2.94, p<0.01**, CI [0.43, 2.16]
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	coeff=1.22, SE 0.44, t=2.75, p<0.01**, CI [0.35,2.09]
	Interactive Media	n.s.

Scientific skills- multiple ordinal logistic regression

Predictor	Significance/ test results	Residual Deviance	AIC
Mentoring by fellow citizen scientists	coeff 1.02, SE 0.42, t=2.45, p=0.01*, CI [0.09, 1.87]	337.511	353.511
Taking responsibility for important project tasks	coeff=1.08, SE 0.46, t=2.38, p=0.02*, CI [0.20,1.99]		
Audiovisual Media	coeff=0.98, SE 0.45, t=2.17, p=0.03*, CI [0.09, 1.87]		

Table SI 3.2.3 Interest in science

	Predictor variable	significance/ test results
Demo-graphics	Gender (female, male)	n.s.
	Age (numeric)	n.s.
	Education (sec. school, vocational training, bachelor, master, PhD)	n.s.
	Length of CS engagement (numeric)	n.s.
	CS project type ('contri-butory', 'collaborative/co-creative/collegial')	n.s.
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	n.s.
	Mentoring by fellow citizen scientists	n.s.
	Taking responsibility for important project tasks	coeff= 1.03, SE 0.43, t= 2.43, p<0.05*, CI [0.19,1.86]
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	n.s.
	Interactive Media	n.s.

Interest in science- Multiple ordinal logistic regression

Predictor	Significance/ test results	Residual Deviance	AIC
Taking responsibility for important project tasks	coeff= 1.03, SE 0.43, t= 2.43, p=0.015*, CI [0.19,1.86]	351.234	363.236

Table SI 3.2.4 Attitude towards science

	Predictor variable	significance/ test results
Demo-graphics	Gender (female, male)	n.s.
	Age (numeric)	n.s.
	Education (sec. school, vocational training, bachelor, master, PhD)	n.s.
	Length of CS engagement (numeric)	coeff= 0.03, SE 0.02, t=2.13, p<0.05*, CI [0.062]
	CS project type ('contri-butory', 'collaborative/co-creative/collegial')	n.s.
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	n.s.
	Mentoring by fellow citizen scientists	coeff= 0.81, SE 0.41, t=1.97, p<0.05*, CI [0.003,1.62]
	Taking responsibility for important project tasks	coeff=0.95, SE 0.43, t=2.19, p<0.05*, CI [0.09,1.79]
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	n.s.
	Interactive Media	n.s.

Attitude towards science- Multiple ordinal logistic regression

Predictor	Significance/ test results	Residual Deviance	AIC
Mentoring by fellow citizen scientists	coeff= 0.81, SE 0.41, t=1.97, p=0.049*, CI [0.003,1.62]	351.24	363.34

Table SI 3.2.5 Experience of personal impact through CS

	Predictor variable	significance/ test results
Demo-graphics	Gender (female, male)	n.s.
	Age (numeric)	n.s.
	Education (sec. school, vocational training, bachelor, master, PhD)	n.s.
	Length of CS engagement (numeric)	n.s.
	CS project type ('contri-butory', 'collaborative/co-creative/collegial')	coeff=0.77, SE 0.36, t=2.08, p<0.05*, CI [0.046, 1.49]
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	n.s.
	Mentoring by fellow citizen scientists	coeff=0.85, SE 0.41, t=2.05, p<0.05*, CI [0.04,1.65]
	Taking responsibility for important project tasks	n.s.
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	n.s.
	Interactive Media	n.s.

Personal impact- Multiple ordinal logistic regression

Predictor	Significance/ test results	Residual Deviance	AIC
CS project type (collaborative/ co-creative/ collegial)	coeff=0.77, SE 0.37, t=2.08, p=0.037*, CI [0.046, 1.49]	316.113	328.113

Table SI 3.2.6 Experience of collective impact through CS

	Predictor variable	significance/ test results
Demo-graphics	Gender (female, male)	coeff=0.89, SE=0.39, t=2.24, p<0.05*, CI [0.11,1.67]
	Age (numeric)	coeff=0.03, SE=0.01, t=2.18, p<0.05*, CI [0.003,0.06]
	Education (sec. school, vocational training, bachelor, master, PhD)	n.s.
	Length of CS engagement (numeric)	n.s.
	CS project type ('contri-butory', 'collaborative/co-creative/collegial')	coeff=0.85, SE 0.39, t= 2.16, p<0.05*, CI [0.079,1.62]
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	coeff=0.83, SE 0.36, t=2.28, p<0.05*, CI [0.12, 1.54]
	Mentoring by fellow citizen scientists	coeff=0.97, SE 0.43, t=2.27, p<0.05*, CI [0.13,1.81]
	Taking responsibility for important project tasks	n.s.
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	n.s.
	Interactive Media	coeff=-0.87, SE 0.44, t= -2.01, p<0.05*, CI [-1.72,-0.02]

Collective impact- Multiple ordinal logistic regression

Predictor	Significance/ test results	Residual Deviance	AIC
CS project type (collaborative/ co-creative/ collegial)	coeff=0.90, SE 0.39, t=2.25, p=0.024*, CI [0.12,1.68]	259.28	271.28
Feedback on project activities	coeff= 0.83, SE 0.37, t=2.24, p= 0.025*, CI [0.105, 1.55]		

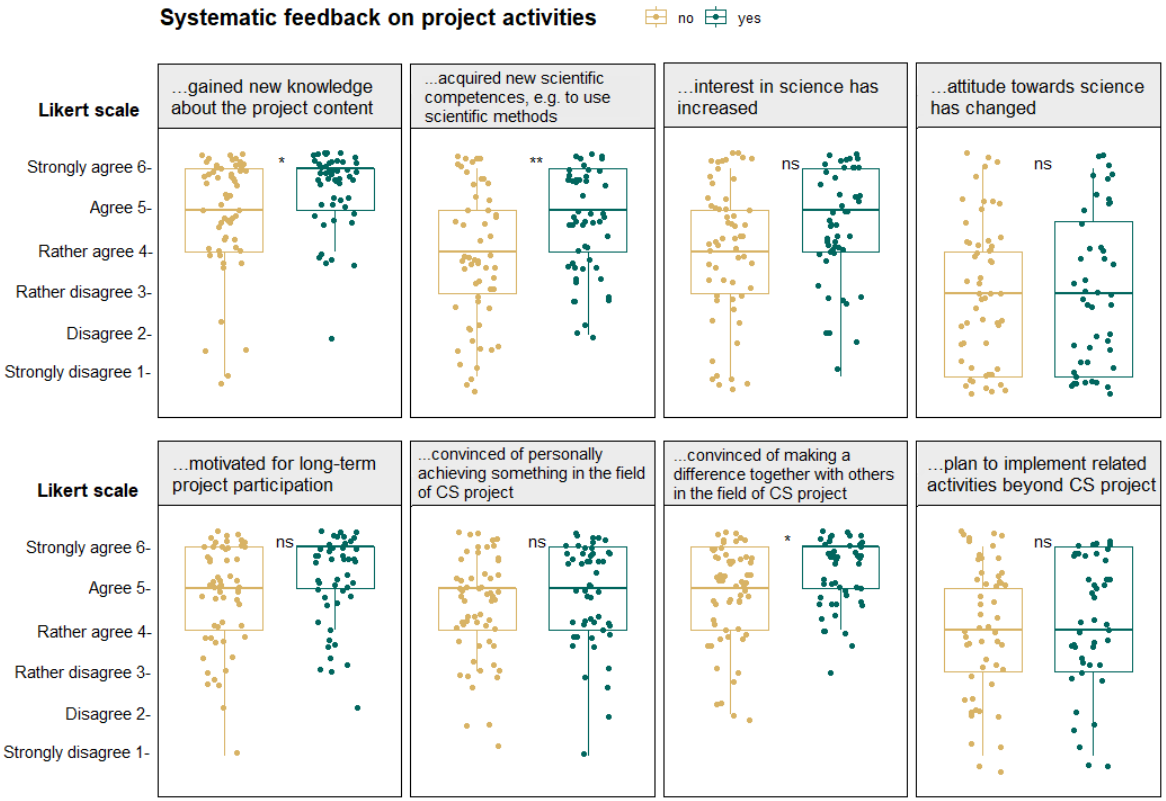
Table SI 3.2.7 Long-term project motivation		
	Predictor variable	**significance/ test results**
Demo-graphics	Gender (female, male)	n.s.
	Age (numeric)	coeff=0.03, SE 0.01, t=2.12, p<0.05*, CI [0.002,0.056]
	Education (sec. school, vocational training, bachelor, Mmaster, PhD)	n.s.
	Length of CS engagement (numeric)	n.s.
	CS project type (‘contri-butory’, ‘collaborative/co-creative/collegial’)	n.s.
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	n.s.
	Mentoring by fellow citizen scientists	coeff=0.91, SE 0.42, t=2.17, p<0.05*, CI [0.08,1.74]
	Taking responsibility for important project tasks	coeff=0.96, SE 0.48, t=2.01, p<0.05*, CI [0.02, 1.91]
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	n.s.
	Interactive Media	n.s.

Long-term project motivation - Multiple ordinal logistic regression			
Predictor	**Significance/ test results**	**Residual Deviance**	**AIC**
Mentoring by fellow citizen scientists	coeff=0.91, SE 0.42, t=2.17, p=0.03*, CI [0.08,1.74]	281.83	293.83

Table SI 3.2.8 Intention to implement further activities		
	Predictor variable	**significance/ test results**
Demo-graphics	Gender (female, male)	n.s.
	Age (numeric)	n.s.
	Education (sec. school, vocational training, bachelor, master, PhD)	n.s.
	Length of CS engagement (numeric)	n.s.
	CS project type (‘contri-butory’, ‘collaborative/co-creative/collegial’)	n.s.
Forms of received learning support (factor with levels yes, no)	Written information material	n.s.
	Feedback on project activities	n.s.
	Mentoring by fellow citizen scientists	n.s.
	Taking responsibility for important project tasks	n.s.
	Onsite Training	n.s.
	Online Training	n.s.
	Audiovisual Media	n.s.
	Interactive Media	n.s.

Fig. SI 3.5A Self-assessment of learning outcomes among citizen scientists in relation to different forms of learning support

Citizen scientists (n=113) were asked to rate their learning outcomes on a 6-point Likert-scale. Differences in self-reported learning outcomes between citizen scientists who received the respective support form (green boxplots) and those who did not receive the respective support form (yellow boxplots) were examined using Wilcoxon tests. Significance levels are indicated with asterisks (n.s. not significant; * p<0.05; ** p<0.01)

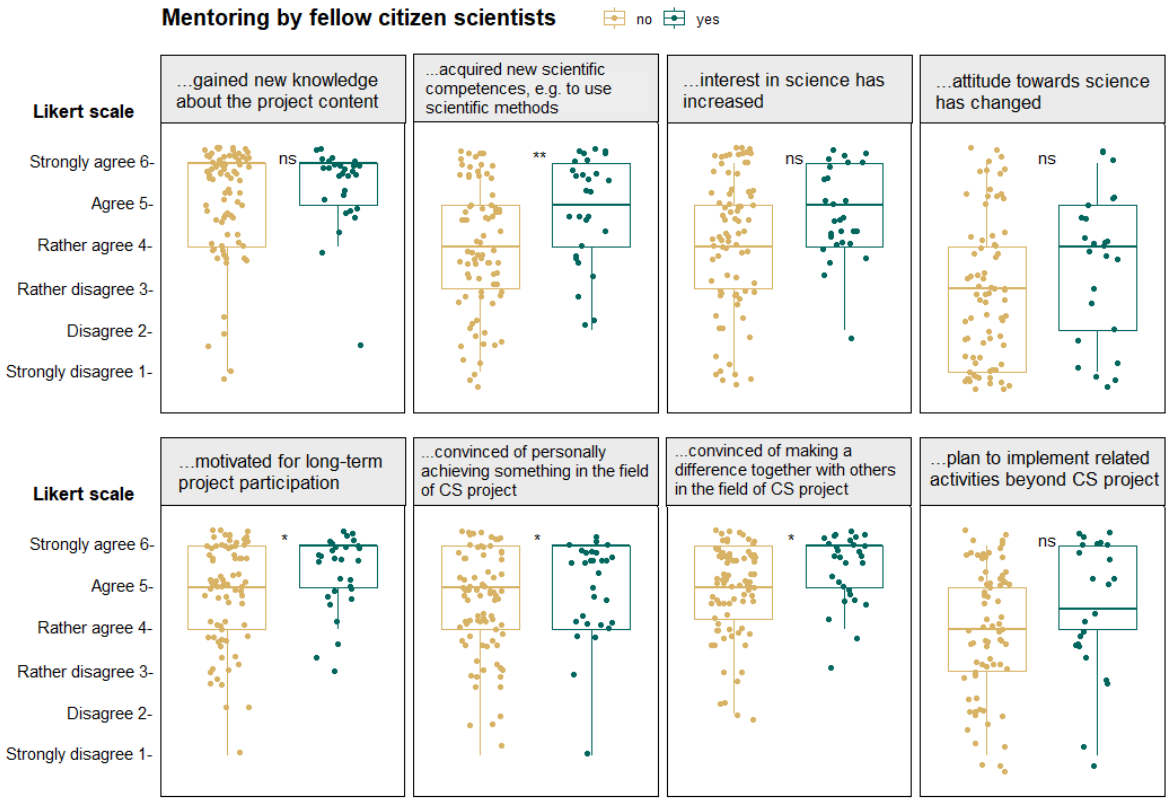


Differences in self-reported learning outcomes between citizen scientists who received systematic feedback on project activities (n 'yes') and those who did not (n 'no').

Learning outcome	n 'no'	n 'yes'	Wilcoxon test p-value	Wilcoxon effect size r
Content knowledge	59	51	0.018*	0.23
Scientific competences	56	51	0.007**	0.26
Interest in science	58	50	0.11 n.s.	
Attitude towards science	56	46	0.86 n.s.	
Long-term project motivation	57	49	0.06 n.s.	
Personal impact	59	51	0.07 n.s.	
Collective impact	60	51	0.02*	0.22
Further activities	52	44	0.56 n.s.	

Fig. SI 3.5B Self-assessment of learning outcomes among citizen scientists in relation to different forms of learning support

Citizen scientists (n=113) were asked to rate their learning outcomes on a 6-point Likert-scale. Differences in self-reported learning outcomes between citizen scientists who received the respective support form (green boxplots) and those who did not receive the respective support form (yellow boxplots) were examined using Wilcoxon tests. Significance levels are indicated with asterisks (n.s. not significant; * p<0.05; ** p<0.01)

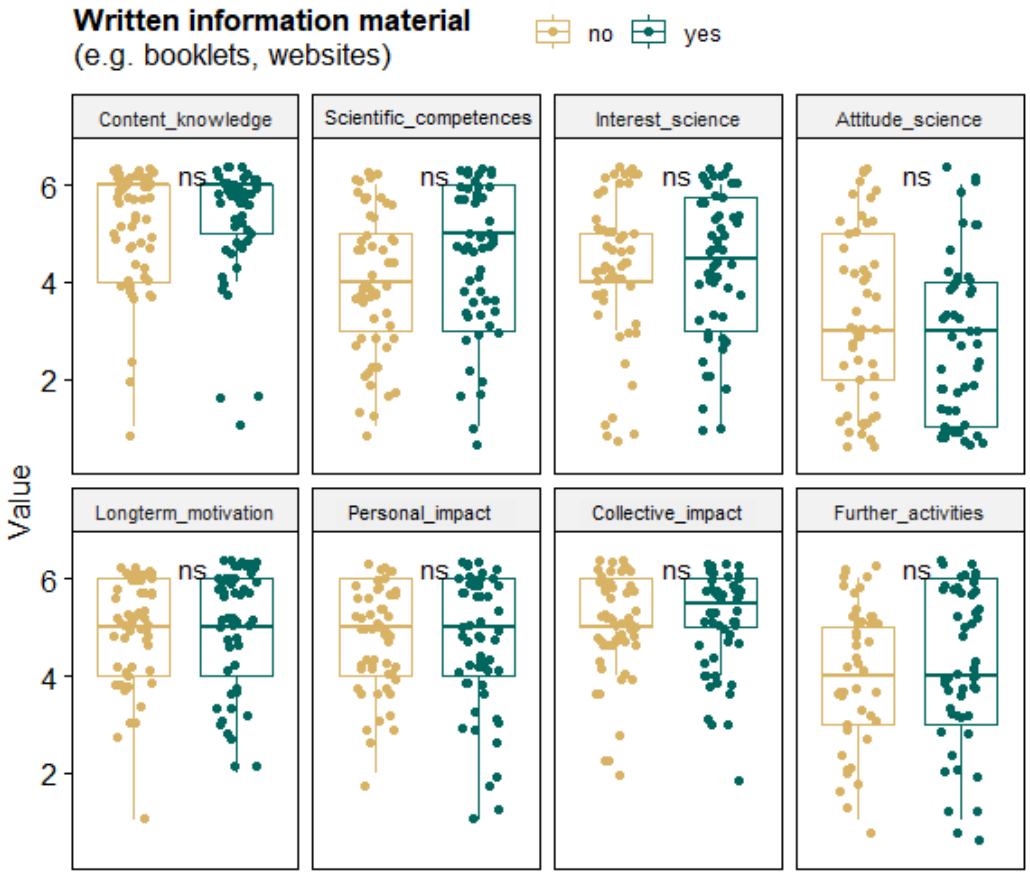


Differences in self-reported learning outcomes between citizen scientists who received mentoring by fellow citizen scientists (n 'yes') and those who did not (n 'no').

Learning outcome	n 'no'	n 'yes'	Wilcoxon test p-value	Wilcoxon effect size r
Content knowledge	81	29	0.15 n.s.	
Scientific competences	79	28	0.005**	0.27
Interest in science	80	28	0.07 n.s.	
Attitude towards science	77	25	0.05 n.s.	
Long-term project motivation	77	29	0.02*	0.21
Personal impact	81	29	0.04*	0.19
Collective impact	82	29	0.02*	0.22
Further activities	72	24	0.15 n.s.	

Fig. SI 3.5C Self-assessment of learning outcomes among citizen scientists in relation to different forms of learning support

Citizen scientists (n=113) were asked to rate their learning outcomes on a 6-point Likert-scale. Differences in self-reported learning outcomes between citizen scientists who received the respective support form (green boxplots) and those who did not receive the respective support form (yellow boxplots) were examined using Wilcoxon tests. Significance levels are indicated with asterisks (n.s. not significant; * p<0.05; ** p<0.01). For the boxplot visualization, original items (see Fig. 5A-B) were abbreviated



Differences in self-reported learning outcomes between citizen scientists who used written information material from their CS project (n 'yes') and those who did not (n 'no').

Learning outcome	n 'no'	n 'yes'	Wilcoxon test p-value
Content knowledge	56	54	0.26 n.s.
Scientific competences	54	53	0.12 n.s.
Interest in science	54	54	0.91 n.s.
Attitude towards science	51	51	0.21 n.s.
Long-term project motivation	55	51	0. 61n.s.
Personal impact	56	54	0.82 n.s.
Collective impact	57	54	0.60 n.s.
Further activities	45	51	0.83 n.s.

Fig. SI 3.5D Self-assessment of learning outcomes among citizen scientists in relation to different forms of learning support

Citizen scientists (n=113) were asked to rate their learning outcomes on a 6-point Likert-scale. Differences in self-reported learning outcomes between citizen scientists who received the respective support form (green boxplots) and those who did not receive the respective support form (yellow boxplots) were examined using Wilcoxon tests. Significance levels are indicated with asterisks (n.s. not significant; * p<0.05; ** p<0.01). For the boxplot visualization, original items (see Fig. 5A-B) were abbreviated

Differences in self-reported learning outcomes between citizen scientists who received on-site training with experts (n 'yes') and those who did not (n 'no').

Learning outcome	n 'no'	n 'yes'	Wilcoxon test p-value
Content knowledge	89	21	0.24 n.s.
Scientific competences	86	21	0.93 n.s.
Interest in science	87	21	0.50 n.s.
Attitude towards science	83	19	0.35 n.s.
Long-term project motivation	85	21	0.68 n.s.
Personal impact	89	21	0.83 n.s.
Collective impact	90	21	0.82 n.s.
Further activities	77	19	0.76 n.s.

Fig. SI 3.5E Self-assessment of learning outcomes among citizen scientists in relation to different forms of learning support

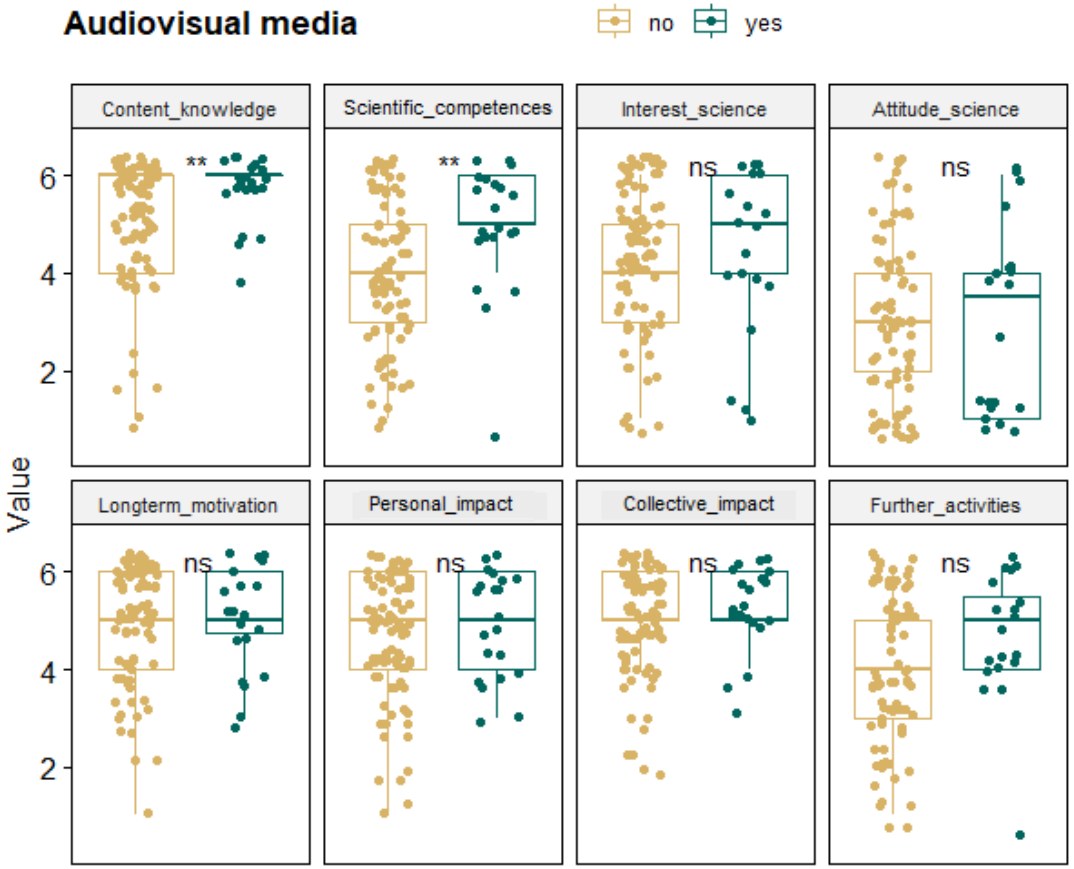
Citizen scientists (n=113) were asked to rate their learning outcomes on a 6-point Likert-scale. Differences in self-reported learning outcomes between citizen scientists who received the respective support form (green boxplots) and those who did not receive the respective support form (yellow boxplots) were examined using Wilcoxon tests. Significance levels are indicated with asterisks (n.s. not significant; * p<0.05; ** p<0.01). For the boxplot visualization, original items (see Fig.5A-B) were abbreviated

Differences in self-reported learning outcomes between citizen scientists who took responsibility for important CS project tasks (n 'yes') and those who did not (n 'no').

Learning outcome	n 'no'	n 'yes'	Wilcoxon test p-value	Wilcoxon effect size r
Content knowledge	87	23	0.07 n.s.	
Scientific competences	84	23	0.003**	0.28
Interest in science	86	22	0.01*	0.24
Attitude towards science	80	22	0.03*	0.21
Long-term project motivation	85	21	0.04*	0.19
Personal impact	87	23	0.06 n.s.	
Collective impact	88	23	0.14 n.s.	
Further activities	75	21	0.10 n.s.	

Fig. SI 3.5F Self-assessment of learning outcomes among citizen scientists in relation to different forms of learning support

Citizen scientists (n=113) were asked to rate their learning outcomes on a 6-point Likert-scale. Differences in self-reported learning outcomes between citizen scientists who received the respective support form (green boxplots) and those who did not receive the respective support form (yellow boxplots) were examined using Wilcoxon tests. Significance levels are indicated with asterisks (n.s. not significant; * p<0.05; ** p<0.01). For the boxplot visualization, original items (see Fig.5A-B) were abbreviated

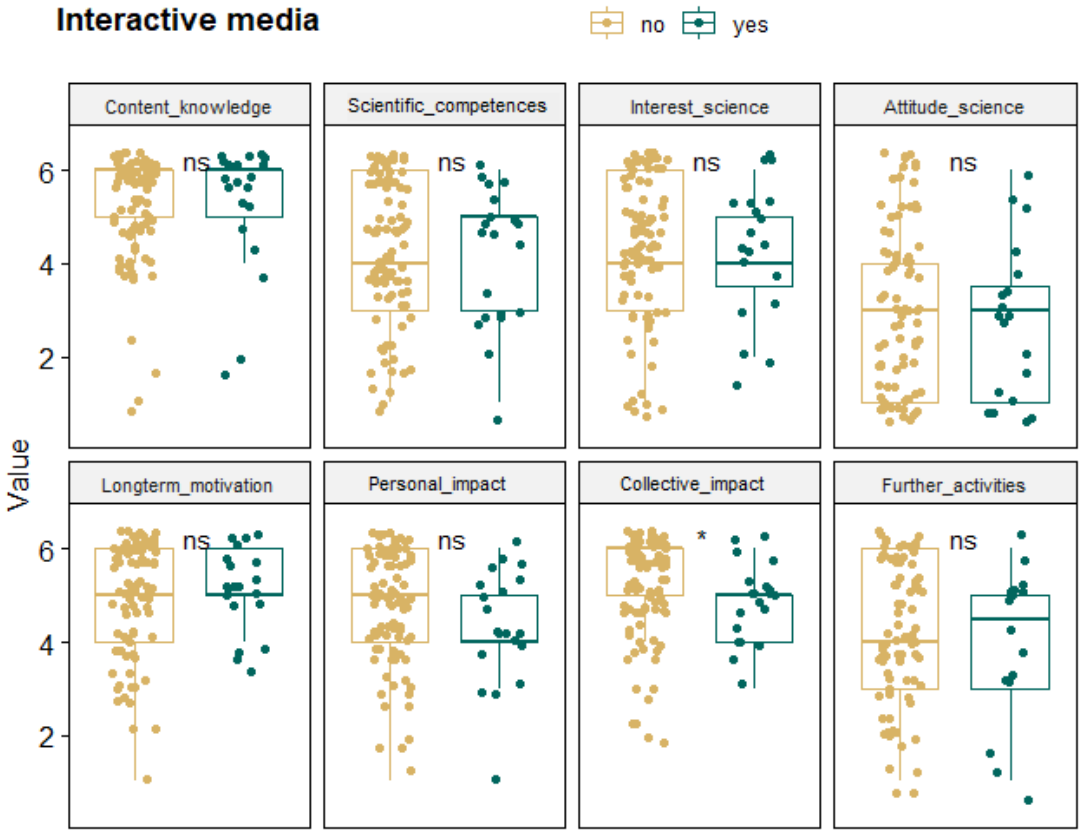


Differences in self-reported learning outcomes between citizen scientists who used audio-visual media in their CS project (n 'yes') and those who did not (n 'no').

Learning outcome	n 'no'	n 'yes'	Wilcoxon test p-value	Wilcoxon effect size r
Content knowledge	89	21	0.008**	0.25
Scientific competences	86	21	0.005**	0.27
Interest in science	89	19	0.61 n.s.	
Attitude towards science	82	20	0.69 n.s.	
Long-term project motivation	86	20	0.98 n.s.	
Personal impact	89	21	0.23 n.s.	
Collective impact	90	21	0.56 n.s.	
Further activities	77	19	0.13 n.s.	

Fig. SI 3.5G Self-assessment of learning outcomes among citizen scientists in relation to different forms of learning support

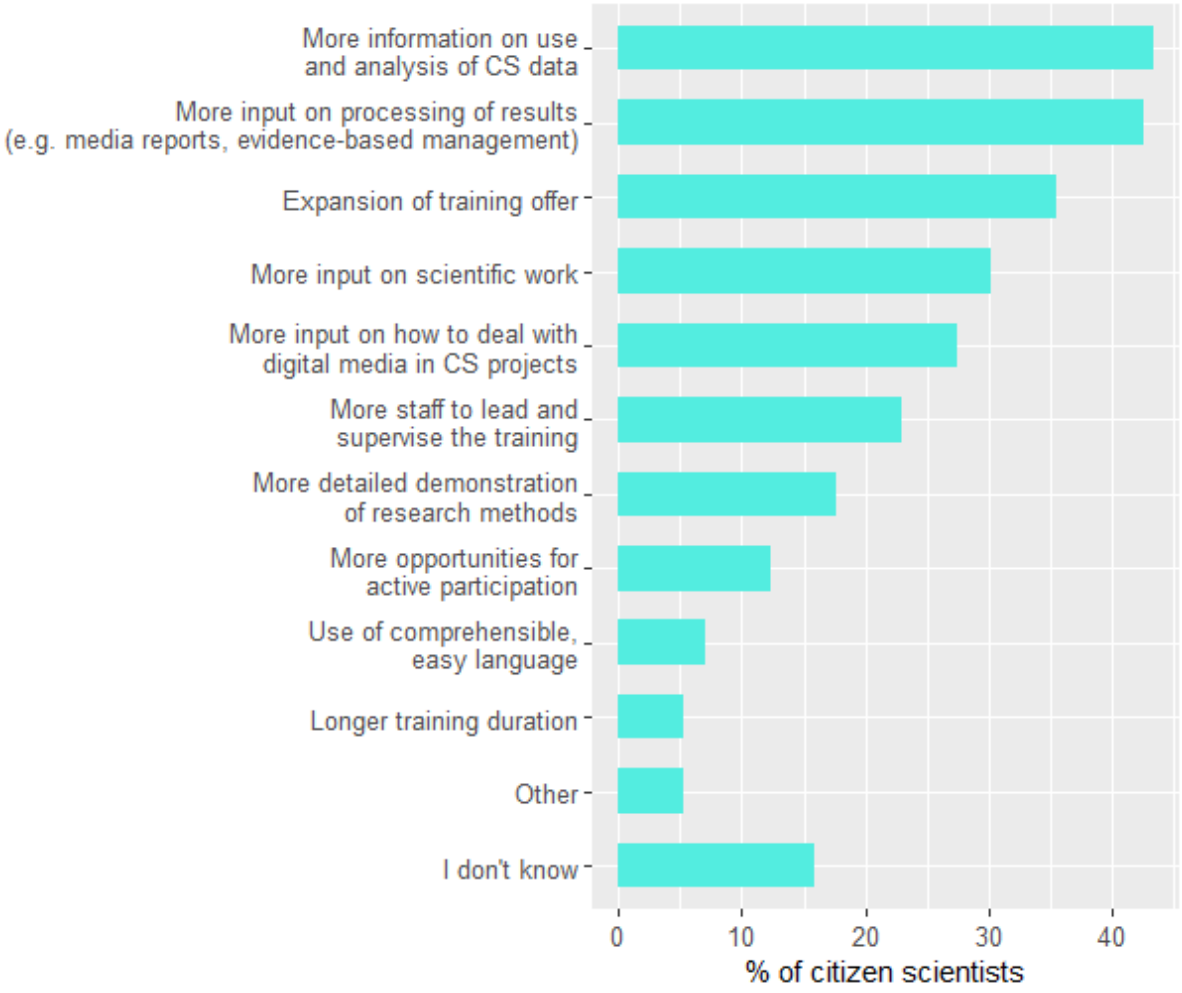
Citizen scientists (n=113) were asked to rate their learning outcomes on a 6-point Likert-scale. Differences in self-reported learning outcomes between citizen scientists who received the respective support form (green boxplots) and those who did not receive the respective support form (yellow boxplots) were examined using Wilcoxon tests. Significance levels are indicated with asterisks (n.s. not significant; * p<0.05; ** p<0.01). For the boxplot visualization, original items (see Fig.5A-B) were abbreviated



Differences in self-reported learning outcomes between citizen scientists who used interactive media in their CS project (n 'yes') and those who did not (n 'no').

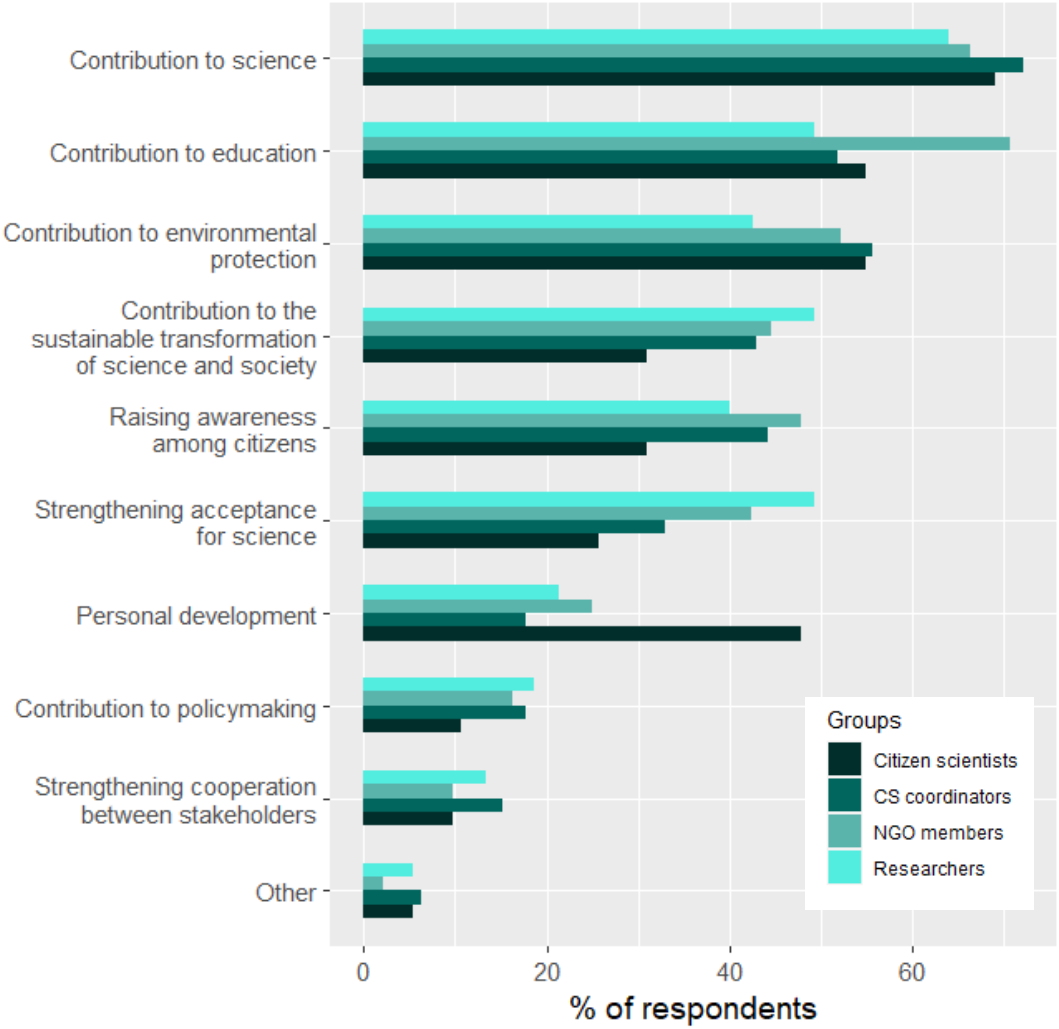
Learning outcome	n 'no'	n 'yes'	Wilcoxon test p-value	Wilcoxon effect size r
Content knowledge	90	20	0.53 n.s.	
Scientific competences	87	20	0.75 n.s.	
Interest in science	89	19	0.69 n.s.	
Attitude towards science	83	19	0.41 n.s.	
Long-term project motivation	86	20	0.97 n.s.	
Personal impact	90	20	0.14 n.s.	
Collective impact	91	20	0.03*	0.20
Further activities	80	16	0.63 n.s.	

Fig. SI 3.6 How do you think CS training offers for project participants could be improved?
Multiple-choice question, n=113 citizen scientists



SI 4: Citizen science and socio-political processes

Fig. SI 4.1 Why are you involved or interested in citizen science? Multiple-choice question with max. 5 answers. N=79 coordinators, 75 researchers, 92 NGO members and 113 citizen scientists. Differences between the groups' absolute response frequencies were tested using Chi-Square tests with Bonferroni Correction



- χ^2= 1.35, df = 3, p= 0.72 n.s

- χ^2= 9.85, df = 3, p<0.05*,
Bonf. correction NGO members p<0.05*

- χ^2= 3.42, df = 3, p= 0.33 n.s.

- χ^2= 7.47, df = 3, p= 0.06 n.s.

- χ^2= 6.79, df = 3, p= 0.08 n.s.

- χ^2= 12.87, df = 3, p<0.01**,
Bonf. correction citizen scientists p<0.05*

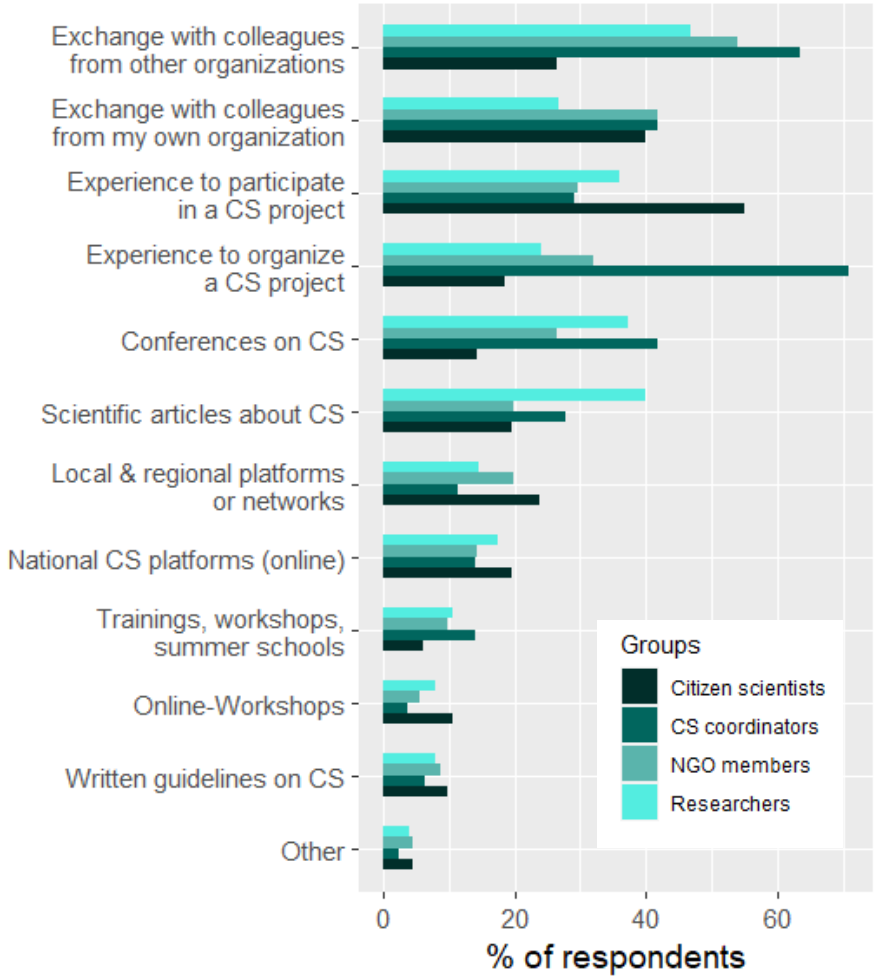
- χ^2= 26.57, df = 3, p<0.001***,
Bonf. correction citizen scientists p<0.001***

- χ^2= 2.99, df = 3, p= 0.39 n.s.

- χ^2= 1.88, df = 3, p= 0.59 n.s.

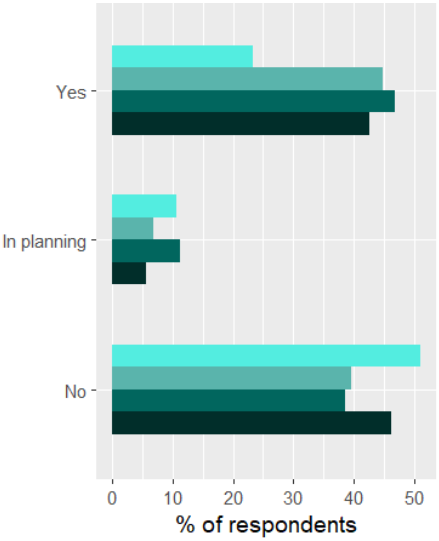
- χ^2= 1.93, df = 3, p= 0.59, Fishers p= 0.56 n.s.

Fig. SI 4.2 What has helped you the most so far in developing expertise in citizen science (CS)? Multiple-choice question with max. 5 answers
N=79 coordinators, 75 researchers, 91 NGO members and 113 citizen scientists. Differences between the groups' absolute response frequencies were tested using Chi-Square tests with Bonferroni Correction



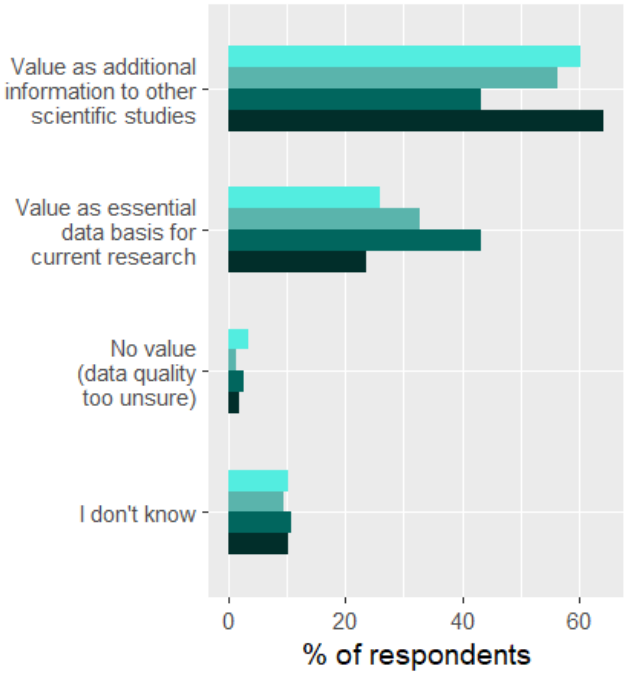
- χ^2=29.00, df = 3, p<0.001***, Bonf. correction coordinators p<0.01*, citizen scientists p<0.001***
- χ^2=5.27, df = 3, p-value = 0.15
- χ^2=18.84, df = 3, p<0.001***, Bonf. correction citizen scientists p<0.001***
- χ^2=62.77, df = 3, p<0.001***, Bonf. correction coordinators <0.001***, citizen scientists p<0.001***
- χ^2=21.42, df = 3, p<0.001***, Bonf. correction citizen scientists p<0.001***
- χ^2=12.19, df = 3, p<0.01**, Bonf. correction researchers p<0.05*
- χ^2=5.71, df = 3, p= 0.13
- χ^2=1.47, df = 3, p= 0.69
- χ^2=3.25, df = 3, p= 0.35
- χ^2=3.78, df = 3, p=0.29
- χ^2=0.72, df = 3, p=0.87

Fig. SI 4.3 Are you active in a local, regional or supraregional network for the promotion of CS or participatory science? Single-choice question
N= 62 coordinators, 47 researchers, 58 NGO members, 54 citizen scientists



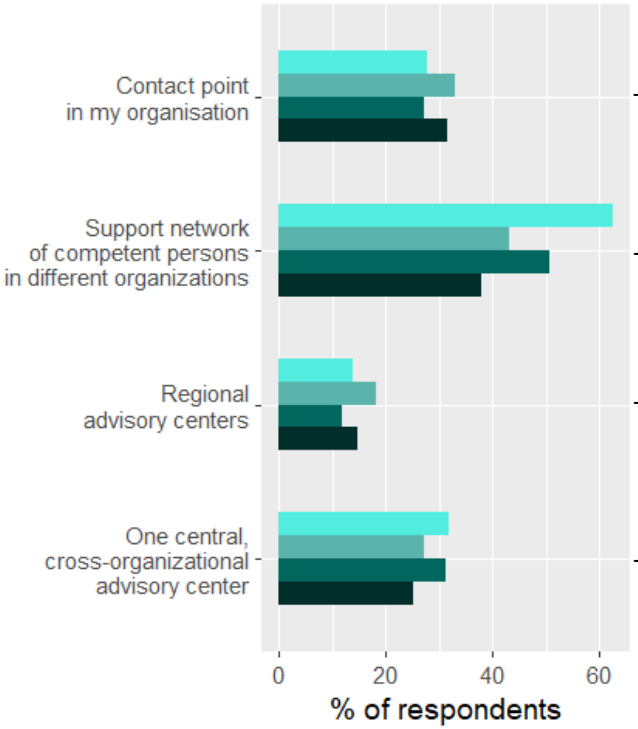
Differences between groups: χ^2=6.94, df=6, p=0.33 n.s., Fisher's p=0.31 n.s.

Fig. SI 4.4 In your opinion, what value do citizen science (CS) data and results have as a basis for political and societal decision-making processes? Single-choice question. N=75 coordinators, 61 researchers, 76 NGO members, 100 citizen scientists



Differences between the groups:
χ^2=10.19, df=9, p=0.34,
Fisher's p=0.29 n.s.

Fig. SI 4.5 How do you think advisory services to support CS projects should be organized? Multiple-choice question with max. 2 answers. N=77 coordinators, 72 researchers, 88 NGO members, 108 citizen



-χ^2=5.15, df=3, p=0.17

-χ^2=0.71, df=3, p=0.87

-χ^2=3.35, df=3, p=0.34

-χ^2=0.67, df=3, p=0.88

Fig. SI 4.6 Please specify to which extent the following statements on citizen science (CS) apply or do not apply to your institution (i.e. institute at university, research centre) 7-point Likert scale, n=75 researchers

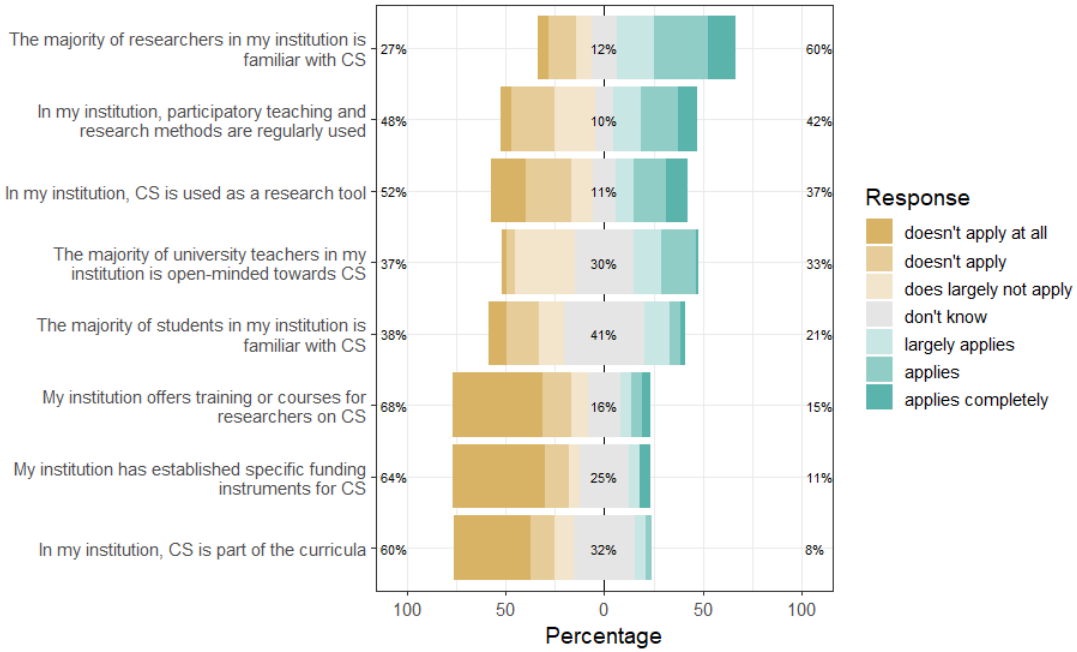


Fig. SI 4.7 Please indicate to what extent the following statements about the role of CS apply or do not apply to your research discipline. 7-point Likert scale, n=75 researchers

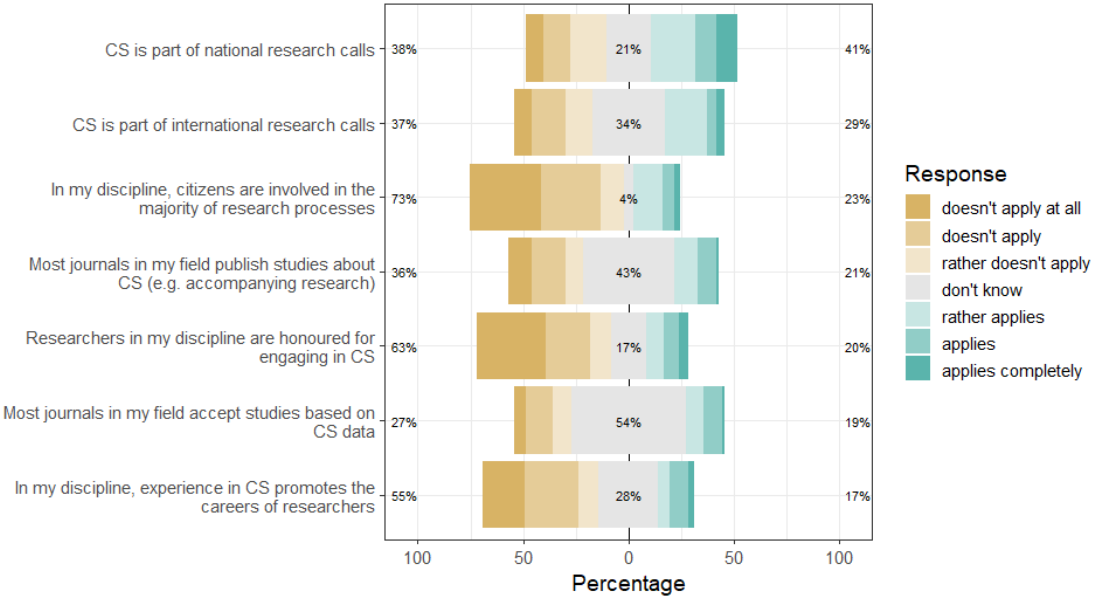


Fig. SI 4.8 Which kind of added value does CS have for your research?
7-point Likert scale, n=75 researchers

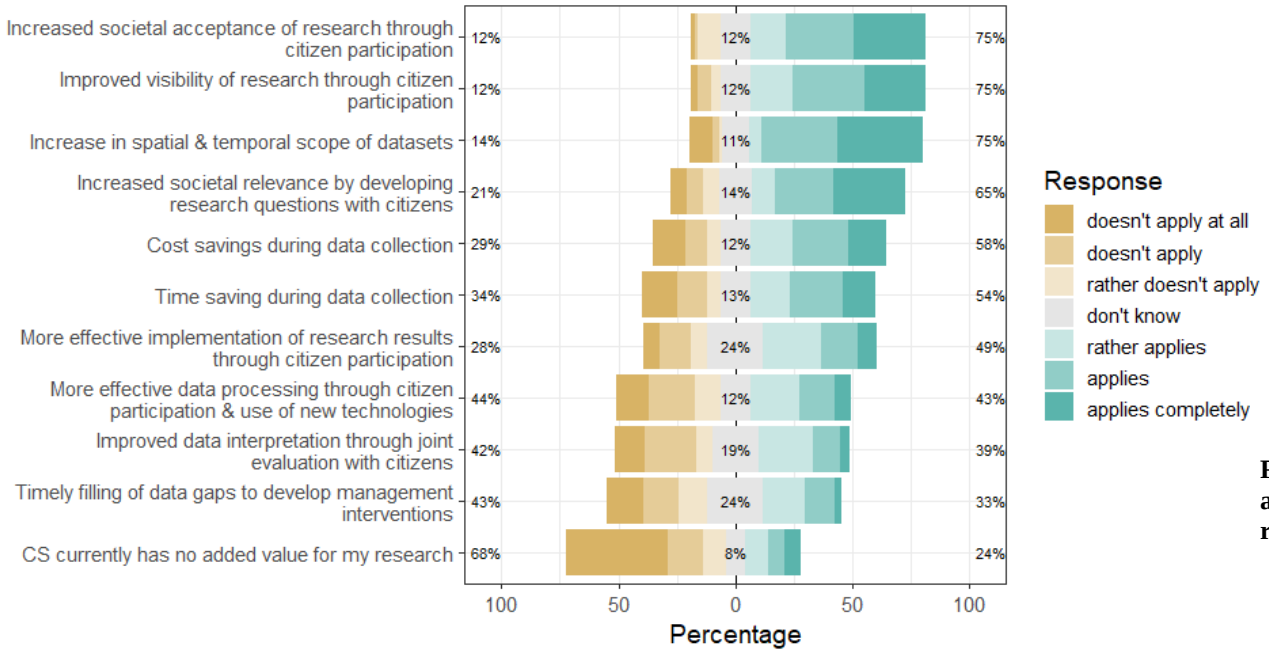
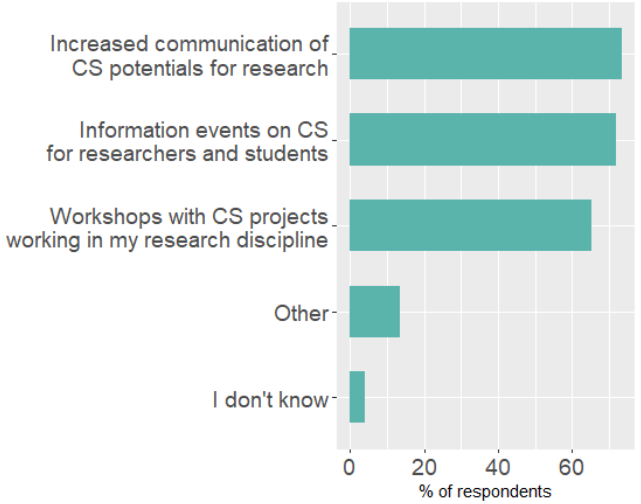


Fig. SI 4.9 In your opinion, how could CS and participatory research approaches be increasingly integrated into university teaching and research? Multiple-choice question, n=75 researchers



SI 5: Support mechanisms for citizen science

Fig. SI 5.1 In your opinion, to which extent do the following statements about the recognition of citizen science (CS) engagement apply or not apply? 7-point Likert scale. N=72 coordinators, 57 researchers, 72 NGO members and 97 citizen scientists

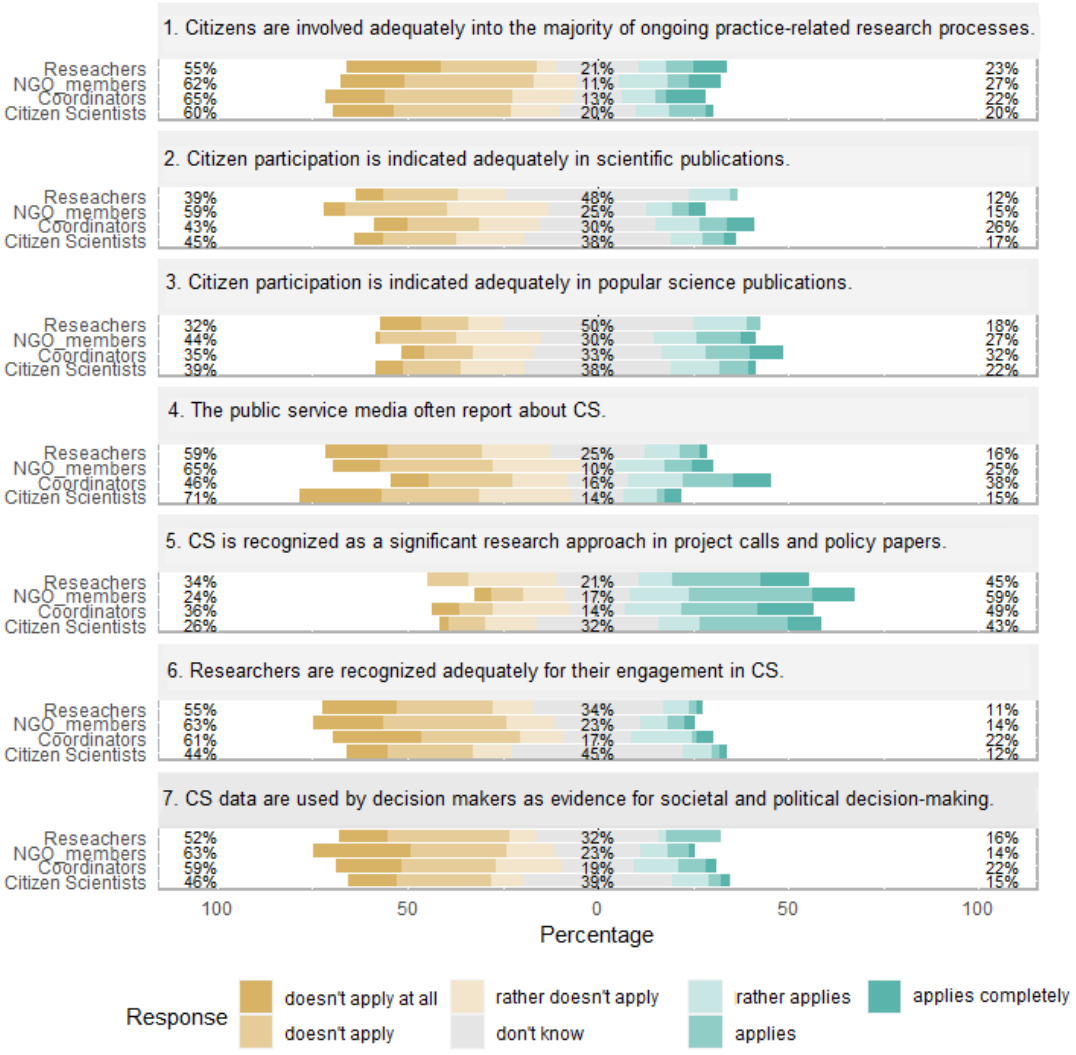
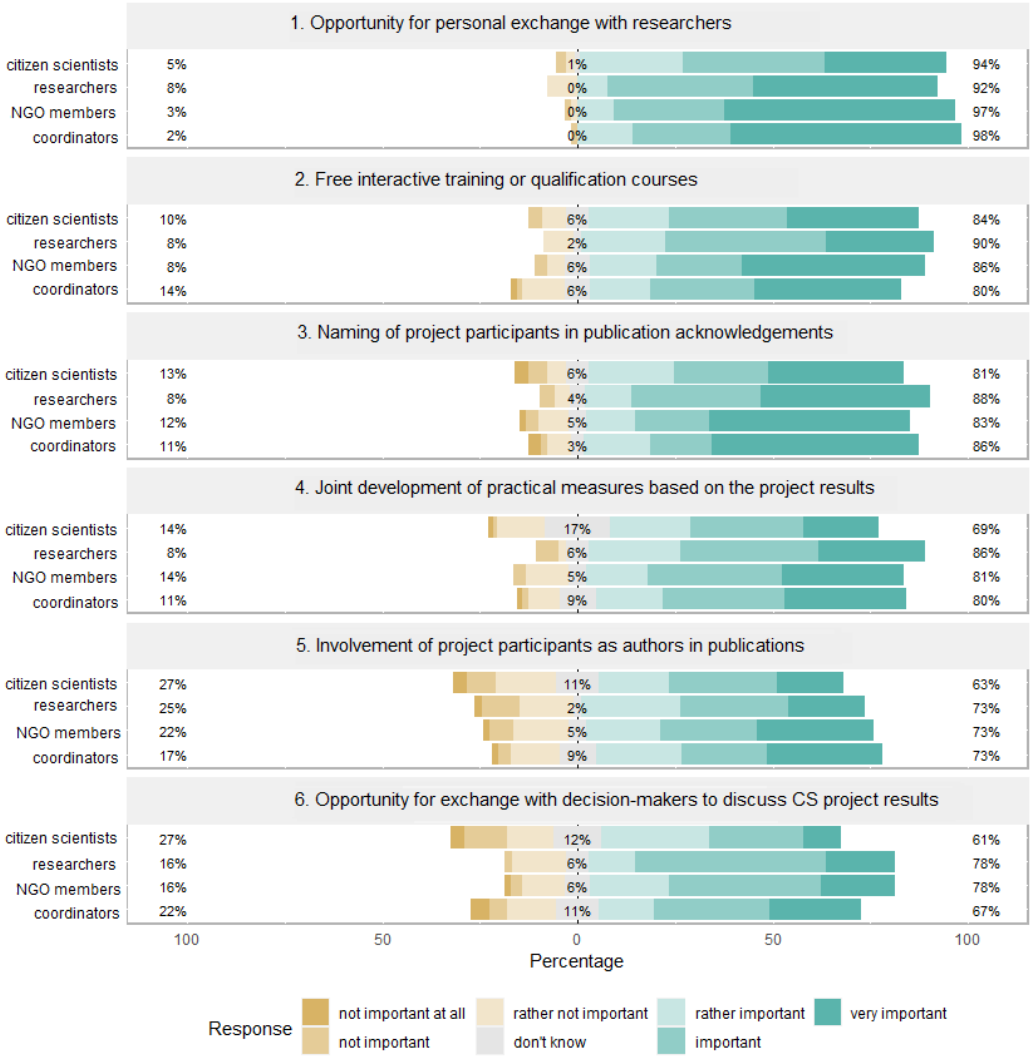


Table SI 5.1 Recognition of CS (see Fig. SI 5.1): Differences between groups - Wilcoxon rank sum tests

Variable	Coordinators vs. other groups	Researchers vs. other groups
Citizens are involved adequately into the majority of ongoing practice-related research processes.	n.s.	n.s.
Citizen participation is indicated adequately in scientific publications.	n.s.	W = 5168.5, p<0.05*, effect size r: 0.15
Citizen participation is indicated adequately in popular science publications.	W = 4148, p<0.05*, effect size r: 0.14	W = 5366.5, p<0.01**, effect size r: 0.18
The public service media often report about CS.	W = 3626.5, p<0.01**, effect size r: 0.22	W = 5124, p<0.05*, effect size r: 0.14
CS is recognized as a significant research approach in project calls & policy papers.	n.s.	n.s.
Researchers are recognized adequately for their engagement in CS.	W = 3567, p<0.01**, effect size r: 0.23	n.s.
CS data are used by decision makers as evidence for societal and political decision-making.	W = 3614.5, p<0.01**, effect size r: 0.22	n.s.

Variable	NGO members vs. other groups	Citizen scientists vs. other groups
Citizens are involved adequately into the majority of ongoing practice-related research processes.	n.s.	n.s.
Citizen participation is indicated adequately in scientific publications.	W = 4046, p<0.05*, effect size r: 0.16	n.s.
Citizen participation is indicated adequately in popular science publications.	W = 4110, p<0.05*, effect size r: 0.15	n.s.
The public service media often report about CS.	W = 4056, p<0.05*, effect size r: 0.15	n.s.
CS is recognized as a significant research approach in project calls & policy papers.	W = 4077, p<0.05*, effect size r: 0.14	W = 6236.5, p<0.05*, effect size r: 0.14
Researchers are recognized adequately for their engagement in CS.	n.s.	n.s.
CS data are used by decision makers as evidence for societal and political decision-making.	n.s.	n.s.

Fig. SI 5.2 How do you think project participants should be rewarded for their citizen science (CS) engagement?
7-point Likert scale. N=72 coordinators, 57 researchers, 72 NGO members and 97 citizen scientists



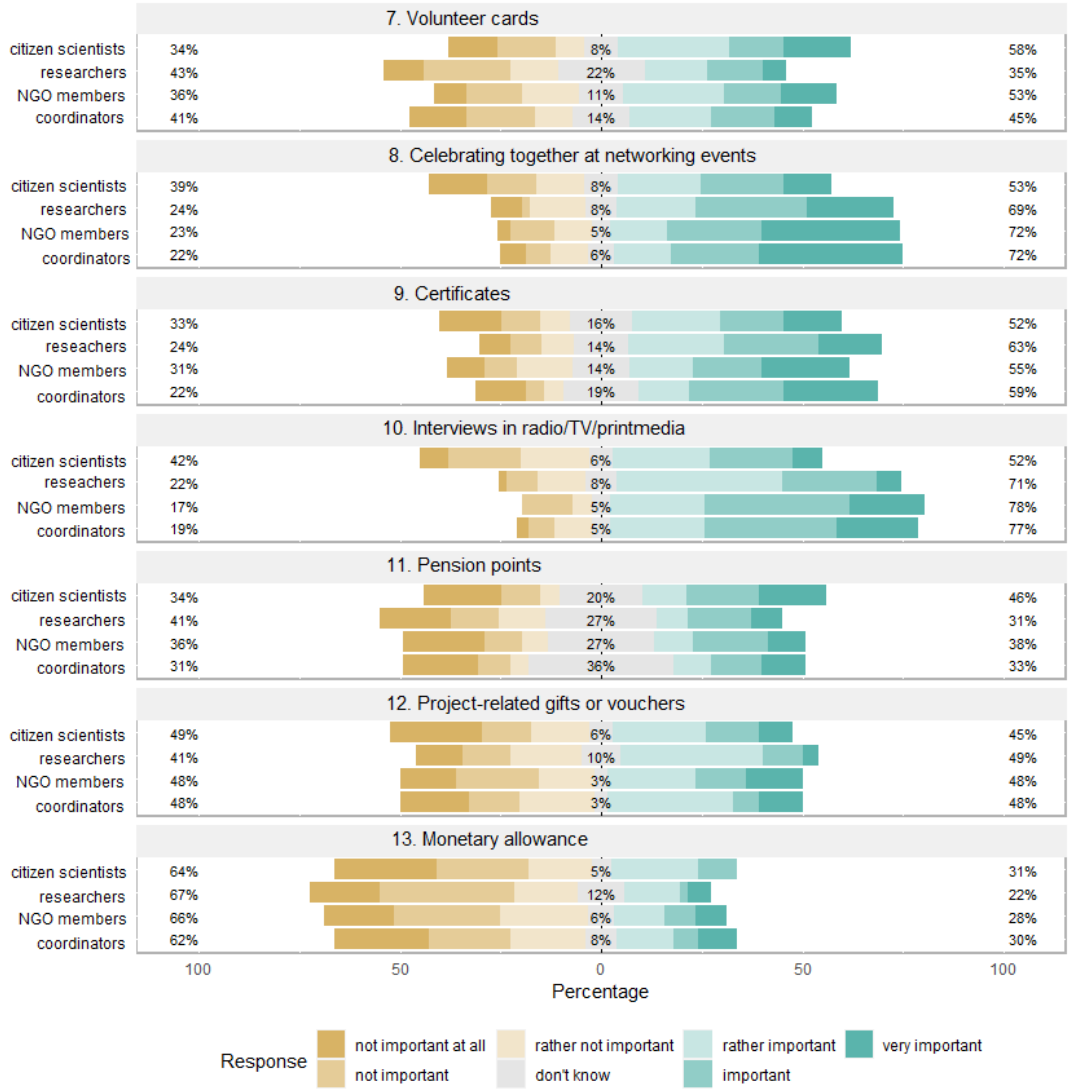


Table SI 5.2 Recognition instruments for CS project participants (see Fig. SI 5.2): Difference between groups - Wilcoxon rank sum tests

Variable	Coordinators vs. other groups	Researchers vs. other groups	NGO members vs. other groups	Citizen scientists vs. other groups
Celebrating together at networking events	W = 3685.5, p<0.01**, effect size r: 0.21	n.s.	W = 3796.5, p<0.01**, effect size r: 0.19	W = 7069, p<0.001***, effect size r: 0.26
Certificates	n.s.	n.s.	n.s.	W = 6029.5, p<0.05*, effect size r: 0.15
Free interactive training or qualification courses	n.s.	n.s.	n.s.	n.s.
Interviews in radio/TV/printmedia	W = 3617.5, p<0.01**, effect size r: 0.23	n.s.	W = 3819, p<0.01**, effect size r: 0.19	W = 7092.5, p<0.001***, effect size r: 0.27
Involvement of project participants as authors in publications	n.s.	n.s.	n.s.	W = 6249.5, p<0.05*, effect size r: 0.15
Joint development of practical measures based on the project results	n.s.	n.s.	n.s.	W = 6670.5, p<0.01**, effect size r: 0.21
Monetary allowance	n.s.	n.s.	n.s.	n.s.
Naming of project participants in publication acknowledgements	n.s.	n.s.	n.s.	W = 6579.5, p<0.01**, effect size r: 0.19
Opportunity for exchange with decision-makers to discuss CS project results	n.s.	W = 3554.5, p<0.05*, effect size r: 0.14	n.s.	W = 7042.5, p<0.001***, effect size r: 0.26
Opportunity for personal exchange with researchers	W = 4162.5, p<0.05*, effect size r: 0.14	n.s.	W = 4139, p<0.05*, effect size r: 0.14	W = 7286.5, p<0.001***, effect size r: 0.32
Pension points	n.s.	n.s.	n.s.	W = 4364.5, p<0.05*, effect size r: 0.14
Project-related gifts or vouchers	n.s.	n.s.	n.s.	n.s.
Volunteer cards	n.s.	W = 4708.5, p<0.01**, effect size r: 0.19	n.s.	W = 3859.5, p<0.05*, effect size r: 0.16

Fig. SI 5.3 Please indicate to what extent you agree with the following statements on the funding of citizen science (CS) projects. 7-point Likert scale, n=277

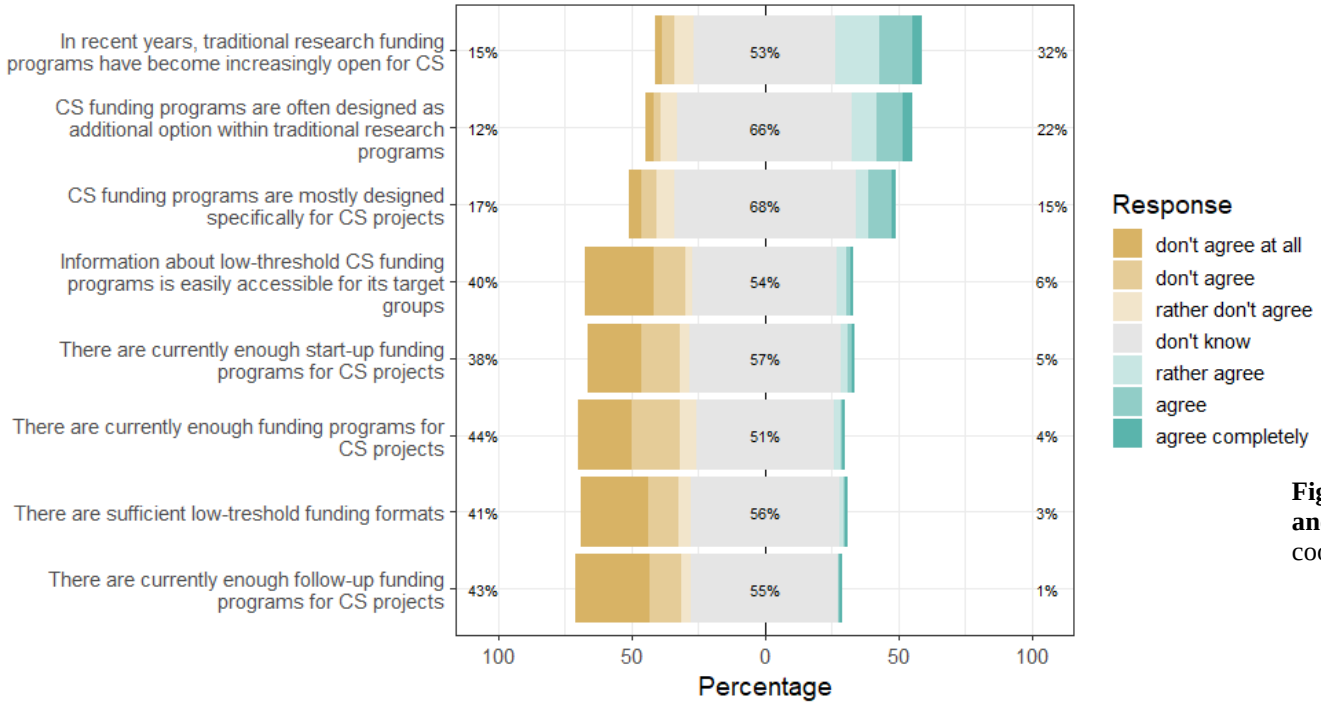
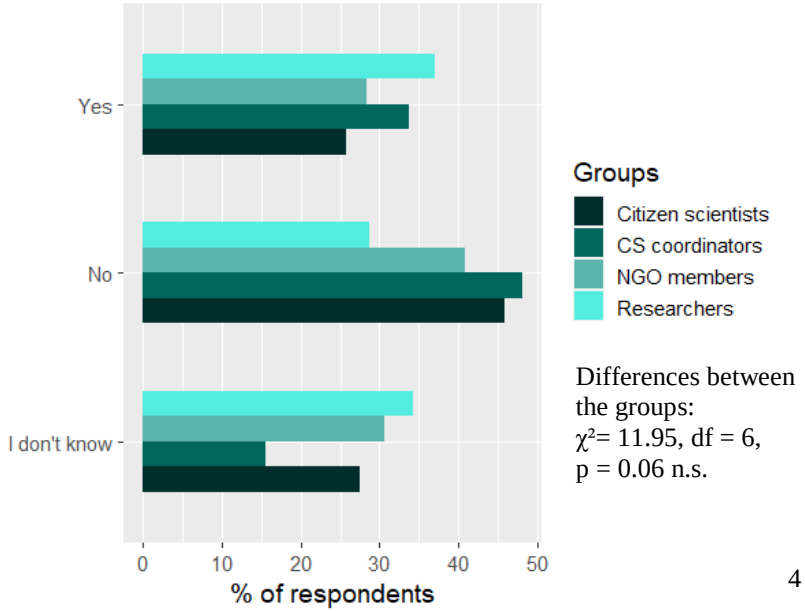
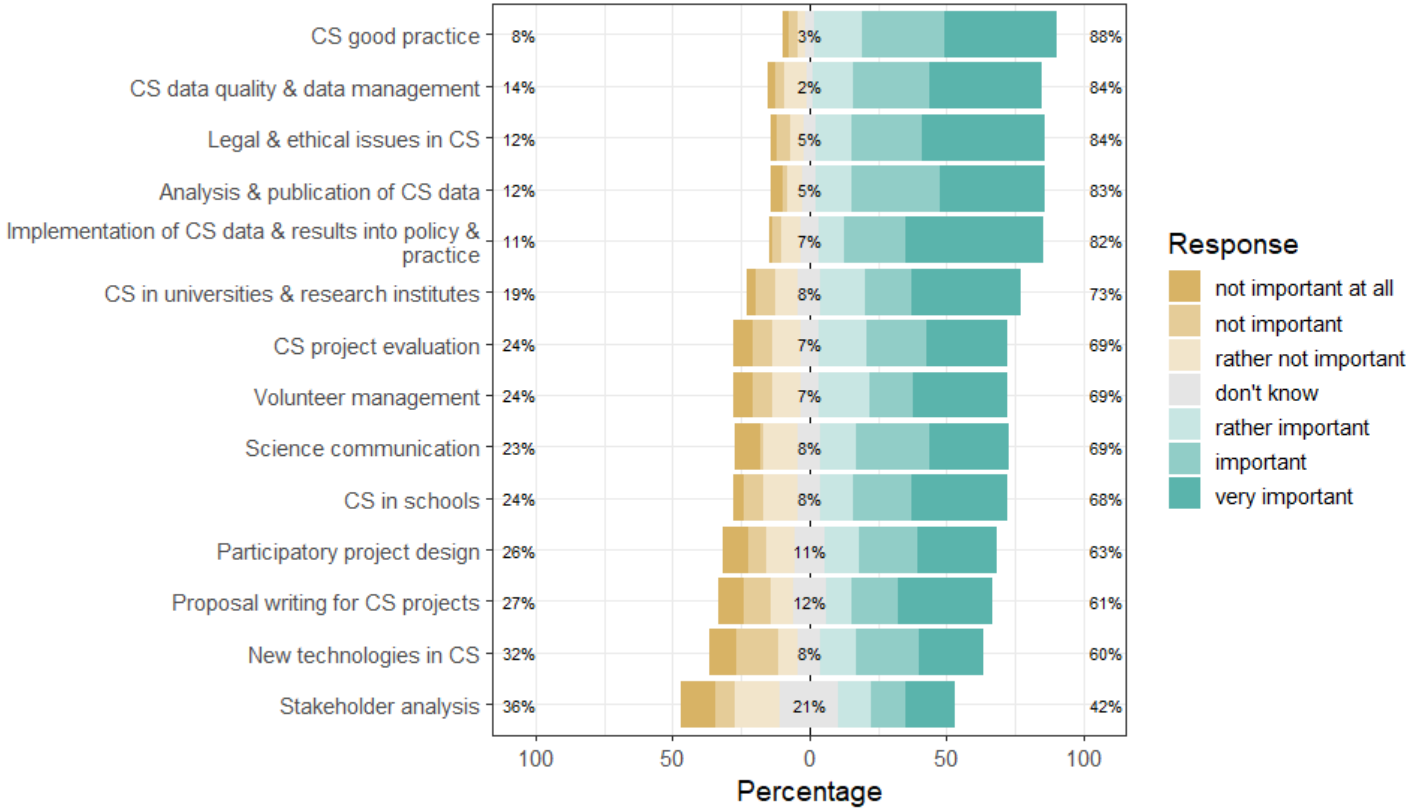


Fig. SI 5.4 Would you like more advice on the planning, implementation and/ or evaluation of CS projects? Single-choice question. N=77 coordinators, 73 researchers, 88 NGO members, 109 citizen scientists



Differences between the groups:
χ^2= 11.95, df = 6,
p = 0.06 n.s.

Fig. SI 5.5 Please indicate how important advice and support in the following areas of CS would be for you. 7-point Likert scale, n=89 respondents who stated wishing for more advice on planning, implementing and/or evaluating of their CS project)



SI 6: Survey to evaluate and develop citizen science in Germany, Austria and Switzerland

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This appendix shows the questions analyzed in this study and gives an overview of additional questions from our survey used to develop the White Paper Citizen Science Strategy 2030 for Germany. Due to space limitations and prioritization of indicators, the questions analyzed and listed in Appendices 1-5 represent a subset of the overall survey. Questions not covered in this study are listed in square brackets.

Dear Participant,

The purpose of this survey is to gather information on the current status of citizen science in Germany, Austria and Switzerland. Based on the results, we would like to develop concrete action strategies for the future development of citizen science. The survey is aimed at…

- project coordinators and researchers active or interested in citizen science
- participants in citizen science projects ('citizen scientists')
- members of associations, NGOs, museums, schools, universities, research institutes
- other practitioners in citizen science projects and networks
- members of citizen science funding organizations

The survey is based on the results of a public online dialogue forum on June 26th 2020 by the citizen science White Paper Working Group in collaboration with 'Bürger schaffen Wissen', CitizenScience@Helmholtz and representatives of 'Österreich forscht' and 'Schweiz forscht'.
The goal of the White Paper Working Group in Germany is to develop a White Paper Citizen Science Strategy 2030 for Germany based on the survey results. The results will be presented to relevant ministries and funding bodies.
In Austria and Switzerland, the survey aims to gather information about the current development of the citizen science landscape. At the same time, it is intended to encourage cross-national exchange.
The results of the survey will be shared with all participants upon request and made available in an open access publication. The survey will take approximately 20 minutes to complete.
By participating, you are helping us to promote and advance citizen science!

Thank you very much for your support!

Information on data protection
This survey is anonymous and your participation is voluntary. We do not collect any personal data which could be traced back to individual persons. The results of the survey will be analyzed and published in anonymous form only. We store and process the information in a UFZ database exclusively within the context of this study for the purpose of research and consulting. The data will not be passed on to third parties.
You can revoke your consent to the processing and storage of your data at any time (by sending an email to julia.goenner@ufz.de).

Contact and information
If you have any questions about the survey, please contact us by email:
Germany: Julia von Gönner (julia.goenner@ufz.de) or Aletta Bonn (aletta.bonn@ufz.de)
Austria: Daniel Dörler and Florian Heigl - Citizen Science Netzwerk Austria (office@citizenscience.at)
Switzerland: Tiina Stämpfli - Citizen Science Netzwerk Schweiz forscht (cs@science-et-cite.ch)

Agreement
I hereby confirm that I am at least 18 years old and that I have been informed about the data protection rights. I confirm that I agree with the conditions of participation and that I want to take part in the survey. *Please select an answer.*

- Yes (I agree to participate in the survey)
- No (I don't want to participate in the survey)

Instruction
Thanks for participating! In this survey, all persons who volunteer in citizen science projects ("Citizen Scientists") are referred to as "project participants".
You can answer the majority of the questions by clicking on the answer options. For some questions you can enter free text answers. Some mandatory filter questions are marked with *. All other questions are non-mandatory. The more questions you answer, the more meaningful the results will be!
We thank you in advance for your time, expertise and commitment!

Survey introduction

1. Why are you involved or interested in citizen science?
Please select one to maximum five answers from the list.

- Contribution to environmental protection
- Contribution to education
- Contribution to policymaking
- Contribution to the sustainable transformation of science and society
- Contribution to science
- Personal development
- Raising awareness among citizens
- Strengthening acceptance of science
- Strengthening cooperation between stakeholders
- Other (please specify)

2. In which country do you live and work?*
Please choose a country.

- Germany
- Austria
- Switzerland

3. How long have you been active in the field of citizen science?

Please enter the duration in years: _____

4. Which statement(s) best describe(s) your connection to citizen science?*
Your answer to this question determines to which group-specific questions you will be directed. You can choose one to three answers.

- I am currently coordinating a citizen science project or have already gained experience in citizen science project coordination.
- I work or study at a university or research institution and I am interested in the field of citizen science.
- I work in an institution which organizes citizen science projects (e.g. educational or cultural center, association, school laboratory, museum, library, archive, zoo, botanical garden)
- I am a high school teacher and take part in a citizen science project with my pupils or plan to do so.
- I am actively participating in a citizen science project as a volunteer.
- I work for a funding institution, foundation or other institution which supports or financially promotes citizen science projects.
- I have a different connection to citizen science (please specify).

(Filter question)

Survey part I: Group-specific questions

1. (Question for both CS project coordinators and citizen scientists)
Which discipline does your citizen science (CS) project belong to?*.
Please select one or more (max. 3 answers) from the alphabetically sorted list.

- agricultural sciences
- anthropology
- archaeology
- architecture
- arts
- astronomy
- biology
- chemistry
- communication sciences
- cultural sciences
- economics
- educational sciences
- engineering
- environmental sciences
- genealogy
- geography
- health sciences
- history
- informatics
- information sciences
- linguistics
- literature
- mathematics
- media sciences
- meteorology
- philosophy
- physics
- political sciences
- psychology
- sociology
- other discipline (please specify)

2. (Question for both CS project coordinators and citizen scientists)
What is the spatial scope of your CS project?*
Please select an answer. My project is a...

- Local project (e.g. in one city or county)
- Regional project (e.g. in 1-3 federal states)
- National project
- International project
- *I don't know*

3. (Question for both CS project coordinators and citizen scientists)
To which project type does your CS project belong?*.
Please select one answer.

- Contributive: Project participants help with data collection.
- Collaborative: project participants are involved in several aspects of the project, e.g. data collection, data analysis, communication of results
- Co-creative: Project participants are actively involved in all phases of the research process, including the definition of the research design.
- Collegial: Citizens carry out a research project independently of institutionalized science.
- *I don't know*

4. (Question for both CS project coordinators and citizen scientists)
Where does the research in your CS project take place?
You can choose up to three answers.

- online, on the internet
- in museums or archives
- in the laboratory
- in buildings, on streets/traffic routes
- in gardens or parks
- in fields or forest
- other locations (please specify)

Questions to citizen science project coordinators

For questions 1.-4., see p. 3

5. **At the moment, which project phase is your citizen science (CS) project in?***
   Please tick one answer.
- Planning: Development of objectives, research questions and design, methods, target groups, data protocol, training material
- Implementation: Data collection and analysis, feedback with stakeholders, publication and presentation of results
- Evaluation: Assessment of process, added value and results
- Long-term establishment
- Project completed
- *I don't know*

6. **How is your CS project financially supported?**
   Please tick one answer.
- Funding by the European Union (EU)
- Funding by the Federal Agency for Nature Conservation (BfN)
- Funding by the Federal Ministry of Education and Research (BMBF)
- Funding by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)
- Funding from other national funding institutions (please specify)
- Funding by foundation (please specify)
- Crowdfunding (e.g. donations)
- Other (please specify)
- Funding planned or in application phase
- There is no external project funding
- *I don't know*

7. **[How many active participants does your CS project currently have?**
   Please estimate the number of project participants who have actively participated in your project at least once _____
   I don't know **]**

In the following, we would like to learn more about the evaluation of your CS project.

8. **[On which of the following aspects does your CS project collect information?**
   Please choose- multiple answers are possible.
- Age structure of the project participants
- Gender of the project participants
- Educational level of the project participants
- Living environment of the project participants
- Other (please specify)
- We do not collect data on any of these aspects **]**

(Filter question)

9. **[Please indicate the distribution of age classes among your participants.** *Multiple-choice question with open fields to enter percentages* **]**
10. **[Please indicate the gender distribution among your participants.** *Multiple-choice question with open fields to enter percentages***]**
11. **[Please indicate the distribution of general educational qualifications among your participants.** *Multiple-choice question with open fields to enter percentages* **]**

12. **In which form is your CS project evaluated?**
    Please tick all items that apply.
    Internal evaluation
    - Survey of the participants with standardized questionnaires
    - Structured interviews with the participants
    - informal (written or face-to-face) exchange with the participants

    External evaluation
    - Survey of the participants with standardized questionnaires
    - Structured interviews with the participants
    - informal (written or face-to-face) exchange with the participants

    - Other (please specify)
    - The project is not or was not evaluated.
    - Comments: _____

Questions to citizen science project coordinators (continued)

13. **[Which of the following goals are systematically evaluated in your citizen science (CS) project?** *Please select all applicable answers from the list.*

Education of the project participants

- Knowledge acquisition (on the nature of science or project-specific content)
- Acquisition of skills (scientific methods, project-related skills)
- Development of interest (for science, for the respective project topic)
- Motivation to participate in science
- Development of attitudes (e.g. towards science, environmental protection)
- Self-efficacy (conviction of being able to make a difference)
- Behavior change

Scientific outcomes

- Collection of high quality data
- Gain of knowledge (to answer research questions)
- Publication of scientific papers
- Creation of databases and datasets

Socio-ecological outcomes

- Citizen participation in science and policymaking
- Social capacity building (new networks and collaborations between citizens, researchers and and decision makers)
- Implementing targeted interventions to protect natural systems
- Promotion of sustainable practices and processes

Project communication

- Identification of relevant stakeholder groups with their interests and needs
- Two-way communication between researchers, citizens and decision makers

- None of the above-mentioned goals are evaluated in my CS project.
- *I don't know* **]**

(Filter question)

14. **[Which of these goals were achieved in your project according to the evaluation results?** *Please indicate to what extent these following statements apply or do not apply to your CS project.* **]**

	1- doesn't apply at all	2- doesn't apply	3- rather doesn't apply	4- rather applies	5- applies	6- applies completely	not evaluated yet
Content knowledge of participants has increased	○	○	○	○	○	○	○
Scientific skills of participants has increased	○	○	○	○	○	○	○
Interest of participants in science/ project content has increased	○	○	○	○	○	○	○
Motivation of participants for participation in science has increased	○	○	○	○	○	○	○
Attitudes of participants towards science/ or towards the project content have changed	○	○	○	○	○	○	○
Self-efficacy of participants has improved	○	○	○	○	○	○	○
Project-related behavior of participants has changed	○	○	○	○	○	○	○
The project produces/ produced high quality data	○	○	○	○	○	○	○
The project has contributed to answering research questions	○	○	○	○	○	○	○
The project has resulted in scientific publications	○	○	○	○	○	○	○
The project has produces scientific datasets	○	○	○	○	○	○	○
The project has promoted political participation of citizens	○	○	○	○	○	○	○
The project has initiated new collaborations between citizens, researchers and decision-makers	○	○	○	○	○	○	○
The project has implemented interventions to protect natural systems	○	○	○	○	○	○	○
The project has promoted sustainable practices and processes	○	○	○	○	○	○	○
Relevant stakeholder groups and their interests have been identified	○	○	○	○	○	○	○
The project has promoted a two-way communication between citizens, researchers & decision-makers	○	○	○	○	○	○	○

Questions to citizen science project coordinators (continued)

Now, we would like to learn more about your CS project's educational programme.

15. Which forms of learning support does your CS project offer to participants?* *Please tick all items that apply.*

- On-site training with experts
- Online training
- Mentoring by fellow citizen scientists
- Systematic feedback on project activities
- Opportunity to take responsibility for important project tasks
- Written information material (e.g. booklets, websites)
- Interactive media (e.g. project app)
- Other (please specify)
- Comments: _____

(Filter question)

16. [Which content is covered in your trainings for project participants? *Multiple-choice question* **]**

17. [Does your project offer multiplicator workshops ('train-the-trainer')? *Single-choice question*]

18. [Does your project have a strategy for science communication? *Single-choice question* **]**

19. [What are the main areas of science communication in your project? *Multiple-choice question* **]**

20. [How often do you use the following channels for internal communication in your project? *7-point Likert scale* **]**

21. [How often do you use the following channels for internal communication in your project? *7-point Likert scale* **]**

The following questions deal with the cooperation with schools and extracurricular places of learning.

22. Does your CS project cooperate with schools?* *Please tick one answer.*

- Yes
- No
- Cooperation is planned *(Filter question)*

23. [Which age group of pupils is participating in your project?
Please tick all answers that apply.

- Primary school pupils (6-10 years)
- Pupils in grades 5-9 (11-15 years)
- Pupils in grades 10-12 (16-18 years)
- All ages groups
- Other (please specify) **]**

24. [Which types of schools do you address with your project? *Multiple-choice question***]**

25. **Why is your project particularly suitable for school classes?** *Multiple-choice question with open field for comments*

26. Does your CS project cooperate with extracurricular places of learning? (e.g. educational or cultural center, school laboratory, museum, library, zoo, botanical garden)?* *Please select one answer.*

- Yes, frequently or regularly
- Yes, sometimes or temporarily
- No
- *I don't know*

(Filter question)

27. With which kind of extracurricular learning places does your project cooperate? *Please tick all answers that apply.*

- Archive
- Botanical garden
- Cultural center
- Educational institution
- Library
- Museum
- NGO/association
- Research institute
- School laboratory
- Zoo/aquarium
- Other (please specify)

Questions to project participants (citizen scientists)

[For questions 1.-4., see p. 3]

5. Which impact did your citizen science (CS) engagement have on your personal development?* *Please indicate to which extent you agree or disagree with the following statements.*

	1- strongly disagree	2- disagree	3- rather disagree	4- rather agree	5- agree	6- strongly agree	don't know
I have gained new knowledge about the project content	◯	◯	◯	◯	◯	◯	◯
I have acquired new scientific skills, e.g. to use scientific methods	◯	◯	◯	◯	◯	◯	◯
My interest in science has increased	◯	◯	◯	◯	◯	◯	◯
My attitude towards science has changed	◯	◯	◯	◯	◯	◯	◯
I am motivated to participate in my project in the long term	◯	◯	◯	◯	◯	◯	◯
I can personally achieve something in the field of my CS project	◯	◯	◯	◯	◯	◯	◯
I can make a difference together with others in the field of my CS project	◯	◯	◯	◯	◯	◯	◯
I plan to implement related activities beyond my CS project	◯	◯	◯	◯	◯	◯	◯

Comments: _____

6. Which of the following learning support tools have you used during your CS activity? *Please tick all answers that apply.*

- On-site training with experts
- Online training
- Mentoring by fellow citizen scientists
- Systematic feedback on project activities
- Opportunity to take responsibility for important project tasks
- Written information material (e.g. booklets, websites)
- Audio-visual media (e.g. video tutorials)
- Interactive media (e.g. project app)
- *I don't know*
- Comments:_____

(Filter question)

7. [How often have you taken part in training or coaching events offered by your CS Project?* *Please estimate the number of events you have attended*

_____

- I havn't taken part in any CS training or coaching events yet. **]**

8. How do you think CS training offers for project participants could be improved? *Multiple answers are possible.*

- Expansion of the training offer
- Longer training duration
- More staff to lead and supervise the training
- More detailed demonstration of research methods
- More information on the analysis and use of CS data
- More input on scientific work
- More information on processing and use the project results (e.g. media reports, planning measures for environmental protection)
- More input on how to deal with digital media in CS projects
- More opportunities for active participation
- Use of comprehensible language
- Other (please specify)
- Comments:_____

Questions to researchers

The following questions deal with the integration of citizen science (CS) into scientific research and university teaching.

1. **Which research discipline do you belong to?*** *Please select one or more (max. 3 answers) from the alphabetically sorted list.*

- agricultural sciences
- anthropology
- archaeology
- architecture
- arts
- astronomy
- biology
- chemistry
- communication sciences
- cultural sciences
- economics
- educational sciences
- engineering
- environmental sciences
- genealogy
- geography
- health sciences
- history
- informatics
- information sciences
- linguistics
- literature
- mathematics
- media sciences
- meteorology
- philosophy
- physics
- political sciences
- psychology
- sociology
- other discipline (please specify)

2. **Please specify to which extent the following statements about citizen science (CS) apply or do not apply to your research institution.**

	1- doesn't apply at all	2- doesn't apply	3- rather doesn't apply	4- rather applies	5- applies	6- applies completely	don't know
The majority of researchers in my institution is familiar with CS.	◯	◯	◯	◯	◯	◯	◯
In my institution, CS is used as a research tool.	◯	◯	◯	◯	◯	◯	◯
In my institution, participatory teaching- and research methods are regularly used.	◯	◯	◯	◯	◯	◯	◯
The majority of students in my institution is familiar with the concept of CS.	◯	◯	◯	◯	◯	◯	◯
The majority of university teachers in my institution is open-minded towards CS.	◯	◯	◯	◯	◯	◯	◯
In my institution, CS is part of the curricula.	◯	◯	◯	◯	◯	◯	◯
My institution offers training or courses for researchers on CS.	◯	◯	◯	◯	◯	◯	◯
My institution has established specific funding instruments for CS.	◯	◯	◯	◯	◯	◯	◯

Comments: _____

Questions to researchers (continued)

3. Please indicate to which extent the following statements on citizen science (CS) apply or do not apply to your research discipline.

	1- doesn't apply at all	2- doesn't apply	3- rather doesn't apply	4- rather applies	5- applies	6- applies completely	don't know
In my discipline, citizens are involved in the majority of research processes.	◯	◯	◯	◯	◯	◯	◯
Researchers in my discipline are honoured for engaging in CS.	◯	◯	◯	◯	◯	◯	◯
In my discipline, experience in CS promotes the careers of researchers.	◯	◯	◯	◯	◯	◯	◯
CS is part of national research calls.	◯	◯	◯	◯	◯	◯	◯
CS is part of international research calls.	◯	◯	◯	◯	◯	◯	◯
Most journals in my discipline accept studies based on CS data.	◯	◯	◯	◯	◯	◯	◯
Most journals in my discipline publish studies about CS (e.g. accompanying research on CS).	◯	◯	◯	◯	◯	◯	◯

Comments: _____

4. Which added value does citizen science (CS) provide for your research?
Please indicate to which extent the following statements about the value of CS apply or do not apply to your research.

	1- doesn't apply at all	2- doesn't apply	3- rather doesn't apply	4- rather applies	5- applies	6- applies completely	don't know
Increase in spatial and temporal scope of datasets.	◯	◯	◯	◯	◯	◯	◯
Cost savings during data collection.	◯	◯	◯	◯	◯	◯	◯
Time saving during data collection.	◯	◯	◯	◯	◯	◯	◯
More effective data processing through citizen participation & use of new technologies.	◯	◯	◯	◯	◯	◯	◯
Improved data interpretation through joint evaluation with citizens.	◯	◯	◯	◯	◯	◯	◯
Improved visibility of research through citizen participation.	◯	◯	◯	◯	◯	◯	◯
Increased societal acceptance of research through citizen participation.	◯	◯	◯	◯	◯	◯	◯
Increased societal relevance of research by developing questions together with citizens.	◯	◯	◯	◯	◯	◯	◯
Timely filling of data gaps to develop management strategies.	◯	◯	◯	◯	◯	◯	◯
More effective implementation of research results through citizen participation.	◯	◯	◯	◯	◯	◯	◯

CS currently has no added value for my research. ◯

Questions to researchers (continued)

5. In your opinion, how could CS and participatory research approaches be increasingly integrated into university teaching and research?
Please select all answers that apply.

- Increased communication of CS potentials of CS for research
- Information events on CS for researchers and students
- Workshops with CS projects working in my research discipline
- Other (Please specify)
- *I don't know*
- Comments:_____

Questions to members of NGOs and educational institutions

1. **[In which type of institution are you working?***
   Please select one answer.

- Archive
- Botanical garden
- Cultural center
- Educational institution
- Government/administration
- Laboratory
- Library
- Museum
- NGO/association
- Private sector
- School laboratory
- Zoo/aquarium
- Other (please specify) **]**

2. **[Is citizen science (CS) part of your educational program?***
   Please select one answer.

- Yes
- No
- In planning
- *I don't know* **]**

(Filter question)

3. **[Which goals do you pursue through cooperation with CS projects?** *Multiple-choice question* **]**
4. **[Which age groups participate in your CS offer?** *Multiple-choice question* **]**
5. **[Which challenges have you encountered in the process of integrating CS into your educational program?** *Please answer in bullet points (max. 500 characters)* **]**

Questions to school teachers

1. [Have you already taken part in a citizen science (CS) project with pupils?*
Please select an answer.

- Yes
- No
- In planning]

(Filter question)

2. [In which CS project(s) have you participated with your pupils?
Please name(s) the project(s). **_____]**

3. [With which age groups of pupils have you participated in CS activities?
Please tick all answers that apply.

- Primary school pupils (6-10 years)
- Pupils in grades 5-9 (11-15 years)
- Pupils in grades 10-12 (16-18 years)
- All ages groups
- Other (please specify) **]**

4. [In what type of school do you participate in CS activities with your pupils? *Multiple-choice question* **]**

5. [In which context do you participate in CS activities with your pupils?
Please select all answers that apply.

- In subject lessons (please specify subject)
- Extracurricular (please explain, e.g. in a working group?)
- Other (please explain) **]**

6. [Which goals do you pursue by participating in CS projects with your pupils? *Multiple-choice question* **]**

7. [In your opinion, what are the prerequisites for integrating CS projects into everyday school life? *Multiple-choice question* **]**

Questions to members of citizen science funding organizations

1. [In which funding organization do you work? *Please specify***.**
_____]

2. [How can your funding organization be classified? *Please select an answer.*
My funding organization is a...

- National State Funding organization
- International state funding organization
- Private funding organization (national)
- Private funding organization (international)
- Other (please specify)]

3. [How does your organization support citizen science (CS)?
Please tick all answers that apply.

- We offer funding specifically for citizen science research.
- We offer general research funding that can be used for citizen science projects.
- We offer funding for citizen science components within research projects.
- We involve citizens directly in the assessment of funding applications (e.g. as lay reviewers).
- We involve citizens directly in defining a research strategy (e.g. by including input from non-experts in strategic policy decisions).
- We provide guidance or other information on citizen science (e.g. good practice or ethics).
- We provide training for researchers on citizen science (please specify).
- Other (please specify) **]**

4. [How many CS funding applications have you received in recent years?
If you do not know exactly, please estimate the number.

- 2016_____
- 2017_____
- 2018_____
- 2019_____
- 2020_____ **]**

Questions to members of funding organizations (continued)

5. **[How much funding did your organization provide to the following types of CS projects in the period from 2016 to 2020?** *If you don't know exactly, please estimate.*
   - Projects with traditional duration (3 years) _____
   - Projects with an extensive scoping or project development phase (more than 3 years in total) _____
   - Projects for accompanying research or evaluation of CS _____
   - Projects for follow-up funding of already established CS projects _____ **]**

6. **[What was the focus of the projects on accompanying research about CS funded by your organization?** *Multiple-choice question* **]**

7. **What impact did your funding and/or support have for CS projects so far?**
   Please explain briefly.

8. **Where do you still see open potential and challenges for CS funding?**
   Please explain briefly.

Survey part II: Questions to all respondents

The following section deals with the current state of networking within the citizen science community.

1. **What has helped you the most so far in developing expertise in citizen science (CS)?** *Please select one or more (max. 5) answers.*
   - Conferences on CS
   - Experience to organize a CS project
   - Experience to participate in a CS project
   - Exchange with colleagues from my own organization
   - Exchange with colleagues from other organizations
   - Local and regional platforms or networks
   - National CS platforms (online)
   - Online workshops
   - Scientific articles about CS
   - Trainings, workshops, summer schools
   - Written guidelines on CS
   - Other (please specify)
   - *I don't know*
   - Comments:_____
2. **[Did you participate in any CS-related events in the period from 2016-2020?** *Single-choice question, filter question* **]**
3. **[How many CS-related events did you attend in the period from 2016 to 2020?** *Please specify.* **]**
4. **[Which topics were covered at the CS events you took part in?** *Multiple-choice question* **]**
5. **[Which CS events were particularly inspiring for you?** *Please specify.* **]**
6. **Which suggestions do you have to improve future CS events and networking opportunities?** *Please explain briefly.*
7. **Are you active in a local, regional or supra-regional network for the promotion of CS or participatory science?** *Please select one answer.*
   - Yes (please specify in which network you are active)
   - No
   - In planning
8. **Would you like more advice on the planning, implementation and/or evaluation of CS projects?** *Please select one answer.*
   - Yes
   - No
   - *I don't know (Filter question)*

9. **Please indicate how important advice and support in the following areas of CS would be for you.**

	1- not important at all	2- not impor-tant	3- rather not important	4- rather impor-tant	5- impor-tant	6- very impor-tant	don't know
Analysis & publication of CS data	◯	◯	◯	◯	◯	◯	◯
CS data quality & archiving	◯	◯	◯	◯	◯	◯	◯
CS good practice	◯	◯	◯	◯	◯	◯	◯
CS in schools	◯	◯	◯	◯	◯	◯	◯
CS in universities & research institutes	◯	◯	◯	◯	◯	◯	◯
CS project evaluation	◯	◯	◯	◯	◯	◯	◯
Implementation of CS data & results into policy & practice	◯	◯	◯	◯	◯	◯	◯
Legal & ethical aspects of CS	◯	◯	◯	◯	◯	◯	◯
New technologies in CS	◯	◯	◯	◯	◯	◯	◯
Participatory project design	◯	◯	◯	◯	◯	◯	◯
Proposal writing for CS projects	◯	◯	◯	◯	◯	◯	◯
Science communication	◯	◯	◯	◯	◯	◯	◯
Stakeholder analysis	◯	◯	◯	◯	◯	◯	◯
Volunteer management	◯	◯	◯	◯	◯	◯	◯

Comments:_____

Questions to all respondents (continued)

10. How do you think advisory services to support citizen science (CS) projects should be organized? *Please choose one or two answers.*

- Contact point in my organization
- Support network (network of competent persons from different organizations)
- Regional advisory centers
- Central, cross-organizational advisory center
- Other (please specify)
- Comments:_____

11. Which of the following guides and guidelines on CS do you know and/or use?
*3-point Likert scale for each item: '*don't know', 'know but don't use', 'use actively'
Comments:_____

12. Do CS projects currently succeed in motivating people from different backgrounds to participate in research?* *Please tick one answer.*

- Yes, CS projects already succeed in doing so.
- No, more efforts need to be made here (*please explain shortly which target groups should be addressed more and how*)
- *I don't know*

The following questions deal with the assurance and control of data quality in citizen science (CS) projects. *Please answer for the project in which you are currently most actively involved.*

13. How is data quality ensured in the CS project you are involved in? *Please tick all options from the drop-down list that apply to your CS project.*

- **Preparatory measures** (before data collection)
  - Project specific data quality guidelines
  - Testing of the participants' knowledge and/or skills
  - Training for participants
  - *There are no data quality assurance measures before data collection*
- **Accompanying measures** (during data collection)
  - Accompanying and support of participants during data collection
  - Automatic data filtering
  - Automatic image, text or sound classification/recognition
  - Automatic plausibility- and completeness control with data entry tool
  - Collection of evidence (e.g. photos, samples for re-examination)
  - Collection of metadata
  - Manual data filtering
  - Self-assessment of data quality by participants
  - Standardized monitoring e.g. through protocols
  - Standardisation via calibrated measuring devices

[Question 13. continued – Accompanying measures]

  - Ranking of the participants' knowledge and/or skills
  - Repeated sampling/measuring
  - Testing of the participants' knowledge and/or skills
  - *There are no data quality assurance measures during data collection*
- **Retrospective measures** (after data collection)
  - Analysis of data together with citizens
  - Automatic data filtering
  - Automatic image, text or sound classification/recognition
  - Comparison of CS data with known (measured) current status
  - Comparison of CS and expert reference data
  - Examining of metadata
  - Expert appraisal of CS data or samples
  - Manual data filtering
  - Normalization of CS data
  - Ranking of the participants' performance
  - Systematic data storage and archiving
  - Triangulation of CS data
  - *There are no data quality control measures after data collection*
- *I don't know*
- Comments:_____

14. Have the data and results from your CS project already been published?* *Please answer for the project you are coordinating or in which you are participating.*

- Yes, they have been published.
- Publication is planned.
- They won't be published.
- *I don't know*
- Comments:_____

(Filter question)

15. Where have the data and results from your CS project been published?
Please tick all answers which apply for the project you are currently involved in.

- Library or collection
- Project website
- Scientific archive
- Scientific data repository
- Scientific journals
- University or institute server
- Other (please specify)
- Comments:_____

Questions to all respondents (continued)

16. [In which form is the data from your citizen science (CS) project published and which groups of people get access to the data?

Project coordination/ all project employees/ all project participants/ the public

- Raw data
- Processed data
- *I don't know* **]**

17. What makes it difficult to publish the data and results from your CS project? *Please list possible aspects in bullet points (max. 300 characters).*

- In the scientific context_____
- In the public context_____

18. Does your CS project have an official policy for handling data, such as a data management plan, which regulates the storage, processing, publication and archiving of data? *Please tick one answer.*

- Yes
- No
- *I don't know*

19. Please specify to what extent you agree or disagree with the following statements about Open Access publishing in the field of CS.

	1- don't agree at all	2- don't agree	3- rather don't agree	4- rather agree	5- agree	6- agree completely	don't know
Scientific content from CS projects should be available free of charge.	◯	◯	◯	◯	◯	◯	◯
Publicly funded research should be published in open access publications	◯	◯	◯	◯	◯	◯	◯
For scientific reputation it is necessary to publish in renowned journals.	◯	◯	◯	◯	◯	◯	◯
Scientific publications have a financial value and should be paid for by readers and users.	◯	◯	◯	◯	◯	◯	◯

20. [Does your CS project take into account regulations on the handling of intellectual property (e.g. regulations on Open Access)? *Single-choice question* **]**

21. [In your opinion, what are reasons for or against the use of artificial intelligence (AI) in CS projects? *Please rate each of the following reasons.***]**

22. [In your opinion, which fields of researchs are particularly suitable for using sensors or AI in CS activities? *Please list possible fields of research.* **]**

23. Are you involved in data management or publication in a CS project?*

Please select an answer.

- Yes
- No

(Filter question)

24. (Only data managers) **Where is the CS data from your project archived?**

Please tick all answers that apply.

- Library or collection
- Scientific archive
- Scientific data repository
- University or institute server
- Other (e.g. private or internal server)
- No systematic archiving takes place (yet)
- *I don't know*
- Comments:_____

25. (Only data managers) **Which metadata standards are used in your CS project?**

Please choose one answer.

- ABCD
- Dublin Core
- EML
- Other (please specify)
- We don't use metadata standards
- *I don't know*

26. (Only data managers) **[Would you publish your data using a standard citation style for CS data (e.g. as DOI with specific metadata standards)?**

Please choose one answer.

- No, definitely not
- Rather not
- I don't know
- Rather yes
- Yes, certainly **]**

Questions to all respondents (continued)

27. What kind of support would be helpful for you to collect and manage your CS data? *Please indicate to what extent the following aspects would be helpful for you or not.*

	1- not at all helpful	2- not helpful	3- rather not helpful	4- rather helpful	5- helpful	6- very helpful	don't know
Additional fincancing for data collection and archiving	◯	◯	◯	◯	◯	◯	◯
Freely available data collection tools	◯	◯	◯	◯	◯	◯	◯
Somebody to support me with data archving	◯	◯	◯	◯	◯	◯	◯
Somebody to support me with data collection	◯	◯	◯	◯	◯	◯	◯
Support by guidelines or tutorials	◯	◯	◯	◯	◯	◯	◯
Thematically appropriate data repositories	◯	◯	◯	◯	◯	◯	◯
User-friendly data collection tools	◯	◯	◯	◯	◯	◯	◯
User-friendly data repositories	◯	◯	◯	◯	◯	◯	◯

Comments:_____

The following three questions deal with the recognition of citizen science (CS) in institutionalized science and society.

28. In your opinion, to which extent do the following statements about the recognition of CS engagement apply or not apply? *Please answer the question with regard to the current state.*

	1- doesn't apply at all	2- doesn't apply	3- rather doesn't apply	4- rather applies	5- applies	6- applies completely	don't know
Citizens are involved adequately into the majority of ongoing practice-related research processes.	◯	◯	◯	◯	◯	◯	◯
Citizen participation is indicated adequately in scientific publications.	◯	◯	◯	◯	◯	◯	◯
Citizen participation is indicated adequately in popular science publications.	◯	◯	◯	◯	◯	◯	◯
CS is recognised as a significant research approach in project calls and policy papers.	◯	◯	◯	◯	◯	◯	◯
CS data are used by decision makers as evidence for societal and political decision-making.	◯	◯	◯	◯	◯	◯	◯
Researchers are recognised adequately for their engagement in CS.	◯	◯	◯	◯	◯	◯	◯
The public service media often report about CS.	◯	◯	◯	◯	◯	◯	◯

Comments:_____

Questions to all respondents (continued)

29. How do you think project participants should be rewarded for their CS engagement? *Please rate how important each of the suggestions is for you.*

	1- not important at all	2- not impor-tant	3- rather not important	4- rather impor-tant	5- impor-tant	6- very impor-tant	don't know
Celebrating together at networking events	◯	◯	◯	◯	◯	◯	◯
Certificates	◯	◯	◯	◯	◯	◯	◯
Free interactive training or qualification courses	◯	◯	◯	◯	◯	◯	◯
Interviews in radio/TV/print media	◯	◯	◯	◯	◯	◯	◯
Involvement of project participants as authors in publications	◯	◯	◯	◯	◯	◯	◯
Joint development of practical measures based on project results	◯	◯	◯	◯	◯	◯	◯
Monetary allowance	◯	◯	◯	◯	◯	◯	◯
Naming of project participants in publication acknowledgements	◯	◯	◯	◯	◯	◯	◯
Opportunity for exchange with decision makers to discuss CS project results	◯	◯	◯	◯	◯	◯	◯
Opportunity for personal exchange with researchers	◯	◯	◯	◯	◯	◯	◯
Pension points	◯	◯	◯	◯	◯	◯	◯
Project related gifts or vouchers	◯	◯	◯	◯	◯	◯	◯
Volunteer cards	◯	◯	◯	◯	◯	◯	◯

30. In your opinion, which value do CS data and results have for political and societal decision-making? *Please select one answer.*

- No value (data quality too unsure)
- Value as additional information to other scientific studies
- Value as essential data basis for current research
- *I don't know*
- Comments:_____

With these last three questions, we would like to learn more about your assessment of the current funding and support mechanisms for citizen science (CS) projects.

31. Please indicate to which extent you agree or disagree with the following statements about the funding of citizen science (CS) projects.

	1- don't agree at all	2- don't agree	3- rather don't agree	4- rather agree	5- agree	6- agree completely	don't know
There are currently enough funding programs for CS projects.	◯	◯	◯	◯	◯	◯	◯
There are currently enough start-up funding programs for CS projects (for scoping phase).	◯	◯	◯	◯	◯	◯	◯
There are currently enough follow-up funding programs for CS projects (for long-term establishment).	◯	◯	◯	◯	◯	◯	◯
There are sufficient low-treshold funding formats to finance local, citizen- and NGO-led CS projects.	◯	◯	◯	◯	◯	◯	◯
Information about low-threshold CS funding programs is easily accessible for its target groups.	◯	◯	◯	◯	◯	◯	◯
CS funding programs are mostly designed specifically for CS projects.	◯	◯	◯	◯	◯	◯	◯
CS funding programs are often designed as additional option within traditional research programs.	◯	◯	◯	◯	◯	◯	◯
In recent years, traditional research funding programs have become increasingly open for CS.	◯	◯	◯	◯	◯	◯	◯

Comments:_____

Questions to all respondents (continued)

32. In your opinion, how could funding instruments for CS projects be improved?
Please shortly explain your ideas (max. 500 characters).

33. In your experience, which topics and aspects should be given more attention in the field of CS? *Please answer in bullet points.*

Lastly, we would like to ask you for some demographic information.

34. How old are you?
Please enter your age: _____ years

35. Gender *(please tick one answer)*

- female
- male
- diverse

36. What is your highest educational qualification?
Please select one answer.

- Secondary school 1 (class 9)
- Secondary school 2 (class 10)
- A-level
- Completed vocational training
- University degree/technical college degree (Bachelor)
- University degree (Diploma, Master)
- Doctorate degree

****

You have now completed the survey! Thank you very much for your time and support!
Best regards - The Citizen Science White Paper Project Team

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SI 7: Supporting qualitative survey results

Table SI 7.1 Overview of responses to open-ended questions about the current status of citizen science (CS). Responses are mapped to general topics and subtopics within the analyzed CS dimensions (i) scientific practices and outcomes, (ii) participant learning and empowerment, (iii) socio-political processes, (iv) implementation of support mechanisms. Questions analyzed (numbering see SI6) are indicated in grey brackets for every general topic. Since many subtopics were mentioned several times in a similar way by the respondents, the number of responses addressing each subtopic are indicated in brackets. Illustrative example quotes are listed for each subtopic

CS dimension	General topics	**Subtopics** (number of responses addressing this issue)	**Example quotes**
Scientific practices and outcomes	**Data quality assurance and control** (Comments on question 13 - all respondents)	CS training and mentoring to ensure data quality (3)	'For data quality assurance, we accompany volunteers during fieldwork and answer individual questions.'
			'Our project has a very successful community approach for data quality management. Volunteers support each other in data collection and documenting.'
		Assessment of data quality by citizen scientists (2)	'Citizen scientists self-assess the quality of their data.'
		Automation of data quality assurance and control (2)	'Data acquisition and generation is almost completely automated in our project through a digital data entry form and so it's hardly possible to enter nonsense data. In addition, sampling is done repeatedly so that independent comparison data sets exist'.
			'We're trying to incorporate block chain technology into the data collection process but are a year or two away from understanding the possibilities and limitations.'
		Collection of evidence for data quality control (1)	'Herbarizing of plants for expert control.'
		Criteria for CS data quality assessment (1)	'CS projects should aim for data quality depending on the processing target.'
	Publishing of CS data and results (Comments on questions 14, 15, 17, 27 - all respondents)	Publication is planned (12)	'A scientific publication is planned two years after the project ends (to allow project staff to write scientific papers based on the CS data before they are made public).'
			'We are still in the process of defining our data ownership, sharing, access, and usage policies.'
		Publication in scientific data repositories (11)	'We submit our data to GFBio.'
			'We publish our data via GitHub.'
		Need for additional resources for publishing (10)	'We would need competent authors to support us with publication writing and publishing.'
			'We lack resources and time for publishing.'
		Publication on project website or online map (9)	'We haven't published the data in scientific journals yet, but they are uploaded on our online map.'
		Various alternative publication media (9)	'Data are published as a report for authorities.'
			'We publish our results in an amateur magazine.'
			'*Mind the fungi* will be published as an open access book.'
		Presentation of results at (online) events (3)	'Public presentation of results at a bar camp.'
	Archiving of CS data (Comments on question 24 - data managers)	Archiving on private servers (13)	'We archive our data in a non-public database owned by the association.'
		Data are archived in governmental data bases (2)	'State database for nature conservation'
		Need for appropriate data archives (2)	'We need more sustainable, user-friendly online data archives and archives that preserve archival materials in analogue form.'

Table SI 7.1 continued: Overview of responses to open-ended questions about the current status of citizen science (CS)

CS dimension	General topics	**Subtopics** (number of responses addressing this issue)	Example quotes
Participant learning and empowerment	**Learning support tools** (Comments on question 15 - coordinators; comments on questions 5+6 - citizen scientists)	Feedback and mentoring (5)	'What helped me a lot in feeling competent as a citizen scientist was the practical field work together with butterfly experts, and the exchange with experienced fellow citizen scientists.'
			'Peer learning is important to strengthen networking and systematically training newly arriving interested citizens.'
		Digital learning support (2)	'We provide a social network-inspired web interface for participants to deepen engagement and that rewards them for frequency and depth of engagement.'
		On-site training (2)	'I take part in a participant training before each measuring campaign.'
	Forms of collaboration and participation (Comments on questions 6, 33 - all respondents)	Collaborative/co-creative approach (9)	'We work at eye level with the participants and organize regular on-site trainings and workshops for exchange.'
			'We are in a co-design process and are currently creating guidelines / instructions for research together with citizens.'
			'Allow citizens to work more freely, and take up the research ideas and interests of citizens instead of developing topics top-down from a scientific perspective; see citizen scientists as equal research participants and not as data collectors (which would also be good for the public image of CS).'
		Importance of volunteer management (2)	'Volunteers want to have fun, are interested in the topic, and want to make a meaningful contribution. Therefore a professional volunteer management is needed. More emphasis should be placed on this.'
	Attitudes towards science (Comments on question 33 - all respondents; Comments on question 5 - citizen scientists)	Creating transparency and trust (3)	'It's important to increase the social acceptance and trust in science through transparency. This is achieved when the scientific methods and ways of thinking are made tangible for citizens'.
			'We should show people how science works. Not only the optimal conditions, also problems, different working methods, etc. I think Citizen Science is good to create more trust in science. Maybe then people will not fall for lies so easily.'
		Little changes in participants' science attitude through CS (3)	'I have always been interested in science (before joining the citizen science project).'
			'My attitude towards science has always been very positive, it has not changed.'
	Awareness raising (Comments on question 7 - members of funding organizations)	Environmental awareness (3)	'Our project has brought the topic of biodiversity loss and butterflies into the media and made it much more visible. The project created one of the largest nature communities in Austria.'
		Awareness for CS potentials (2)	'The project has improved awareness for CS among researchers and local communities.'

Table SI 7.1 continued: Overview of responses to open-ended questions about the current status of citizen science (CS)

CS dimension	General topics	**Subtopics** (number of responses addressing this issue)	Example quotes
Socio-political processes	**CS in universities and high schools** (Comments on questions 2,3,5 - researchers; Comments on question 25 - coordinators)	Needs and recommendations for integrating CS into high school and university education (13)	'I would like to visit workshops on how to strategically embed Citizen Science in research institutions.' 'Incentivize researchers to start CS projects and include CS in calls for research proposals.' 'Citizen science initiatives need to be acknowledged and actively supported by the university leadership and management.' 'To establish CS in schools, we need a program like 'Sparkling Science' in Austria, which has funded citizen science projects with high school students.' 'We need more information for teachers about Citizen Science and specific CS projects, most of my colleagues have never heard of it.'
		Barriers to the integration of CS into higher education (8)	'I have the impression that my institute acts like an 'ivory tower society', as usual at the universities…' 'The interface from university to the public is missing in the sense of communication, infrastructure, and space. Why aren't the engineering workshops also public FabLabs? Why is there no supervised S1 lab for biotechnology enthusiasts to develop their own projects?' 'In terms of CS, there are some pioneers in my institution that could be much more visible.' 'Citizen science currently plays no role in my research institute.'
		Cooperating with high schools (6)	'We develop education material for teachers and organize school competitions.' 'We know that some high school teachers use our app with pupils – but have no detailed information about this.'
		Support by universities (4)	'Our project is funded and supported by the university.'
	Integration of CS into decision-making processes (Comments on questions 30+ 33, all respondents)	Potential for societal transformation through CS (9)	'Politics usually react very slowly to various societal issues (e.g. labor market and education). Possibly this could be changed by CS.' 'Involving citizens could be a good counterweight to industry-driven participation, especially in environmental issues, where often only the business lobby is heard.' 'Major challenges (e.g. climate, Corona, conspiracy theories, right-wing populism) require a social rethinking. In my opinion, it is essential to involve society and provide options to influence political agendas. Diversity, education and discussion at the societal level must be systematically promoted, e.g. being able to counter fake news with scientific arguments.' 'CS can contribute to solutions by encouraging a continuous collection of ideas, idea ranking, problem recording, problem networking, process monitoring, and process transparency.'
		Need for collaboration with decision-makers and different stakeholders (7)	'It takes a lot of expertise and collaboration of different actors to build decision-making processes on CS data, because the data never simply speaks for itself. This needs framing and interpretation. It seems to me that there are still a lot of challenges.' 'In nature conservation, Citizen Science data are indispensable and have long been the data basis. Intensive discussions should take place with the federal agencies and other subordinate authorities to see how environmental data from CS projects can also be incorporated elsewhere.' 'Active involvement of decision-makers is needed to enable anchoring of CS results in different organizations.' 'A lot of work is still needed to convince decision-makers of the importance of Citizen Science.'
		Requirements for data quality and management (3)	'The quality of the CS data must be verifiable, and the data collection must be critically reviewed by the scientific community. Valid, scientifically collected data can be used in decision-making processes.'
		Best-Practice-Examples (1)	'Positive example: The Swiss Litter Report has led to Federal Berne addressing the waste issue.'

Table SI 7.1 continued: Overview of responses to open-ended questions about the current status of citizen science (CS)

CS dimension	General topics	**Subtopics** (number of responses addressing this issue)	Example quotes
Socio-political processes	**Tools for capacity building in citizen science** (Comments on questions 1,6,10,11 - all respondents)	Personal exchange (8)	'Practical work with my colleagues from the professional association.'
		Best practice examples (7)	'More opportunity for personal exchange at workshops would be helpful.'
			'Discussion of best practice examples are very helpful.'
		Regional CS contact points (7)	'To develop and establish CS further we need CS contacts persons or staff offices in all major NGOs and research organizations.'
		Workshops and counselling (6)	'Workshops on community building and coordination of citizen groups would be helpful.'
			'We need advice on data management, publication and archiving.'
			'Advice on legal and data protection issues would be important.'
		Use of (online) guidebooks or toolkits on CS (6)	'https://rri-tools.eu/'
			'Digital tool for CS data analysis projects: CS project builder'
			'Instruction pages for projects, e.g. at GenWiki'
		(Online) guidebooks not well disseminated (3)	'I don't know any guidebooks on CS'
		Learning by doing (3)	'Learning by doing helped me to coordinate the project.'
	General challenges for CS (Comments on questions 6, 9, 12, 17, 33- all respondents; Comments on question 8 - members of CS funding organizations)	Need to reach a broader audience (51)	'Currently, CS project don't manage yet to involve people from different backgrounds. Participants are very educated, white and relatively wealthy.'
			'Inclusion of non-academics is an important task!'
			'Citizen science is currently too dominated by academics and academic institutions. Instead, more project should be initiated and led by NGOs and citizen initiatives.'
		Lack of recognition in the science system (14)	'Many members of the scientific community are still skeptical about citizen science – for them it's too time-consuming, too expensive, too imprecise. More tools and best practice models are needed to counter and overcome these attitudes.'
		Lack of networking between CS actors (10)	'CS projects often are not interconnected yet.'
			'More networking and synergies between CS actors are needed.'
		Lack of visibility of CS (8)	'Citizen science is not yet well known enough.'
			'Most people don't know about citizen science yet.'
			'Citizen science needs to become more present in the mass media.'
		Legal issues, data protection (4)	'Clarification of data copyright & authorship, GDPR, collection of personal data'

Table SI 7.1 continued: Overview of responses to open-ended questions about the current status of citizen science (CS)

CS dimension	General topics	**Subtopics** (number of responses addressing this issue)	Example quotes
Implementation of support mechanisms	**Recognition instruments** (Comments on questions 28+29 - all respondents)	More citizen participation in research processes (7)	'As a reward for my voluntary engagement, I would appreciate more insights and participation in the work of the research team. Currently it is a black box, I hand in the results and don't know how they proceed with it. This is demotivating.'
		Monetary reward/paid engagement (5)	'Monetary reward: definitely not: it would destroy the volunteer character of the project.'
		Variety of recognition instruments (4)	'There are many different promising recognition instruments and it depends on project context and concerned individuals which ones will be appreciated most. However, recognition will only be successful if it happens at eye level.'
		Visibility of citizen science contributions in reports and on platforms (4)	'Co-authorship for citizen scientists or mention of Cs contributions in acknowledgements.' 'We plan to make the authors of data points visible on data maps in our online portal, if requested. Stories can also be posted and contributors named/honored via social media channels.'
		Certificates (3)	'Qualification certificates for citizen scientists would be useful.'
		Support of citizen science engagement by governments or employers (2)	'I would like to see something like an 'educational leave': The project participants would be given free time to carry out the CS project.' 'Pension points for CS engagement would be an option'
		Monetary compensation (2)	'An expense allowance would be useful for example to pay for the journey to the sampling sites.'
		Recognition of researchers involved in CS (2)	'For scientists, a performance evaluation that is recognized by the scientific community is essential.'
	Funding for CS projects (Comments on questions 31+32 - all respondents)	More funding for CS needed (21)	'There currently too few funding opportunities, and funding volumes are much too low'.
		Low-threshold programs (19)	'More easily accessible funding opportunities with straightforward procedures are needed so that citizen groups and local associations also have a chance to participate.'
		Funding for different project phases (8)	'Start-up financing for CS project scoping phases and possibilities to finance long-term project establishment are very important.'
		Support with funding applications (7)	'Advice services for the application process and possibility to co-design applications together with researchers and citizens'
		No external funding (3)	'In my opinion, many CS projects currently don't receive any external funding.'
	CS project evaluation (Comments on question 12 - coordinators; Comment on question 8 - members of CS funding organizations)	No systematic project evaluation (6)	'The data will be scientifically analyzed, but the CS approach will not be evaluated in our project.' 'We have not yet dealt with this issue in detail.' 'Currently, the project is not being evaluated, but we welcome feedback from participants.'
		Informal feedback by participants (3)	'Of course we talk about project outcomes in informal meetings, but they are not systematically evaluated.' 'We run public and non-public project forums where participants can express wishes, criticism, etc. at any time. We then discuss the inputs and if possible and suitable, incorporate them into the project. In this way, we can take into account a wide range of suggestions.'
		CS evaluation needs (2)	'We need more research on Citizen Science and its effectiveness. With the accompanying research in our current funding period, we try to make a contribution here.'
		Evaluation by funding organization (2)	'The external evaluation (project sponsor) will investigate to which extent citizen science was helpful for generating scientific knowledge and why participants joined our project.'