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Technical Brief: Self-Efficacy for Learning and Doing Citizen Science **(Custom)**

Description:

Self-efficacy, or a person's beliefs about his/her capabilities to learn specific content and perform particular behaviors (Bandura 1997) is associated with choice, effort, and persistence in the pursuit of those behaviors (Bandura 1982; 2000; Schunk, 1991). Individuals who feel efficacious put more effort into their activities and persist at them longer than those who doubt their abilities. Self-efficacy is sometimes referred to as "perceived competence" (in Self Determination Theory) and "perceived behavioral control" (Ajzen's Theory of Planned Behavior, 1991). Berkowitz et al. (2005) treat self-efficacy as an essential component in environmental citizenship (along with motivation and awareness), which is dependent on an individual's belief that they have sufficient skills, knowledge, and opportunity to bring about positive change in their personal lives or communities. In the context of citizen science, self-efficacy is the extent to which a learner has confidence in his or her ability to participate in a science or environmental activity. Crall et al. (2011) determined that self-efficacy is important in carrying out the principal activities of the project.

Intended Use/Audience: Adults

This scale measures an individual's confidence in learning science topics specific to a *citizen science project and engaging in citizen science*. It contains 8 items and can be administered in its entirety or split into its two components: learning science and doing citizen science. The scale can be administered online, by telephone, or via paper. It should take about 10 minutes to complete and can be administered as a pretest and/or posttest. The scale was developed and tested in the context of informal science learning environments (primarily with participants of citizen science projects).

Evidence Reliability/Structure:

The customized measure to assess self-efficacy is based on the general version of the Self-Efficacy for Learning and Doing Science (SELDS), an 8-item scale (range 1-5) that underwent a series of validity tests with citizen scientists in the Great Backyard Bird Count (GBBC, an annual bird count hosted by the Cornell Lab of Ornithology) and various water quality monitoring projects. In-person focus groups, online feedback, and expert review were initially conducted with small groups of citizen science participants (8-50) to establish face and content validity. Pilot tests (N=460) included tests to assess Cronbach's alpha coefficients; the alpha coefficient of the generic SELDS was 0.92, indicating high internal consistency. The two-week test-retest reliabilities for the total averaged items were $r = .82$ and $.89$ indicating the SELDS scale could achieve stable responses from a single sample over time. Item-total correlations measured by Pearson's correlation between each item and the total scale ranged from .54 to .83, indicating all items measure consistently with the total scale, and suggesting a

positive item discrimination power. The SELDS scale also showed positive correlations with a different scale measuring interest in science and motivation for learning and doing science, suggesting concurrent validity. Lastly, an exploratory factor analysis was conducted and showed a unidimensional scale with all factor loadings above .0.70.

This version of the SELDS was pilot tested with participants in NestWatch, a nest monitoring project, to contextualize the items for the “learning” content (i.e., breeding bird biology) and the “doing” activity (i.e., monitoring breeding birds through NestWatch participation). Internal consistency for the pilot study was good (Cronbach’s $\alpha = .825$, $N=129$). The scale was later field tested with more than 1,500 participants from six different citizen science projects. Internal consistency (Cronbach’s α) = 0.836 for the full 8-item version of the scale; 0.793 for the Learning subscale; and 0.728 for the Doing subscale. Exploratory Factor Analysis revealed three factors (Learning, Doing, and negatively worded items); all items load at $>.60$; Eigen Values = 3.8, 1.1, 1.0.

Tips for modifying the scale

- 1.) *View the example scale* – We provide an example of a modified scale using water quality monitoring as the topic. The examples are used as placeholder text in the editable fields of the scale.
- 2.) *Decide on the most useful level of specificity and choose one phrase to describe the activity* – Project activities can be called out individually in the scale. Using water quality monitoring as an example, you might want to measure participant confidence in selecting appropriate test sites, collecting water samples, or analyzing samples. However, the scale is intended to measure confidence in learning about and doing just one thing. If you are interested in multiple activities, you will need to create a separate scale for each activity. For this reason, we encourage you to choose a more general concept that encompasses the complete group of activities within your project (e.g. “monitoring water quality”). Then, include this one phrase in each of the items of the scale.
- 3.) *Proofread carefully* – Changing particular words within each statement may require making small changes to the rest of the statement so that it reads well to project participants. You should make as few changes to each statement as possible while also making sure the modified statement is easy to understand. It’s best to let one or two other people read through the modified scale for clarity and ease of reading before administering it to your project participants. We encourage you to contact us with any questions you have or if you would like feedback on your modifications. Please email questions to: <clo-evaluation_research@cornell.edu>

How to Score:

Cleaning your data

Some project participants will not respond to this scale as carefully as you might hope. It is important to clean your data to account for this. Once you have entered the data into a

spreadsheet such as Microsoft Excel or a statistical package such as SPSS or R, keep an original version of the master data set, and make a copy from which to work. Do the following simple checks:

- 1) Look across each row or case (i.e., set of responses from individual participants). If more than 25% of responses are missing from any row, exclude that row (participant) from your analysis.
- 2) Look across each row again, checking for rows in which all responses are the same. In general, seeing the same response for all items in a row is an indication that the respondent was not reading the items carefully. In particular, items 3 and 7 are “reverse coded,” which means they are worded in such a way that they should receive opposite answers from other questions if respondents are answering all questions in a consistent manner. We recommend excluding from your analysis cases where all answers are the same unless they are all threes, as many respondents legitimately provide midpoint responses to all questions.

Scoring instructions

Once you have implemented the Self-Efficacy for Learning and Doing Science scale and have cleaned your data, calculate the self-efficacy score as follows:

- 1.) Reverse the responses to questions 3 and 7 such that 1s become 5s, 2s become 4s, 3s stay 3s, 4s become 2s, and 5s become 1s.
- 2.) Average together the scores for all of the items for each participant.
- 3.) You can also average together the overall scores from all of your participants for an overall group score.
- 4.) Scores below 3 indicate low levels of confidence in learning project-related information and/or participating in project activities. Given that the scale includes separate sets of items for learning (items 1-4) and doing (items 5-8), you might want to average those sets of responses (either for individual or group) separately to investigate whether participants are more or less confident with one or the other concept.

Note: If you are administering the scale before and after program participation and comparing the two sets of scores as part of a pre-post evaluation, you might want to consider first grouping your participants into those who started out relatively low in self-efficacy and those who started out relatively high in self-efficacy. While it is reasonable to expect an increase among participants who started out relatively low in self-efficacy, you should not expect to see much, if any, increase in those who started out already quite confident in their abilities. You should consider merely maintaining that high level as a positive outcome.

Analytic Options: After your data have been cleaned, the scores can be treated as either ordinal or continuous variables and used in a multitude of analytical options such as t-tests, ANOVA, and regressions.

References:

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The Self-Efficacy for Learning and Doing Citizen Science scale is on the next page. There is a form field above the scale so that you may enter your own title for your survey. Form fields are also located after both of the “e.g.,” in the title for each section, and in the statements for the second section. Please enter terms specific to your project, similar to the examples provided.

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Please indicate how much you **DISAGREE** or **AGREE** with each of the following statements by circling the number in the appropriate column. Please respond as you really feel, rather than how you think “most people” feel. Please respond regardless of whether you've previously participated in citizen science.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
These statements are about how you feel about learning and understanding science content (e.g.,					
1. I think I'm pretty good at understanding science topics.	1	2	3	4	5
2. Compared to other people my age, I think I can quickly understand new science topics.	1	2	3	4	5
3. It takes me a long time to understand new science topics.	1	2	3	4	5
4. I feel confident in my ability to explain science topics to others.	1	2	3	4	5
These statements are about how you feel about doing citizen science activities (e.g.,					
5. I think I'm pretty good at following instructions for activities.	1	2	3	4	5
6. Compared to other people my age, I think I can do activities pretty well.	1	2	3	4	5
7. It takes me a long time to understand how to do activities.	1	2	3	4	5
8. I feel confident about my ability to explain how to do activities to others.	1	2	3	4	5