A New Instrument to Assess the Scientific Literacy of Citizen Scientists

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Background and Objectives

Although a stated goal of many citizen science programs is to improve the scientific literacy of citizen participants, to date there have been few efforts to empirically test whether a citizen science project can meet this goal. One of the few efforts1 to assess the impact of a citizen science project on participants’ scientific literacy used a “generalized” instrument2 to evaluate pre–post changes in participants’ scientific literacy. This generalized instrument is the same one used by the National Science Foundation (NSF) to track the scientific literacy of United States citizens. Brossard found no change in the scientific literacy of participants in a bird-monitoring project using the NSF’s generalized instrument.1

Our objective was to develop an environmentally focused “context-specific” instrument to evaluate the impact of a citizen science experience on the scientific literacy of its participants. We then compared the ability of our context-specific instrument to detect improvements in citizens’ scientific literacy to the NSF’s generalized instrument.

Methods

Subjects were citizen volunteers in two 2-day citizen science events to train invasive species monitors held in Wisconsin in May 2009 and Colorado in June 2009. Fifty-seven citizens were assigned to a “treatment” condition that received in-person training in identification of invasive species, sampling techniques, and the use of GPS devices, and 90 were assigned to a “control” condition that did not receive training. Treatment subjects were given a survey before and after their training that included both the NSF’s generalized item and our context-specific items. Control subjects received this survey once.

Two raters independently scored survey responses according to Miller’s rating system (NSF generalized items) and to a codebook we developed (context-specific items). Rater agreement was evaluated with the Cohen’s kappa test (generalized items) and the Cronbach’s alpha test (context-specific items). Pre-test scores on generalized items were compared to those of control subjects using the Chi-square test. Pre-test scores on context-specific items were compared to those of control subjects using the independent samples t-test. Pre-test scores on generalized items were compared to those of post-test scores for treatment subjects with the McNemera Chi-square test. The total pre-test context scores of the treatment group were compared with their total post-test context scores using the paired-samples t-test.

Results

Inter-rater agreement reached .950 (NSF scores) and .733 (context scores). The scores of the control group did not significantly differ from the pre-test scores of the treatment subjects on either the generalized NSF item (P = .47; Pearson’s .53; effect size .06) or on the total context-specific scores (t = -.14; P = .14). The pre-test scores on the Miller item did not differ significantly from the post-test scores for that item (P = .53) (Figure 1). However, subjects scored significantly higher on the post-test context-specific scientific literacy than they did on the pre-test, with an effect size approaching moderate (P = .006; t = -2.84; effect size = .38) (Figure 2).

Discussion

Our results are consistent with those of Brossard, who saw no improvement in scientific literacy in citizen scientists when pre–post change was measured using the NSF’s generalized literacy item.1 The significant gains in the scientific literacy of those same subjects we observed using our context-specific instrument, however, suggests that the NSF’s generalized instrument may not be the optimal method to assess the impact of citizen science programs on participants’ scientific literacy. Citizens may be better able to articulate their scientific understanding when prompted with an instrument that activates their context-specific knowledge (in this case, of invasive species monitoring methods) than when prompted with an instrument like the NSF’s that asks about generalized, abstract knowledge of the scientific process. The results we observed, however, may also be due to the fact that the context-sensitive instrument was an aggregate of four items rather than the single-item NSF instrument that Brossard used.

We recommend that invasive species monitoring programs use our four-item context-sensitive instrument, rather than the NSF’s scientific literacy item in isolation, to assess the effectiveness of their training program in improving the scientific literacy of citizen scientists.

References


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