

REQUEST FOR APPROVAL under the Generic Clearance for NASA Education Performance Measurement and Evaluation, OMB Control Number 2700-0159, expiration 04/20/2018

I. TITLE OF INFORMATION COLLECTION:

NASA Office of Education STEM Challenges Impact Surveys: Student Follow-Up Instruments

II. TYPE OF COLLECTION:

- Attitude/Behavior Scale
 - Baseline Survey
 - Cognitive Interview Protocol
 - Consent Form
 - Focus Group Protocol
 - Follow-up Survey
 - Instructions
 - Satisfaction Survey
 - Usability Protocol
-

GENERAL OVERVIEW: NASA Office of Education Science, Technology, Engineering, and Mathematics (STEM) Engagement line of business activities are designed to provide opportunities for participatory and experiential learning activities that connect learners to NASA-unique resources. NASA Education's STEM Engagement line of business activities are based on best practices in motivation, engagement, and learning in formal and informal settings and include the following areas:

- **Public Education Activities** that foster interactions with learners of all ages to spark an interest in STEM disciplines using NASA-unique materials and resources. These may be part of a larger public event and are often shorter in duration than Experiential Learning Opportunities and STEM Challenges. Public Education Activities often require close coordination with the NASA Office of Communications.
- **Experiential Learning Opportunities** that enable learners to acquire knowledge, understand what they have learned, and apply that knowledge through inquiry-based and project-based activities. NASA opportunities include participatory activities designed to increase involvement, knowledge, understanding/comprehension, and application of learning in one or more STEM disciplines using NASA's resources.
- **STEM Challenges** that provide creative applications of NASA-related science, technology, engineering, mathematics, and cross-cutting concepts. They challenge existing assumptions and encourage learners to demonstrate their knowledge of STEM subjects while enhancing innovation, critical thinking, and problem-solving skills.

In coordination with data and information gathered from the baseline instrument, this follow-up instrument information collection is specific to determining the impact of engineering design and scientific research STEM Challenge activities on middle school students (grades 5 through 8, depending on the school system of record in the U.S.)

III. INTRODUCTION AND PURPOSE: STEM Challenge activities are based on best practices in motivation, engagement, and learning for students and educators in formal and informal settings (e.g., Farland-Smith, 2012; Gasiewski, Eagan, Garcia, Hurtado, & Change, 2012; Kim, et al., 2015; Leblebicioglu, Metin, Yardimci, & Cetin, 2011; Maltese & Tai, 2011). The constructs of interest for these follow-up surveys are the engineering design and scientific research processes. In a NASA engineering design

challenge (EDC) activity, the focus is a design task in which students must meet certain criteria through a series of steps that engineers follow to arrive at a solution to a problem. This engineering problem is within the context of NASA-unique content and subject matter experts. Similarly, in a scientific research challenge (SRC) activity, students are connected with opportunities to participate in science data collection by conducting real, hands-on science according to the scientific method, a body of techniques for investigating phenomena, acquiring new knowledge in an empirical or measurable manner, and then correcting and/or integrating previous knowledge subject to specific principles of scientific reasoning.

Our interest is in understanding why, how, and in what ways students are impacted in the short-, intermediate, and long-term by participation in STEM Challenge activities with an engineering design or scientific research process focus. Thus, the purpose for pilot testing is to develop valid instruments that reliably explain the ways in which participants' attitudes and behaviors are impacted by participation in these activities. Guided by the most current STEM education and measurement methodologies, it is the goal of this rigorous instrument development and testing procedure to provide information that becomes part of the iterative assessment and feedback process for the NASA STEM Engagement line of business.

Hence, the goals of this cycle of pilot testing are as follows:

- Determine clarity, comprehensibility, and preliminary psychometric properties (e.g., validity, reliability) of these instruments. And, to explore individual item functioning, and to make any necessary adjustments in preparation for large-scale testing as the basis for more sophisticated statistical testing.
- Determine an accurate response burden for these instruments.

Relevant information was gathered from representative respondents on the companion baseline survey through a truncated usability testing. For reason that the follow up instrument is parallel to the baseline instrument in items and constructs, we are confident that the follow-up instrument is adequate for pilot testing.

- I. **RESEARCH DESIGN OVERVIEW:** NASA Education is using a one-group pretest-posttest quasi-experimental design. Responses will be used to validate these follow-up surveys for clarity, comprehensibility, and to determine psychometric properties with the respondent pool.

Following this pilot phase of testing, indeed NASA Education has tentative research questions and hypotheses to test regarding the impact of STEM Challenge activities on all participants—students and teachers alike. Thus, this work is integral to the iterative assessment and feedback process for the STEM Engagement line of business.

- II. **TIMELINE:** Pilot testing of surveys will take place approximately September 1, 2016 through February 28, 2017, coordinated with the implementation periods of the STEM Challenge activities.
- III. **SAMPLING STRATEGY:** NASA Education employed an estimation procedure to determine the statistically adjusted number of respondents for the final sample size that meets the minimum criteria for number of respondents ($N \geq 200$) necessary to determining preliminary item characteristics (Komrey & Bacon, 1992; Reckase, 2000). This estimation procedure accounts for the potential respondent universe, estimated variance in respondent universe, precision desired, confidence level, and the prior observed response rate for the category of respondents (Watson, 2001). Watson's

sample size formula as applied to respondent estimates in Table 1 demonstrates the number of respondents this pilot effort should reach in order to collect the base sample size of respondents (2001). In brief, this formula suggests that this pilot effort oversample EDC students by 218 respondents. NASA Education will randomly sample EDC sites to meet the 545 respondent minimum, but because the number of educators in the EDC activity and the number of participants and educators in the SRC activity are 200 or less, NASA Education will administer surveys for testing to the census of participants in those categories.

Table 1. Calculation chart to determine statistically relevant number of respondents

Data Collection Source	(N) Population Estimate for FY16	(A) Sampling Error +/- 5% (.05)	(Z) Confidence Level 95%/ Alpha 0.05	(P) *Variability (based on consistency of intervention administration) 50%	Base Sample Size	Response Rate	(n) Number of Respondents
EDC students	2,200	0.0025	3.8416	0.5	327	0.6	545
SRC students	110	N/A	N/A	N/A	110	N/A	110
EDC Educators	200	N/A	N/A	N/A	200	N/A	200
SRC Educators	10	N/A	N/A	N/A	10	N/A	10
TOTAL							865

IV. BURDEN HOURS: Burden calculation is based on a respondent pool of individuals as follows:

Data Collection Source	Number of Respondents	Frequency of Response	Total minutes per Response	Total Response Burden in Hours
EDC students	545	1	15	136
SRC students	110	1	15	28
EDC Educators	200	1	5	17
SRC Educators	10	1	5	1
TOTAL				182

*Burden for Educators, in this instance, is calculated to determine the amount of time spent reading instructions to student survey respondents.

V. DATA CONFIDENTIALITY MEASURES: Any information collected under the purview of this clearance will be maintained in accordance with the Privacy Act of 1974, the e-Government Act of 2002, the Federal Records Act, and as applicable, the Freedom of Information Act in order to protect respondents' privacy and the confidentiality of the data collected.

VI. PERSONALLY IDENTIFIABLE INFORMATION:

1. Is personally identifiable information (PII) collected? Yes No
2. If yes, will any information that is collected be included in records that are subject to the Privacy Act of 1974? Yes No
3. If yes, has an up-to-date System of Records Notice (SORN) been published?
 Yes No

Published in October 2007, the Applicable System of Records Notice is NASA 10EDUA, NASA Education Program Evaluation System - http://www.nasa.gov/privacy/nasa_sorn_10EDUA.html.

APPLICABLE RECORDS:

- 4. Applicable System of Records Notice: SORN: NASA 10EDUA, NASA Education Program Evaluation System - http://www.nasa.gov/privacy/nasa_sorn_10EDUA.html
- 5. Completed surveys will be retained in accordance with NASA Records Retention Schedule 1, Item 68D. Records will be destroyed or deleted when ten years old, or no longer needed, whichever is longer.

VII. PARTICIPANT SELECTION APPROACH:

- 1. Does NASA Education have a respondent sampling plan? Yes No

If yes, please define the universe of potential respondents. If a sampling plan exists, please describe? The universe of potential respondents includes a statistically representative sample of EDC student participants, the census of EDC educator participants, and the census of SRC student and educator participants.

If no, how will NASA Education identify the potential group of respondents and how will they be selected? Not applicable.

VIII. INSTRUMENT ADMINISTRATION STRATEGY

Describe the type of Consent: Active Passive

- 1. How will the information be collected:
 - Web-based or other forms of Social Media (95%)
 - Telephone
 - In-person
 - Mail
 - Other (5%)

If multiple approaches are used for a single instrument, state the projected percent of responses per approach. The feedback forms will be administered via the web. Because it is preferable that all follow-up surveys be administered at the end of an activity, hard copy surveys will be made available to collect survey responses in the event web access is temporarily unavailable. In the past, no more than 5% of respondents were asked to complete hard copy surveys due to internet or computer difficulties.

- 2. Will interviewers or facilitators be used? Yes No

Note: "Facilitators" refers to Educators who will read and explain student survey instructions.

IX. DOCUMENTS/INSTRUMENTS ACCOMPANYING THIS REQUEST:

- Consent form
- Instrument (attitude & behavior scales, and surveys)
- Protocol script (Specify type: Script)

- Instructions NOTE: Instructions are included in the instrument
 Other (Specify _____)

X. GIFTS OR PAYMENT: Yes No If you answer yes to this question, please describe and provide a justification for amount.

XI. ANNUAL FEDERAL COST: The estimated annual cost to the Federal government is \$420. The cost is based on an annualized effort of 10 person-hours at the evaluator's rate of \$42/hour for administering the survey instruments, collecting and analyzing responses, and editing the survey instruments for ultimate approval through the methodological testing generic clearance with OMB Control Number 2700-0159, exp. 04/30/2018.

XII. CERTIFICATION STATEMENT:

I certify the following to be true:

1. The collection is voluntary.
2. The collection is low burden for respondents and low cost for the Federal Government.
3. The collection is non-controversial and does raise issues of concern to other federal agencies.
4. The results will be made available to other federal agencies upon request, while maintaining confidentiality of the respondents.
5. The collection is targeted to the solicitation of information from respondents who have experience with the program or may have experience with the program in the future.

Name of Sponsor: Richard Gilmore

Title: Educational Programs Specialist/Evaluation Manager, NASA GRC Office of Education

Email address or Phone number: richard.l.gilmore@nasa.gov

Date: 09/13/16

Bibliography

- Farland-Smith, D. (2012). Personal and Social Interactions Between Young Girls and Scientists: Examining Critical Aspects for Identity Construction. *Journal of Science Teacher Education*, 23(1), 1-18.
- Gasiewski, J. A., Eagan, M. K., Garcia, G. A., Hurtado, S., & Change, M. J. (2012). From gatekeeping to engagement: A multicontextual, mixed method study of student academic engagement in introductory STEM courses. *Research in Higher Education*, 53(2), 229-261.
- Kim, C., Kim, D., Yuan, J., Hill, R. B., Doshi, P., & Thai, C. N. (2015). Robotics to promote elementary education pre-service teachers' STEM engagement, learning, and teaching. *Computers & Education*, 91, 14-31.
- Komrey, J. D., & Bacon, T. P. (1992). Item analysis of achievement tests based on small numbers of examinees. *Paper presented at the annual meeting of the American Educational Research Association*. San Francisco.
- Leblebicioglu, G., Metin, D., Yardimci, E., & Cetin, P. S. (2011). The Effect of Informal and Formal Interaction between Scientists and Children at a Science Camp on Their Images of Scientists. *Science Education International*, 22(3), 158-174.
- Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among US students. *Science Education*, 95(5), 877-907.
- nasa.gov. (2016, January). Retrieved from NASA Education Implementation Plan 2015-2017: http://www.nasa.gov/sites/default/files/atoms/files/nasa_education_implementation_plan_ve4_2015-2017.pdf
- Reckase, M. D. (2000). The minimum sample size needed to calibrate items using the three-parameter logistic model. *Paper presented at the annual meeting of the American Educational Research Association*. New Orleans.
- Watson, J. (2001). *How to Determine a Sample Size: Tipsheet #60*. Retrieved from Penn State Cooperative Extension: <http://www.extension.psu.edu/evaluation/pdf/TS60.pdf>