Summary of External Evaluation Activities for NSF #1611953: Science Cafes: Modeling and Assessing a Structured Adult Informal Science Education Program

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Rockman et al (REA), an independent research and evaluation company, conducted the external evaluation for Virginia Commonwealth University's NSF Exploratory Pathways AISL project on science cafés. Specifically, REA staff members served as educational assessment consultants who worked with the project team to (a) qualitatively assess the validity of and refine the constructs for the science café assessment tool; and (b) construct and refine the summative assessment questionnaire. The evaluators also conducted a focus group with five members of Richmond's African American community, and reviewed drafts of project deliverables such as a conference poster and a research manuscript. Throughout the project, REA met regularly with Dr. Karen Rader and Ms. Cynthia Gibbs to monitor the success of the project and provide feedback that Dr. Rader subsequently incorporated into her research.

Consultation on assessment development

The research team created the assessment questionnaire using an iterative process of (1) construct identification; (2) item construction; (3) item scoring; and (4) item review and validation (Bass, Drits-Esser & Stark, 2016). To support the team's construct identification, REA engaged in conversations with Dr. Rader and Ms. Gibbs on what they expected science café participants would learn about the nature of science. Evaluators provided K-12 educational standards and research literature (e.g., Aikenhead & Ryan, 1992; Conley, Pintrich, Vekiri, & Harrison, 2004; NGSS Lead States, 2013). The research team ultimately narrowed down its constructs to three: "Engagement with Science and Technology," "Science as a Human Endeavor," and "Complexities in the Development of Scientific Knowledge." They presented those constructs, along with initial items, to the project advisory board. This served as evidence of construct validity for the measure. REA suggested a template for this review (Gehlbach & Brinkworth, 2011), which Dr. Rader adapted for the advisory board.

Evaluators also consulted with the researchers on the construction of the summative assessment questionnaire. During the construct identification process, REA shared nature of science instruments for K-12 students. Dr. Rader and Ms. Gibbs reviewed those measures along with past café instruments to generate a collection of items to include on their assessment. They expanded existing quantitative items by asking participants to explain their answers. They created two forms of the instrument in order to test multiple questions measuring the same construct. Evaluators reviewed the instruments before they were distributed at the cafés. For example, they flagged one "double-barreled" item (Artino, Gehlbach, & Dunning, 2011) that measured more than one idea and encourage the research team to separate it into two questions. The final instrument reflects this feedback.

After the research team collected assessment data from eight cafés, they compiled it and drafted a coding scheme. This served as a way to explore what participants had learned from the cafés about the nature of science. It was also an opportunity to gather response process evidence for the validity of the measures (AERA, APA, & NCME, 2014). Researchers treated ambiguous, difficult to code responses as indicators that respondents may not have understood the item in the

way the developers had intended. REA evaluators reviewed the research team's codes, and the example responses provided for each code. They highlighted codes they found to be too broad or too narrow, suggesting the researchers divide the former codes into subcategories, or consolidate the latter codes into other categories. Evaluators also suggested relabeling one code to be more consistent with educational literature. Finally, evaluators speculated with the research team about on potential sources of construct-irrelevant variance in the items, particularly cases where the wording of the question may have influenced the answers.

Additional evaluation activities

In addition to consulting on the researchers' assessment development, REA also conducted a focus group with five members of Richmond's African American community. The purpose of the focus group was to assess participants' interest in science and society issues, and to identify practical concerns they may have in attending an informal science event in the community. Participants acknowledged that while they were inundated with news about science, technology, and health, they would still be interested in attending a café about food production, skin care, sustainable energy, or black excellence in STEM. Members of the group also recommended venues that would be most likely to attract African Americans, including the Black History Museum, a public library, and local community centers. They also encouraged café organizers to market their events widely, including Facebook and the Richmond Free Press. In response to the focus group feedback, café organizers produced events entitled "The Diversity Problem in Science," and "Hidden Histories of Slavery, Medicine, and Healing." They marketed the events extensively on Facebook, newspapers, and a gospel radio station.

Finally, evaluators periodically reviewed drafts of project deliverables, including a poster that Dr. Rader presented at the 2019 AISL PI Meeting, and a program description manuscript in preparation for submission to the *Journal of STEM Outreach.* Evaluators followed up their written feedback with conversations with Dr. Rader and Ms. Gibbs to discuss the comments and prioritize revisions. REA typically asked for clarification on ambiguous wording or claims, or suggested additional citations or examples the researchers could add to their work. The evaluators also offered suggestions to improve the narrative flow of the manuscript. They anticipate further iterations to and discussions of the manuscript through January 2020.

Conclusion

In sum, REA evaluators' ongoing consultation with the VCU research team directly informed the content and marketing of two science cafés, and influenced the construction, refinement, and dissemination of the survey assessment questionnaire. Consistent with AISL program requirements, the PI has regularly and effectively elicited and incorporated external, critical reviews of project activities, and used them to improve the project. The culminating manuscript reflects REA's feedback and is evidence of the attainment of the project's goals and the quality of its exploratory research activities.

References

American Educational Research Association (AERA), American Psychological Association (APA), National Council on Measurement in Education (NCME). (2014). *Standards for Educational and Psychological Testing.* Washington, D.C.: AERA.

Aikenhead, G. S. & Ryan, A. G. (1992). The development of a new instrument: "Views on Science-Technology-Society" (VOSTS). *Science Education, 76,* 477-491.

Artino, A. R., Gehlbach, H., & Dunning, S. J. (2011) AM Last Page: Avoiding five common pitfalls of survey design. *Academic Medicine, 86*(10), 1327.

Bass, K. M., Drits-Esser, D. & Stark, L. A. (2016). A primer for developing measures of science content knowledge for small-scale research and instructional use. *CBE-Life Sciences Education, 15*(2), 1-14.

Conley, A. M., Pintrich, P., Vekiri, I., & Harrison, D. (2004). Changes in epistemological beliefs in elementary science students. *Contemporary Educational Psychology, 29*, 186 – 204.

Gehlbach, H. & Brinkworth, M. E. (2011). Measure twice, cut down error: A process for enhancing the validity of survey scales. *Review of General Psychology, 15*(4), 380-387.

NGSS Lead States. (2013). *Next Generation Science Standards: For states, by states.* Washington, DC: The National Academies Press.