

Assessing Broader Impacts

Oludurotimi O. Adetunji^{1,2} and Susan. D. Renoe³

¹The Science Center and Department of Physics, Brown University, Providence, RI 02912, USA

²The Office of the Dean of the College, Brown University, Providence, RI 02912, USA

³Broader Impacts Network, University of Missouri, Columbia, MO 65211, USA

ABSTRACT

The National Alliance for Broader Impacts (NABI) seeks to foster a community of practice that increases individual and institutional capacity for, and engagement in, broader impact (BI) activities and scholarship. NABI currently has 537 individual members representing more than 210 institutions and organizations who are part of the growing network of professionals. The National Science Foundation (NSF) evaluates all proposals on their intellectual merit and their broader impacts. Many investigators grapple with how to articulate and effectively engage broad audiences in materials science and STEM. Here, we describe the effort of NABI to address BI challenges, present the NABI document Broader Impacts, Guiding Principles and Questions for National Science Foundation Principal Investigators and Proposal Reviewers; highlight the impacts of NABI as a catalyst for building BI capacity; and provide an example of assessing an innovative program's BI.

INTRODUCTION

Broader impacts (BI) is defined by NSF as the societal benefit of research, but it can also be thought of a process utilized by any entity or person to achieve societal benefit in a finite, measured amount of time [1]. This can be achieved through research, teaching, outreach, and service, among many other things. Although the term broader impacts is specific to NSF, other funding organizations such as the National Institutes of Health, and the United States Department of Agriculture are requiring principal investigators to justify the relevance or impact of their work in certain capacities. There are several challenges associated with broader impacts; not the least of which being that it is still poorly understood by many researchers, and the realities of award size and duration make it difficult to create BI activities that are unique, innovative, and assessable. Addressing ways in which scientists can better address the BI criterion is a major part of the mission of the National Alliance for Broader Impacts (NABI).

Formation of the National Alliance for Broader Impacts (NABI)

NABI was born out of an online BI community of 155 members, who shared a common vision for a formalized BI community. In 2014, through funding from NSF (MCB-1408736), this group formed the first members of NABI; a nationwide network of individuals and organizations working together to build institutional capacity, advance BI, and demonstrate the societal benefits of research. Today, NABI currently has 537 individual members representing more than 210 institutions and organizations (see Figure 1).

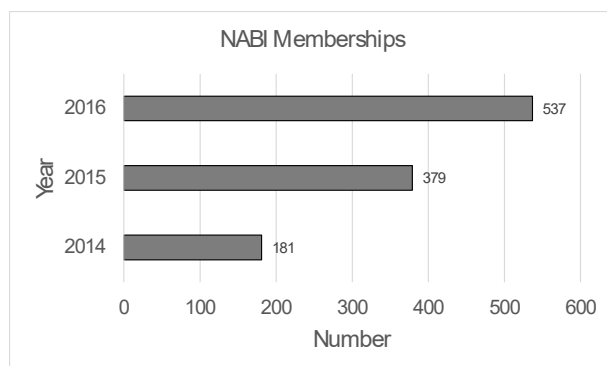


Figure 1. NABI membership since 2014

NABI has four specific objectives: 1) Identify and curate promising models, practices, and evaluation methods for the BI community; 2) Expand engagement in and support the development of high-quality BI activities by educating current and future faculty and researchers on effective BI practices; 3) Develop the human resources necessary for sustained growth and increased diversity of the BI community; and 4) Promote cross-institutional collaboration on and dissemination of BI programs, practices, models, materials, and resources. In this article we describe several strategies related to these four objectives that NABI employs to address these grand BI challenges. These include hosting an annual BI summit, developing a BI guiding principles document, and building individual and institutional BI capacity through training and consultations. We also provide an example of assessing BI for a program that develops multimedia science education videos.

NABI'S INNOVATIVE APPROACHES FOR ADDRESSING THE BROADER IMPACTS CHALLENGES

Each of NABI's four objectives is crucial to addressing the challenges of designing, implementing, and evaluating high-quality broader impacts plans. Below we will discuss three specific strategies NABI uses to build individual and institutional broader impacts capacity: (1) An annual professional development conference for BI practitioners; (2) The creation of BI support documents to aid both investigators and practitioners; and (3) Individual and institutional trainings for investigators, future investigators, and research development staff.

One of NABI's stated goals is to develop the human resources necessary for sustained growth and increased diversity of the BI community. One way this is accomplished is through the continued support of an annual broader impacts summit. Each year, for the last five years,

BI professionals and other stakeholders have gathered in different areas around the country to share ideas and resources, identify challenges and opportunities, and plot the course for the future of broader impacts. The summit serves as the primary professional development opportunity for BI professionals.

The first broader impacts summit was convened by the University of Missouri in 2013 and brought together researchers, representatives from NSF, and BI practitioners from across the U.S. The first summit demonstrated the need for a community of practice around broader impacts and continued professional development opportunities for BI professionals. This led to two important outcomes: the writing of an NSF research coordination network (RCN) proposal to fund a national network and the convening of another broader impacts summit in Arlington, Virginia in 2014. This summit was sponsored by a NSF EPSCoR Conference Award (OIA-1437105) and served as the basis for the NSF Perspectives on Broader Impacts document [2]. Since then, NABI has hosted annual broader impacts summits at the University of Wisconsin-Madison (2015) and the University of Pennsylvania (2016). The 5th broader impacts summit will be hosted by Oregon State University and held April 26-28, 2017 at Skamania Lodge in Stevenson, Washington.

NABI's objectives also include identifying and curating promising models, practices, and evaluation methods for the BI community and promoting cross-institutional collaboration and dissemination of BI programs, practices, models, materials, and resources. In the spring of 2015, several NABI members attended the Informal Science and Broader Impacts (IS+BI) Convening, hosted by the Center for Informal Science Education (CAISE). Over the course of the convening, it was suggested that a working group be formed to develop a guiding principle document for the evaluation of broader impacts that investigators could use when developing or reviewing proposals. The working group members included NABI representatives from Brown University, Iowa State University, Montana State University-Bozeman, North Carolina State University, Northeastern University, University Cooperation for Atmospheric Research, University of Alaska Fairbanks, University of Arizona, University of California Berkeley, University of Florida, University of Missouri, University of Oklahoma, University of Pennsylvania, University of Rhode Island, and Youngblood & Associates, LLC.

The resulting Broader Impacts Guiding Principles and Questions for National Science Foundation Proposals [5] provides information on what are considered as broader impacts according to the NSF Grant Proposal Guide, information on NABI, key terms and definitions, and guiding principles and questions that are based on the five review questions found in the NSF Grant Proposal Guide. It is designed to build individual capacity within investigators so that they can create high-quality broader impacts plans and can recognize high-quality broader impacts activities when they serve on NSF review panels. Thousands of these documents have been given out across the country to investigators as well as to NSF program officers. Several directorates at NSF have also been giving them to panelists. In addition to paper copies of the document, it is also available as a downloadable PDF on the NABI website [5]. The guiding principles document is the first of many BI support documents that NABI hopes to produce.

A key objective of NABI is to expand engagement in and support the development of high-quality BI activities by educating current and future faculty and researchers on effective BI practices. Since its inception, NABI has been developing, designing, and hosting workshops to engage higher education stakeholders, including senior administrators, deans, department chairs, research development staff, investigators, postdocs, and graduate students. The workshops include but are not limited to how to effectively address the BI criterion when applying for traditional and early investigator awards, graduate research fellowships, and how to create BI support infrastructure. In academic year 2015-2016, there were more than 1,000 participants in NABI-sponsored events and trainings. There is currently a waiting list of institutions that would like to host a NABI-sponsored training. These workshops provide much-needed BI support at institutions that do not currently have BI infrastructure and help those institutions build capacity for BI support. In addition, the workshops and trainings build confidence and ability within researchers as they seek to effectively address the BI criterion.

ASSESSING BI IN A MULTIMEDIA SCIENCE VIDEO DEVELOPMENT PROGRAM

Sci-Toons [3,4] is an iterative experimental teaching and learning approach that engages students in the development of narratives about scientific research or concepts via interaction with experts, visual representations and multimedia platforms. The Sci-Toons model has been used to develop animated videos to explain complex scientific research concepts to broad audiences. These videos can be accessed through its YouTube Channel [6]. Sci-Toons engages students and professors, scientists and artists, in using animation to make science compelling and accessible to the public. BI for this program can be demonstrated in a number of ways.

The demographics data of the Sci-Toons Creation Group (SCG) has become very diverse in the past five years, supporting claims of BI. Figure 2 and Figure 3 show increases in the participation of students by gender and by race/ethnicity respectively.

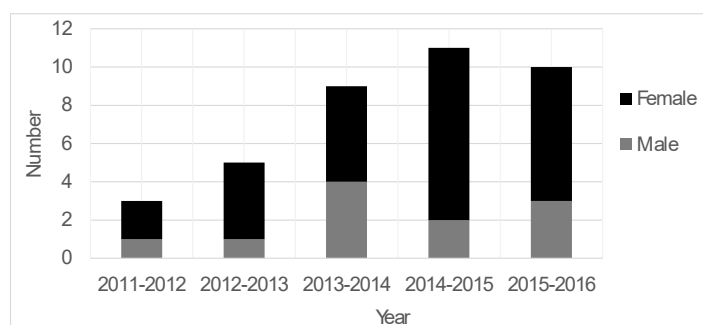


Figure 2. Participation of SCG student members by gender

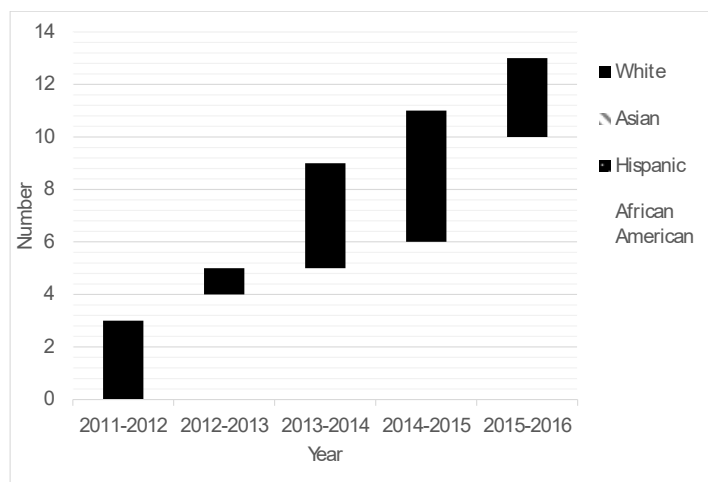


Figure 3. Participation of SCG student members by race or ethnicity

Broader impacts can also be demonstrated through demonstrating wide use of the Sci-Toons products by diverse audiences. As of October 25, 2016, Sci-Toons videos have been watched in over 190 countries and viewed online over 140,000 times via its YouTube channel. Table 1 shows impact data for the three most viewed Sci-Toons videos. Viewer demographics data is presented in Table 2. These data were retrieved on October 25, 2016 via google analytics.

Table 1. Number of Views of selected Sci-Toons videos.

Selected SciToons	Publication Date	Number of Views	# Countries
Conductive Polymers	October 28, 2013	30,166	153
Color	April 3, 2014	90,932	192
Graphene	August 7, 2014	5,686	102

Table 2. Sci-Toons video user demographics.

Selected SciToons	Male	Female
Conductive Polymers	75.4%	24.6%
Color	42%	58%
Graphene	76.8%	23.2%

CONCLUSION

The National Alliance for Broader Impacts' (NABI) efforts to date have been well received by BI professionals, investigators and federal funding agencies. It has more than doubled the membership of its national network since its inception three years ago. NABI contributions to the understanding of broader impacts has been enhanced through its summits and the development of its first guiding document. The Sci-Toons impact and demographics data exemplify how readily available data can demonstrate the broader impacts of an effective and innovative approach for engaging SCG members and the public in science.

ACKNOWLEDGEMENTS

The authors would like to thank the National Science Foundation (MCB-1408736) and Brown University, Office of the Dean of the College for funding.

REFERENCES

- [1] O.O. Adetunji and M. Thompson (2016). The Broader Impacts Conceptual Framework (BICF) 2014 Lexicon Modification for the Engaged Scholarship and Broader Impacts Joint Committee Year End Report of 2015-2016. Brown University Volume I. 2016.
- [2] National Science Foundation (2014). Perspectives on Broader Impacts. Available at: https://www.nsf.gov/od/oia/publications/Broader_Impacts.pdf (accessed 25 October 2016).
- [3] O.O. Adetunji and R. Levine (2016). Toward a New Model of Science Learning, Teaching, and Communication. MRS Advances, doi:10.1557/adv.2016.105.
- [4] O.O. Adetunji, (2015). UMRI Alumni: From Characterization of High Temperature Solution Growth Cr 2+: CdSe to Developing Videos to Enhance Metacognition and Diversity in Materials Science and STEM (Science, Technology, Engineering, and Mathematics). In MRS Proceedings (Vol. 1762, pp. mrsf14-1762). Cambridge University Press. <http://dx.doi.org/10.1557/opl.2015.188>
- [5] O. O. Adetunji, G. Scowcroft, K. Coakly, J. Dawe, C. Dugan, J. Fields, S. Kobilka, M. Koroly, H. Menninger, S. Renoe, J. Ristvey, K. Spohr, S. Sundararajan, M. Thompson, and T. Youngblood, Broader Impacts Guiding Principles and Questions for National Science Foundation Proposals. Available at: http://broaderimpacts.net/wp-content/uploads/2016/05/nabi_guiding_principles.pdf (accessed 25 October, 2016).
- [6] The Sci-Toons YouTube channel available at <https://www.youtube.com/user/SciToons> (accessed 25 October 2016)