JOURNAL OF MICROBIOLOGY & BIOLOGY EDUCATION
DOI: https://doi.org/10.1128/jmbe.v18i1.1244

A Model Approach to Public Engagement Training for Students in Developing Countries †

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INTRODUCTION

Public engagement activities enable scientists to dialogue with members of the public about the conduct, direction, benefits, and ethics of scientific research (1). Notwithstanding its importance in shaping the future of responsible research, public engagement is underdeveloped in many developing countries (2, 3). This situation must change if scientists in these countries desire to better influence policy, research funding allocation, and career paths for the next generation of professionals (2–4). After all, why should policy makers and the public support improved research funding and infrastructure without being well-informed about the value of research? Similarly, how would scientists influence talented young students to choose scientific careers without these students ever having firsthand interactions with scientists themselves? Moreover, the ethical implications of research is a controversial and sensitive subject in many developing world communities, mainly due to disagreements between research protocols and indigenous cultures, as well as perceived exploitation of the local public by researchers that may lead to their mistrust of scientists (5). Developing meaningful approaches for effective, two-way scientist-society dialogue in these countries may help to address the above-stated challenges.

Public engagement approaches are better developed in high income countries than in their low-income counterparts. For example, many universities and scientific societies in Europe and the United States have established outreach offices dedicated to continuous engagement with the public about science (6). In addition, several public engagement training programs for undergraduate students have been developed to enhance scientist-society partnerships and dialogue (7–9). On the other hand, such initiatives have been lacking in many developing countries. Nonetheless, public engagement provision appears to be gaining momentum in recent years in such countries, with several scientists and scientific organizations devising diverse means of engaging the public (10, 11). An important aspect that has received little attention, however, is the long-term sustainability and propagation of these efforts through the systematic education of trainee scientists to enable them to engage the public in interactive ways (2).

To initiate a discussion as to how more educators in the developing world can incorporate public engagement activities in their scientific training process, we describe here an approach we have designed and implemented to train budding scientists in Ghana to become better science communicators.

PROCEDURE

Outreach training: development and implementation process

In this voluntary, extracurricular scheme, undergraduate biochemistry students at the Kwame Nkrumah University of Science and Technology in Ghana are trained in best practices regarding how to plan, develop, implement and evaluate outreach projects (11). The training focuses on five core principles: Initiate, Develop, Implement, Evaluate and Share (explained in detail in Fig. 1). Following completion of this initial training component, participants are tasked with independently designing and implementing appropriate outreach activities for a specified audience. When planning an outreach event, students decide on a suitable topic on their own. They subsequently meet periodically to brainstorm, research and agree on activity content, which is developed and implemented through a *shared responsibility* approach, ensuring that participants contribute to the success of events through multiple roles. Students are grouped into teams that are assigned different roles, including activity coordination (maintaining correspondence with outreach beneficiaries, arranging a venue, organizing logistics, and

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Received: 15 September 2016, Accepted: 9 November 2016, Published: 21 April 2017.
†Supplemental materials available at http://asmscience.org/jmbe

ensuring health and safety), content development (designing outreach activity in line with outcome of initial discussion with outreach beneficiaries), activity delivery (interactive implementation of outreach activity), and evaluation (obtaining and analyzing feedback from participants). Students are rotated between roles over time to ensure that they are adequately trained in all aspects of outreach provision. Example outreach activity development and implementation processes are shown in Figure 2 and Appendix 1. So far, over 40 undergraduate students and graduate teaching assistants in biochemistry and biotechnology in a single Ghanaian university have benefitted from the training scheme, some of whom have co-authored a peer-reviewed publication that emanated from our activities (11).

A unique advantage of our training model is that it is directly aimed at addressing outreach challenges common in many developing countries, thereby providing an approach with the potential to help shape the future of public engagement (Fig. 2). For example, outreach activities targeted at

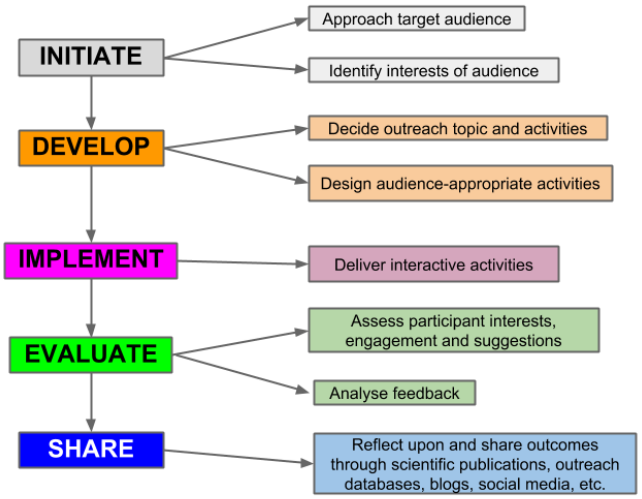

FIGURE 1. A model for the development and implementation of scientific outreach activities. This model focuses on five principles: initiation, development, implementation, evaluation, and sharing. 1) Initiate. In an environment where scientist-community outreach partnerships are uncommon, scientists initiate outreach programs by approaching a potential audience to identify their interest and discuss possible activities. 2) Develop. After confirming support from the intended audience, outreach activities are developed, with special consideration for resources needed, who to collaborate with, source of funding, and outreach instructors. 3) Implement. Activities are delivered in an interactive manner, engaging the audience with relevant discussions around the theme. 4) Evaluate. Feedback from the audience is obtained and analyzed to determine how receptive they were to the activities and to inform the researchers as to whether the outreach aims were achieved. Feedback could be formal (e.g., using purpose-designed questionnaires) or informal (e.g., through unstructured word-of-mouth comments). 5) Share. Share outcomes with the wider public (such as through peer-reviewed publications, blog posts, social media, and online outreach databases) to support others in developing similar activities.

community groups are delivered in the appropriate local languages, in simple terms, and with consideration for cultural and religious sensitivities. In interacting with non-English speaking communities, students in the program who are native speakers of the appropriate languages are made to lead outreach activity delivery. Similarly, students who belong to specific religious establishments take lead roles when interacting with religious groups. This concomitantly addresses cultural, literacy and language challenges, which have been documented as barriers to effective community engagement in these settings (12). The wide diversity of students enrolled in the program has helped us overcome possible language, cultural, and religious challenges in engaging with an audience. However, in a future situation where no team member is fluent in a local language, native speakers will be recruited and trained in the *Initiate* stage (Fig. 1) for language translation and assistance with religious and cultural issues, in collaboration with the beneficiary community.

Example student-led outreach activities: design, implementation, and evaluation

With guidance and support from faculty members, our student science communicators have developed and implemented outreach activities for diverse audiences including primary school children, high school students and teachers, fellow undergraduate students, and community groups. One of our recent projects was the Ghana Science Initiative, which was aimed at improving science literacy among the Ghanaian populace through the development of closer scientist-community interactions. As part of this, specific outreach activities were provided to learners at the primary, junior and senior high school levels (details available in (11, 13)). In these activities, participants' pre- and post-outreach performance in a quiz developed from outreach activity content showed that the activities led to improvements in their understanding of the scientific concepts discussed. Feedback reports also showed that participants' appreciation of the contribution of scientific research to social development was improved, leading many to consider future careers in science (1). Additionally, a survey of the trained student outreach providers showed that they acquired key transferrable skills in time management, public speaking, project management, and teamwork.

More recently, the outreach training model enabled the development and facilitation of a novel training program we have developed for junior high school science teachers in Ghana. The aim of this program was to develop teachers' capacity to use alternative, low-budget approaches to teach practical aspects of scientific concepts in resource-limited settings (14). In the *Initiate* step (Fig. 1), dialogue was begun through a scientist-teacher focus group discussion that helped identify major challenges with practical science education in junior high schools (additional information in Appendix 1). The trained student outreach providers served as instructors for "hands-on" laboratory activity sessions in

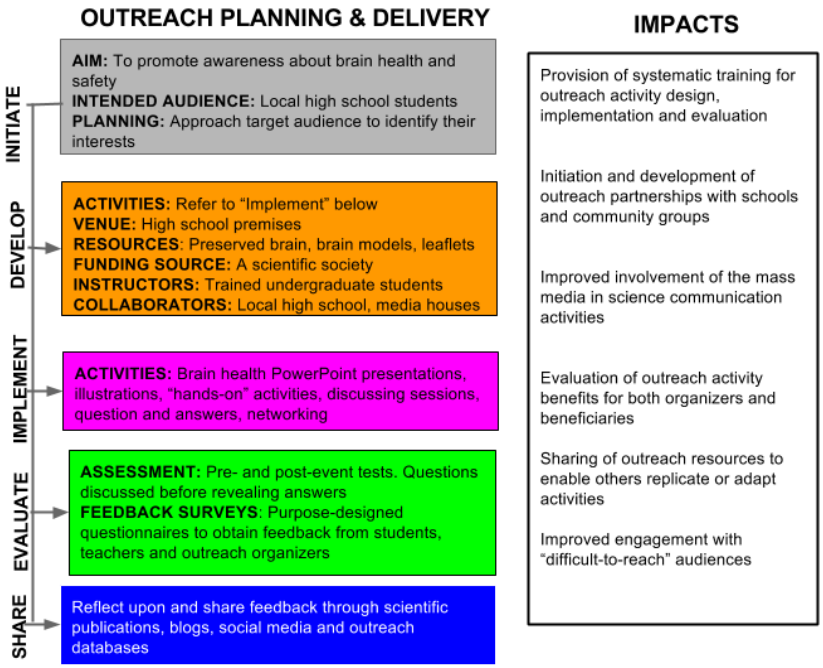

FIGURE 2. An example outreach activity developed and implemented following the model described in Figure 1. Our trained student outreach providers followed this scientist-driven, evidence-based model to plan and implement a neuroscience-themed public engagement activity for high school students in Kumasi, Ghana, leading to beneficial impacts that can be built upon to improve scientist-public interactions in similar settings.

microbiology, biochemistry, microscopy, histology, and cell structure for participating teachers.

CONCLUSION

Training in public engagement enables students to explore and develop their interests in science communication, teaching, public speaking, and science journalism, with potential benefits to their future careers (2). Nonetheless, this training is often lacking in developing countries, partly due to time constraints and the intensity of the scientific training process (2). The program described in this article provides a model to develop a culture of training and early involvement of student scientists in public engagement activities. An advantage of offering the program as a voluntary, extracurricular scheme is that it removes the over-dependence on grades, building students' interest in public engagement driven by their own initiatives and creativity. Moreover, the shared responsibility component enables role playing among students, with twofold benefits: it allows them to develop their preferred roles in outreach provision while at the same time challenging them to improve their command of roles they may not be comfortable with. In so doing, the program focuses on raising students to become initiators of outreach activities who proactively seek engagement opportunities and independently develop innovative engagement activities, particularly in difficult-to-reach communities where public inclination to participate in scientific outreach is poor.

We believe that the program described here will be beneficial to organizations and individuals interested in pursuing similar projects elsewhere. An advantage of this training scheme is that it is not specific to any area of study; it can be applied in training students in any field, be it science or nonscience. Furthermore, it can be flexibly provided either as an extracurricular activity or as a module to enable both students and instructors to obtain academic credits from it.

SUPPLEMENTAL MATERIALS

Appendix 1: An example public engagement activity designed and implemented by the trained undergraduate students

ACKNOWLEDGMENTS

This outreach project was funded in part by outreach grants awarded to TKK by the Biochemical Society (https://www.biochemistry.org), The Physiological Society (http://www.physoc.org), the European Society for Evolutionary Biology (http://eseb.org), and the University of Warwick, UK (https://www2.warwick.ac.uk). TKK was funded by Biotechnology and Biological Sciences Research Council (BBSRC; http://www.bbsrc.ac.uk/) grant number BB/J014532/1, through the Midlands Integrative Biosciences Training Partnership. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The authors declare that there are no conflicts of interest.

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