The Role of Scientist-Educator Partnerships in Improving Science Education

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ABSTRACT

Vital to meeting the need for improved science education is the involvement of scientists in collegial partnership with science educators. Potential partners in education include educators who work in school classrooms, museums, aquariums, planetariums, and other organizations that develop educational products and programming. Successful partnerships elicit complementary talents and expertise from each partner and offer the opportunity for each to develop additional capabilities. Both parties can increase their awareness and appreciation of each other as professionals in allied realms of endeavor, expand their skills in co-creating effective science learning experiences for others, and develop confidence in playing leadership roles in science education reform. Such mutual professional development is the primary advantage of scientist-educator partnerships, and while this is good and valuable to science education, it is not easy to acheieve. Good partners must endeavor to navigate the natural challenges and cultural differences that may arise in a way that is responsible to the ultimate needs of the learners. A successful scientist-educator partnership can be a rewarding source of mutual satisfaction and enjoyment as the goals of providing effective science learning experiences for students or colleagues are realized.

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Good science education generates the levels of science literacy that will: 1) promote public critical thinking and discourse on the growing number of scientific issues that affect the quality of our lives; and 2) populate the diverse 21st century workforce with socially responsible scientific expertise. The involvement of scientists in collegial partnership with science educators is vital to sustaining and improving the quality of science education.[1] Potential partners in education include educators who work in school classrooms, museums, aquariums, planetariums, and other organizations that develop educational products and programming. The partnership can involve any number of educational activities, but three of the most common are: 1) co-instruction in classrooms or workshops, 2) collaborative research, and 3) co-creation of products for use in formal or informal education.

Successful partnerships elicit complementary talents and expertise from each partner and offer the opportunity for each to develop additional capabilities. Both parties can increase their awareness and appreciation of each other as professionals in allied realms of endeavor, expand their skills in co-creating effective science learning experiences for others, and develop confidence in playing leadership roles in science education reform. Such mutual professional development may well be the primary advantage of scientist-educator partnerships.

The research directorates of US government agencies such as NASA and NSF have begun to recognize the potential of scientist involvement in partnership with educators. In the last several years a number of them have developed policies that encourage (or require) funded space and Earth scientists to contribute to K-12 education and public outreach (EPO). [2,3] These policies are helping to create new opportunities and greater acceptance in the science community of the value of EPO involvement.

Scientists naturally have much to contribute to the EPO realm[4], including 1) respect and influence in the community that can affect educational standards and policy; 2) deep knowledge of fundamental scientific concepts and the process of inquiry that are so vital to improved science teaching; 3) exciting connections to real-world exploration that inspire interest in learning science; 4) EPO access to data and facilities to enrich and update educational products and activities; and 5) role modeling that reveals scientists to teachers and students as accessible human beings with interesting lives.[5] It is commonly held among scientists that they should avoid becoming involved in EPO if they are not adept at public speaking. While it is true that virtually every space or Earth scientist will eventually be asked to give a public or classroom talk, there are many other EPO roles scientists can play that are suited to a broader diversity of talents and interests.[6,7] It is quite possible to avoid undesired visibility and still make very positive and powerful EPO contributions. Scientists can serve as advisors, reviewers, writers, or collaborators in the design and development of courses, curricula, teacher workshops, exhibits, websites, educational TV & radio programs, and so on. It is important for scientists to match their talents, interests, and time commitment to suitable roles, and to be open to developing new knowledge and skills along the way through partnership with experts in education and science communication.

While successful scientist-educator partnerships are good and valuable to science education, they are not so easy. Scientists and educators who work together on EPO projects often discover the challenge of crossing cultures. For example, scientists are generally very competitive by nature and prefer to confront and solve problems head on. On the other hand, educators are generally more collaborative by nature and tend to work around problems rather than confront them directly. Such differences must be anticipated and well navigated for scientist-educator partnerships to achieve the synthesis of expertise needed to improve science education. Good partners accept responsibility for their own experience of the partnership and endeavor to navigate the challenges and cultural differences that may arise in a way that is responsible to the ultimate needs of the learners. A successful scientist-educator partnership can be a rewarding source of mutual satisfaction and enjoyment as the goals of providing effective science learning experiences for students or colleagues are realized.

To succeed in EPO partnership, scientists must be willing to develop a collegial relationship based on respect for the professional capabilities of educators. Scientists often have to learn through experience how EPO expertise can complement their expertise in science for greater educational benefit. Educators and other professional communicators of science must learn to assert their talents (e.g. classroom management, metaphorical techniques for communicating scientific ideas) in the face of the scientists' confident intellect, while also respecting the scientists' justifiable need to have science accurately represented.

As with any partnership, it is important to learn enough to be a good communicator and collaborator across disciplinary or cultural interfaces. This will involve learning some new vocabulary and being conscious of when the jargon of either science or education may be unfamiliar to the other. The scientist may struggle with the meaning of "embedded assessment" or "informal learning", while the educator may struggle with how to interpret "electromagnetic spectrum" or "extremophile". The partnership must have sufficient mutual trust that the scientist can ask "stupid" questions about science education, and the educator can ask "stupid" questions about science. A trusted EPO partner offers an especially good way for a scientist to gain perspective on his or her communication skills, whether they are applied in private interaction or in public/classroom settings.

Scientists and educators also need to be aware of each other's practical needs. Scientists need to feel that their time spent in EPO collaboration is being used wisely and that the impact of their service will be assessed in some appropriate way.[8] For educator partners the primary needs usually involve meeting educational standards or pressing deadlines for completion of a project. Scientists are often unfamiliar with science education standards[9,10] and thus they may not be adequately sensitive to the need to engage their research domains as motivational *contexts* for teaching and learning more fundamental concepts such as energy transfer, gravity, electricity & magnetism, states of matter, systems, and cycles.[11] S"From Interstellar Polycyclic Aromatic Hydrocarbons and Ice to Astrobiology" (with all due apologies to the distinguished author) is not a very relevant topic for educational purposes in the K-12 and public realms. Although the bigger picture idea that the chemical building blocks of life are pervasively found among the stars certainly is of general interest. Moreover, this larger idea can provide an inspiring context for learning fundamental concepts in astronomy, biology, and chemistry. The *process* of the scientific inquiry and the excitement of the adventures associated with the investigation might

also be appropriate to share in a conceptual way devoid of excessive detail. In spite of the deep nature of inquiry in their work, scientists are often compelled to educate as they were educated, using extended lectures, memorization of terms, and little (if any) interactivity with learners. Educator-partners must help to guide scientists toward the more age-appropriate, interactive, and experiential methods of instruction that are consistent with how people learn.[12]

Successful scientist-educator partnerships are a rich source of professional development for both scientists and educators. If scientist-educator partnerships are to fulfill their role in improving science education, scientists must endeavor to leave with their EPO partners a legacy of fundamental science understanding and a framework for ongoing learning rather than a "one-shot" dose of details that are disconnected from educational needs. For example, it is better for an educator to come away from a partnership with a deeper conceptual understanding of gravity and what it means to be in orbit, than it is for him/her to come away with a pretty lithograph of the complex trajectory of a spacecraft's flight path. Educators must endeavor to leave their scientist partners with a legacy of perspective on the social challenges of modern educational settings and of increased awareness of the similarities between the ways scientists practice science and the inquiry-based way science education research is calling upon formal and informal educators to teach science (i.e., "students as scientists"). Discovering this common ground can be a useful way of focusing the talents of scientists in support of high-quality science education in both the classroom and informal settings.[13] For example, it is better for scientists to come away from partnerships with a fundamental understanding of how their expertise can help improve science education rather than to come away with handfuls of (admittedly gratifying) thank-you notes from children.

We must not underestimate the crucial value and impact of successful scientist-educator partnerships in improving science education. They are worth the time and energy. From such partnerships educators can derive and apply new science learning for the rest of their careers, positively influencing the attitudes and abilities of a generation of learners. There is also evidence[14] that they can gain the confidence to become leaders for improved science education in their districts. Through effective scientist-educator partnerships scientists can become more valuable allies and advocates for good science education at all levels and improve their science communication skills. In addition, they can derive and apply new inquiry-based and socially relevant perspectives in undergraduate and graduate courses they might teach, positively influencing a generation of teachers and scientists. In these ways, scientist-educator partnerships also support science literacy and the socially responsible space and Earth science research that helps to create a global society we all want to live in.

A summary mnemonic for the essential aspects of a successful scientist-educator partnership is PARTNER. The P is for Professional & personal development (e.g. science knowledge, communication skills, experience with addressing educational needs, perspective on exemplary practice, confidence in leadership). The A is for Appreciation (for one another as professionals in allied realms of endeavor); R is for Respect (for partner's professional expertise); T is for Trust (safety to reveal to your partner what you know and don't know); N is for Needs (awareness of the practical needs of each partner – time constraints, meeting science standards); E is for Enjoyment; and R is for Responsibility (for navigating the challenges of the partnership and for addressing the needs of the learners).

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FOOTNOTES and REFERENCES:

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[14] The evaluation of Project ASTRO – a nationwide project in the US to establish longer-term partnerships between astronomers and educators – has revealed examples of the mutually developmental aspects of a sustained scientist-educator relationship that carries value for education beyond the tenure of close partnership. See "Project ASTRO: Partnerships between Astronomers and Teachers" in Percy, J. ed., Astronomy Education: Current Developments, Future Coordination. 1996, ASP Conference Series Volume 89, Astronomical Society of the Pacific.

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