2000

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JOURNAL OF RESEARCH IN SCIENCE TEACHING VOL. 37, NO. 2, PP. 107–108 (2000)

EDITORIAL

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In the typical mode of formal schooling, adults and youngsters interact within boundaries of clearly defined roles in which teachers teach and students learn. An alternative format is one in which not only adults teach children, but children teach adults, as multiple generations work together on a topic of common concern to their community. Evidence of the benefits of an intergenerational, community-based approach to science education is emerging in various parts of the world.

Much service learning (Carver, 1997) is premised on the positive benefits of intergenerational interactions for participants and the community at large. For instance, collaborative work between children and adults in Thailand addressing reversal of deforestation has been reported by Wheeler, Gallagher, McDonough, and Soopakakit-Namfa (1997a), Wheeler, McDonough, Gallagher, Soopakakit, and Duongsa (1997b), and McDonough and Wheeler (1998). Children in eight upper-elementary and lower-secondary schools, under the guidance of their teachers, identified ways of resolving forest-related environmental problems in their local communities. This required students to frame questions, collect and interpret data, refine data collection techniques, and report findings to the leadership and members of local communities. Using this information, students and adults identified a problem needing resolution and then formulated an action plan to address it. Finally, they collaborated to implement and evaluate the effects of the action plan.

A team of researchers monitored the actions and events that surrounded this work during a 30-month period, beginning with collection of baseline data. The results were very promising. Teachers changed their approach to teaching in very profound ways. Student achievement, motivation, and self esteem improved, as did school–community interactions. The collaborative actions of youth and adults in local communities precipitated a cycle of activities that holds promise for long-term improvement of forests, soils, and water supplies in the region. But most importantly, children and adults began to learn from each other. They learned to respect and communicate with one another in ways that were not evident at the outset of the project. And adults began to give serious thought to environmentally unsound practices that previously had been ignored.

In every part of the world, short-term goals of adults are having detrimental consequences for the long-term quality of the environment. Destruction of ecosystems including rainforests, aquifers, prime agricultural land, wildlife habitats, and fisheries occurs when immediate needs eclipse concerns with long-term effects. When governments or outsiders try to guide adults in local communities to make essential changes in forest management, protection of water supplies, land use, or protection of wildlife, frequently, the response is minimal. However, when children and adults work together to understand local problems and jointly make the case for protection of the environment, adults appear to be more responsive. As one village leader in Thailand put it at the close of a joint meeting of community members and school children, "People from the gov-

ernment have often come to our village to talk with us about our forests and we did not listen. Today, our children and our grandchildren came and talked with us and it is time that we listen."

The science education community has only limited experience using intergenerational and community-based education to achieve its goals. Yet by taking a holistic perspective on human development we can view learning as arising from an individual's interactions within multiple life–world contexts, including a range of interpersonal relations, activity settings, institutions, and the larger cultural milieu of a society (Bronfenbrenner, 1993). Examining science learning experiences that expand the boundaries of typical schooling gives new meaning to the term systemic educational reform when "the system" embraces the community at large. New and potentially important feedback loops within the expanded system, such as between multiple-age groups, become evident.

As children and adults participate together in science-based practices in their communities, could benefits arise from children teaching adults, as well as adults teaching children portions of the learning agenda that underlies our current science education reform efforts? Moreover, given the low level of concrete adult response to significant environmental issues in most parts of the world and their limited adherence to laws, rules, and recommendations set out by governments and others with responsibility for assuring environmental sustainability, would collaborative efforts between adults and children, like those demonstrated in a small set of Thai communities, alter deeply ingrained environmental behaviors and attitudes? We speculate that the answer to both of these questions is yes. So we encourage others to create, implement, and systematically study models of intergenerational and community-based science education. Some questions which need addressing are: When compared to other models of science education, do these approaches yield gains or deficits in learning, and for whom(?); and, Should we consider measuring learning outcomes at a community as well as at an individual level? We surmise that such inquiries have potential to provoke new thinking that could expand our field's basic conceptions of what it means to learn and practice science.

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