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**Universities as Catalysts for Community Building among Informal STEM educators: The
Story of POISEDⁱ**

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Abstract

Science, technology, engineering, and mathematics [STEM] learning prepares youth for democratic citizenship and an increasingly technological workplace. POISED is a grassroots initiative to engage more under-represented youths in STEM fields through the creation of a network of skilled informal STEM education providers in their communities that are well equipped to use and adapt the many available STEM education resources. Through POISED, university faculty are actively involved as catalysts in community building by collaborating with community-based organizations to develop and sustain strong STEM out-of-school time [OST] programs. This paper documents work by POISED to date in a region that ranges from rural (22 persons/mi²) to urban (2213 persons/mi²).

Introduction

Quality opportunities to learn and apply science, technology, engineering, and mathematics [STEM] skills are invaluable to preparing youth for the 21st century workplace and for democratic citizenship. For years, the U.S. economy has been experiencing a growing trend toward technical sophistication in the workplace. Since 1980, the number of positions requiring an understanding of science and engineering has risen at more than four times the rate of growth for all jobs (National Science Foundation [NSF], 2004). The Bureau of Labor Statistics projected differential growth of the U.S. labor force from 2000 to 2010, with much of the difference attributable to strong growth in mathematics and computer-science related occupations. Outside of the workplace, the need for a strong understanding of STEM is equally important. For example, Steen (1997) argued that in today's society, a strong tendency exists to reduce complex information to numbers—with these numbers also helping to shape public policy. He suggested that the quantification of public policy issues is increasingly making vulnerable those citizens lacking strong quantitative reasoning skills.

The need for strong STEM knowledge and skills is clear, multifarious, and nationally recognized. However, STEM disciplines and careers have historically attracted an audience that does not reflect America's diversity. According to the NSF's *Science and Engineering Indicators* (2004) report, collectively, African Americans, Latinos, and other ethnic groups constituted 24 percent of the U.S. population in 1999, but only 7 percent of the science and engineering workforce. Further, although women constituted close to half (46 percent) of the U.S. workforce in 1999, they constituted only 24.7 percent of the college-educated science and engineering workforce. The Partners for Outreach in Informal STEM Education [POISED] teamⁱⁱ believes change is needed now.

In January 2004, leaders from the Exploratorium in San Francisco, the Lawrence Hall of Science at UC Berkeley, and TERC in Cambridge, Massachusetts convened with representatives from after-school and youth development communities to develop *the Coalition for Science After School* (Coalition for Science After School, 2007). The coalition articulated that after-school programs can offer the kind of STEM learning that is likely to interest and motivate youth. Such kinds of STEM learning opportunities, which are learner centered, have been articulated by Carlson and Maxa, (1997), the National Council of Teachers of Mathematics, (1989, 2000) the National Research Council (1996) and Zubrowski, (2002). The Coalition for Science After School offered a vision for youth from all backgrounds to have access to high quality STEM learning experiences during their out-of-school time. They proposed the means to achieve this vision to be "purposeful, coordinated, strategic efforts that make full use of available knowledge, research, resources, and materials" (p. 10). The coalition described the critical need for sharing STEM knowledge and resources. One key area in the Blueprint for Action is *building OST staff capacity* in STEM.

In line with the Coalition's recommendation, POISED believes that one way to support diverse youth interest, engagement, and integrated understandings in STEM is to support *the development of quality community resources through the professional development of community-based organization (CBO) staff in STEM*. Numerous, STEM activities and resources

are currently available in different formats. However, CBOs serving youth do not yet have integrated networks of professional support for STEM learning.

POISED also believes that universities have the potential to play a crucial role as a catalyst for such networks. Checkoway (2001) noted that research universities in the United States have “immense intellectual and institutional resources that are the envy of the world.” POISED believes that these resources should be used to help promote democratic relations in the communities that serve these universities. Further, attempts by universities to facilitate democratic relations should be tangible. Kezar and Rhoads (2001) discussed the lack of consistent institutional support for university-based initiatives created to foster community relations such as service learning programs.

Public colleges and universities were created to serve the public good. Many American research universities were established with a civic mission to prepare students for active citizenship and to develop knowledge that improves communities. However, few administrators demonstrate consistent commitment to this mission, few faculty consider a civic mission central to their work, and community groups often find it difficult to get the assistance they need from universities (Checkoway, 2001; also see O’Meara, 2002). In the spirit of Dewey (1916/1997; 1938), POISED believes universities have an obligation to serve their communities in meaningful ways, and our team is committed to developing democratic university-community partnerships. Another mission of POISED is to demonstrate how university faculty can be actively involved in community building. In this case, we believe that university faculty can collaborate with community-based organizations to help build strong STEM out-of-school time [OST] programs. This paper documents our efforts to date.

The POISED Team

During the fall of 2005, eight Virginia Tech STEM faculty members and six Montgomery County public school teachers, coordinators and supervisors had started to meet and discuss the possibility of common OST STEM projects. Four of the Virginia Tech faculty members had ideas for further projects and a meeting in December 2005 with Hubert Dyasi, a professor and leader in the field of science education, fostered new ideas and further energized the four VT faculty members. The group focused on the students “foregrounds” i.e. how the students through our projects could begin to visualize their future with respect to STEM fields. In February 2006, the group met with the Institute for Learning Innovation (ILI) in Maryland to discuss project ideas and possible collaboration. In April 2006, this group grew to include faculty members at Radford University, and we renamed our project, POISED. The members of this group coalesced around the same question, articulated a few years earlier by Checkoway (2001): How should a research university renew its civic mission in a diverse, democratic society? Specifically, we were interested in ways to attract a diverse youth into science, technology, engineering and mathematics. POISED grew out of this conversation into a grassroots initiative with the goal of engaging a greater number of under-represented youths in STEM fields through the creation of a network of skilled informal STEM education providers in their communities.

POISED Partnerships

POISED has formed seven partnerships with local and regional CBOs in the New River and Roanoke valleys of Virginia; two of these organizations, 4-H and the YMCA, are part of nationally recognized informal youth organizations. We continually seek and add new partners in these regions. Our partners provide OST programs for youth aged 6-18 who are diverse by ethnicity, socio-economic status, and geography (urban, rural, and suburban). For example, one of the CBO partners with whom we have been collaborating in a pilot program, Total Action Against Poverty, describes itself as "helping the residents of 11 cities and counties in southwestern Virginia to escape poverty and become self-sufficient" (www.tapintohope.org). One of Total Action Against Poverty's programs, *Project Discovery*, is described as "serving economically disadvantaged, potential first generation post-secondary education attendees, ... promot[ing] education as a means to end the cycle of poverty for our current and future generations of students" (www.projectdiscovery.org). We have also established a mechanism for recruiting qualified volunteers through the service learning programs of Radford and Virginia Tech as well as Virginia Tech's Center for the Enhancement of Engineering Diversity.

Population Served

Population densities in the Roanoke and New River valleys range from 22 persons/mile² to 2,213 persons/mile². Montgomery County, in the New River Valley, has 23.2% of persons below the poverty level; Roanoke City has 15.9%. In comparison, the state of Virginia has 9.6% of persons below the poverty level. According to the most recent National Census Bureau statistics, Roanoke City has 69.4% White, 26.7% African American, 1.5% Latino, and 1.2% Asian population. It is worth noting that our communities are perhaps even more ethnically diverse than these numbers demonstrate. In 2006, the *Roanoke Times* newspaper's series of articles titled "Land of Opportunity" reported that evidence shows the Latino population is actually about 9.6% of the city's population, with between 10,000 and 12,000 Latinos—which is at least five times larger than census figures show. The differences in nationally and locally reported numbers stem in part from increasing numbers of Latino immigrants putting down roots in the Roanoke Valley. The New River Valley is predominantly White (approx. 88.8%).

Needs Assessment

Our team decided to assess and document the extent to which STEM professional development is needed. Methods for our needs assessment consisted of Likert-type measures of attitudes towards STEM, knowledge of STEM, and STEM skills of youth professionals working in community-based programs for youth (CBO staff) POISED also conducted face-to-face interviews of CBO staff.

Participants indicated a strong interest in STEM professional development, particularly among CBOs whose staff had limited prior knowledge in STEM. All partner CBOs also described their unique strengths that could support CBO collaborative capacity building.

Results from face-to-face interviews of CBO staff confirmed the need for more attention to STEM community building of the kind POISED offers. For example, Annette Addisonⁱⁱⁱ, a 4-H extension agent, expressed an interest in having access to and learning about new science and engineering activities and resources. Ms. Addison later noted that that access to the online STEM education center POISED will provide would be "absolutely wonderful." However, she also described already having knowledge and access to a very broad range of available science curriculum activities and resources that she used regularly in her work with youth. One of the more pressing issues for this agent's 4-H organization was the lack of volunteers and too little community collaboration to maximize potential 4-H community impact with youth.

Ms. Addison and her colleague, Mr. Robert Fischer, another 4-H agent, also expressed interest in contributing to development of a regional STEM community by sharing with other CBO partners' experiences incorporating STEM activities with youth. Among other efforts to support 4-H, POISED will work to secure additional volunteers through the Radford University and Virginia Tech service learning programs, through the Center for Enhancement of Engineering Diversity, and through additional sources.

Catherine Anderson, a CBO senior staff member from Beans and Rice, a partner organization involved in after school tutoring of low income youth, told POISED that traditional professional development workshops would be inadequate, and not especially useful, for their staff. Ms. Anderson and other members of this organization explained that because many of the volunteer staff of their program have little experience working with youth, it would be most beneficial if POISED staff demonstrates activities directly with youth in their programs, with staff on hand to observe. This would provide staff with opportunities to learn how to work with youth at the same time as learning how to provide innovative STEM learning opportunities. Later, staff could independently try out new STEM activities with youth, learning from each other's experiences. POISED's professional development co-coordinator has substantive experience working with youth and will facilitate this kind of hands-on professional development with Beans and Rice staff.

Based on the total number of youth each of our CBO partners serve, POISED expects to serve over 7,500 people annually through partners' youth and family programs.

Pilot Program

POISED has also launched a pilot version of our professional development program with the CBO Total Action Against Poverty [TAP], including Project Discovery. Five staff members from TAP participated in a series of pilot program workshops with POISED, held over a three-day period and tailored to specific STEM interests expressed by Total Action Against Poverty. The POISED team modeled some STEM activities with TAP staff by having TAP staff participate in the activities as learners, similar to how they might carry out the activities with youth. Based largely on specific requests for more information by TAP staff, numerous additional STEM activities were also summarized and discussed.

The head of *Project Discovery*, Charlotte Jordan, has begun implementing POISED activities with school-aged youth. Ms. Jordan visits 26 different elementary, middle, and high

schools in low-income areas each month, conducting workshops with youth that often involve mathematics and science. Following pilot program professional development with POISED, POISED activities were implemented with youth at two different locations with very positive results. In conversations during our pilot program workshops, *Project Discovery* agreed to share with other CBOs their own successes and challenges with implementing STEM activities with youth. Albert Griggs of Total Action Against Poverty, the organization that headquarters Project Discovery in the Roanoke Valley, mentioned that others in Total Action Against Poverty who work with youth who attended the professional development workshops discussed their learning about STEM with enthusiasm. As he stated, this “does not usually happen after required professional development workshops here, which says an awful lot.” We will continue pilot work with additional CBOs.

Development of a Theoretical Model for POISED Professional Development

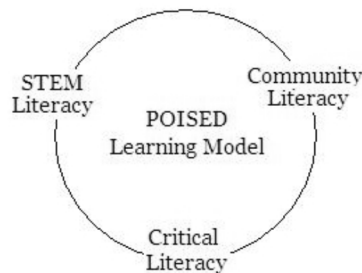
As relationships developed between POISED and our partnerships, we began to develop language to describe our interactions with CBOs. The POISED professional development model incorporates four overlapping components: (1) Interdisciplinary STEM content, (2) Research-based learning model, focused on supporting equity and diversity in STEM, (3) Expert-to-expert approach, and (4) Collaborative design. These components are described below.

Interdisciplinary STEM Content

POISED believes informal STEM learning is inherently interrelated. Developing a holistic understanding of STEM involves creating rich, integrated knowledge structures (National Center for Improving Student Learning and Achievement in Mathematics and Science, 2004).

Research-Based Learning Model, Focused on Supporting Equity and Diversity in STEM

The POISED learning model has a tri-fold emphasis on developing youth’s integrated (1) STEM literacy, (2) community literacy, and (3) critical literacy (cf., Gutstein, 2006). Respectively, these forms of literacy emphasize STEM content, community relations and actions, and social critique.



(1) Developing STEM Literacy

We draw on overlapping beliefs and pedagogies included in informal and formal educational standards and use constructivist principles for how people learn (e.g., Carlson

& Maxa, 1997; National Council of Teachers of Mathematics, 1989, 2000; National Research Council, 1996, Zubrowski, 2002). For example, POISED:

- Emphasizes inquiry-based STEM activities
- Acts as guide and facilitator to CBO professionals' STEM learning
- Helps CBOs nurture STEM community and youth collaborations in STEM

(2) Developing Community Literacy

We incorporate a tailored and responsive design and include place-based emphases. People have and produce valuable knowledge about their communities and their lives. Tapping into this knowledge, and valuing all different ways of producing knowledge, can enhance learning for everyone (e.g., Lave, 1988; Moll & González, 2004).

(3) Developing Critical Literacy

We work to support equity and social justice. Freire (1970/2004) advocated for problem-posing education where "people develop their power to perceive critically *the way they exist* in the world *with which* and *in which* they find themselves; they come to see the world not as a static reality, but as a reality in process, in transformation" (p. 83). POISED believes youth need opportunities to learn and experience first-hand the ways STEM knowledge can empower them as citizens and can help improve their communities (cf., Roth & Barton, 2004).

Expert-to-Expert and Assets-Based Approach

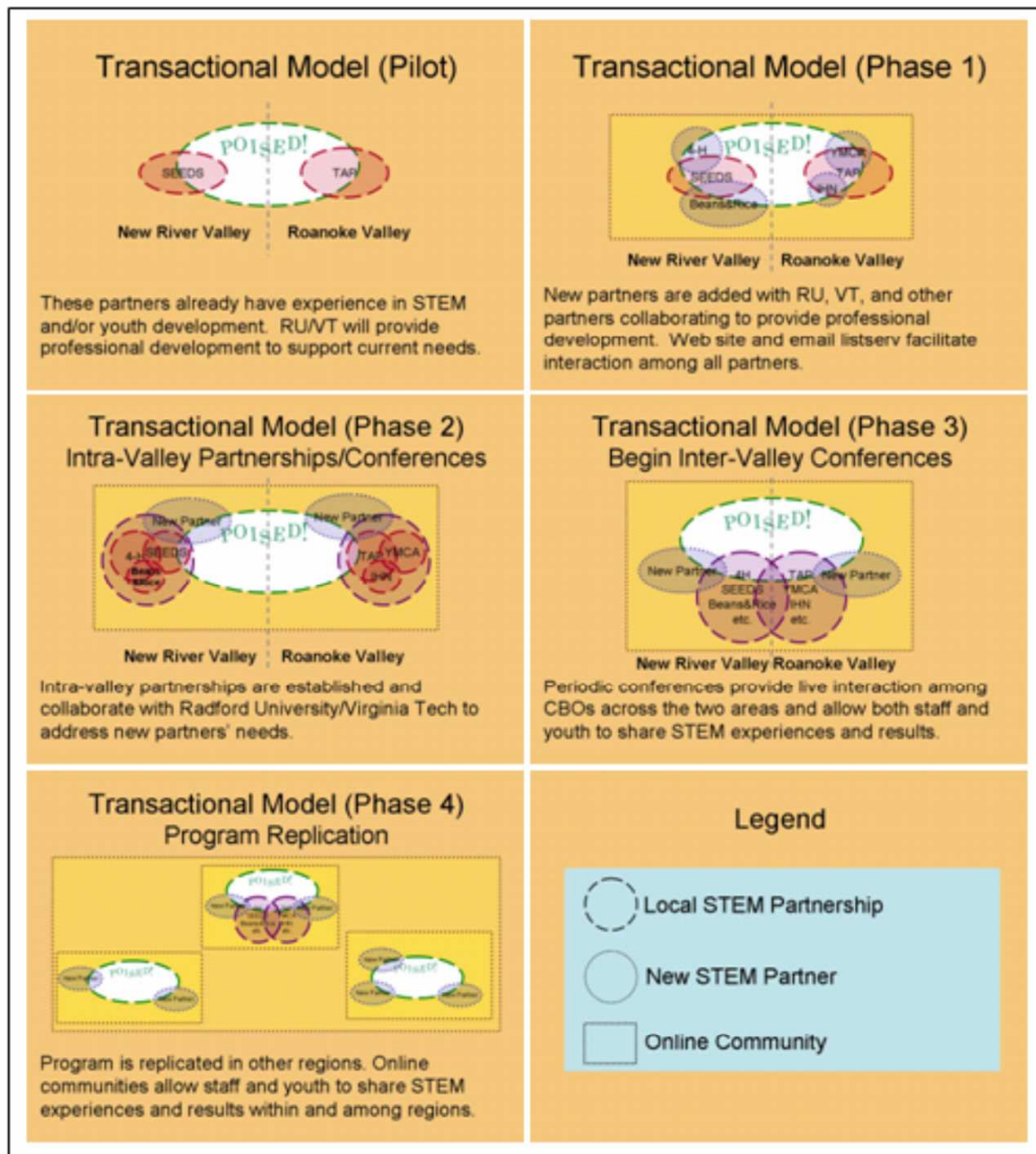
POISED takes an expert-to-expert approach to collaborative professional development, which applies John Dewey's theory of democratic human interactions (Dewey, 1916/1944). We aim to provide an environment for CBOs to interact freely and to share in determining and achieving common purposes and interests in STEM programs for youth. We believe CBOs have capacities, abilities, and gifts that they can respectively use, express, and give to become more powerful and more well-connected to other CBOs—also strengthening the community through this process (cf., Kretzmann & McKnight, 1993). POISED values the diverse and unique knowledge, community connections, and cultural resources each CBO partner has and can use to support STEM professional development. We believe CBOs have socially distributed "funds of knowledge" (Moll, Tapia, & Whitmore, 1993) about youth needs and development, about youth programs, and about our communities. These funds of knowledge can be shared as resources to facilitate the growth of POISED's professional support system for STEM in our region and elsewhere. Such shared knowledge can be mutually transformative with respect to CBOs and POISED staff. Our definition of mutually transformative is based on Garrison's (2001) derivation of Dewey and Bentley's formulation of transactional relationships. Garrison explained that in democratic, equitable relationships, all persons involved learn with and from one another. The POISED Transactional Model, which depicts how we anticipate the project to develop, is illustrated in Figure 1.

Collaborative Design

POISED aims to help produce and sustain a STEM community of practice among CBO professionals (cf., Lave & Wenger, 1991). Our emphasis is on producing a learner-centered environment where professional development efforts are mutually constituted by POISED and collaborating CBOs and driven by the needs and interests of CBO partners.

- Grassroots transactional model of collaboration
- Tailored and responsive program
- Emergent problem-solving agenda guiding STEM community development (cf., Lemke, 1995)

Figure 1. POISED Transactional Model



Conclusion

The need for capacity building in STEM in out-of-school time programs has been well documented in the literature. There is also a need for quality professional development that addresses diverse learners. One purpose of this paper *was to describe an effort among STEM faculty from two universities to create and organize a professional development program for informal STEM educators that address both of these issues*. Another purpose was to demonstrate how university faculty can be involved in grassroots community-building. We believe that significant progress has been made to establish partnerships, document interest in our efforts to date, and build a program that addresses a diversity of organizations and learners. We will continue to work with existing partners on a small scale. We hope to secure funding for this project in order to increase our program offerings and maintain quality collaborations with community based organizations.

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ⁱ POISED stands for Partners for Outreach in Informal STEM Education

ⁱⁱ The POISED team consists of faculty members from Radford University and Virginia Tech

ⁱⁱⁱ Names of all contacts are pseudonyms.