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Emergent Model for Community Engagement: Developing Courses and Programs

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Abstract

This retrospective emergent design qualitative evaluation study documents the development of a unique model for community engagement and engaged scholarship in higher education. The primary novel aspect of the model is participatory involvement of both the target audience for the program and representatives of various stakeholder groups who initiated, conceptualized, tested, assessed, and evaluated the courses and program with the professor. Members of the target audience and stakeholder groups also recruited participants, contributed to refining the courses and program to meet the needs of the stakeholder groups, and contributed to redesigning courses for online learning. The model emerged while developing and evaluating the *Informal Science Institutions Environmental Education Graduate Certificate Program (ISI Program*) at the University of South Florida. Garnering the resources of a previously untapped audience, the informal science education (ISE) community, presented the university with a way to increase enrollment. Also reported are sample benefits accrued to learners in the program, to the ISI community, to the community at large, and additional benefits to the University.

Keywords: engaged scholarship, high impact practices, informal science education, graduate certificate programs, professional development, increasing enrollment

Introduction

In this era of shrinking budgets for higher education and the call for accountability by the public, it is advantageous for a university to cultivate audiences previously not served in the surrounding community and beyond. Ensuring that the offerings by the university meet the actual and perceived needs of new audiences can be a challenge. Typical procedures for developing new courses and programs may need to be modified. A traditional approach used by university professors to develop new courses is for a single professor to sit at a computer and design the syllabus based on the professor's expert knowledge and stream of logic. The course developed is usually totally teacher directed. Discussion with other professors in the person's department regarding the need for a specific course may occur. Occasionally, a professor sends a short needs assessment to a sample audience prior to developing the course.

An alternative approach is to involve the community from the target audience for the course in initiating the idea for a course, verifying need, conceptualizing content, implementing a pilot, and conducting evaluation research. This approach is likely to meet authentic needs and engage members of that community in recruitment for the program. This approach contributes to a university fulfilling its commitment to community engagement and engaged scholarship.

A commonly used format for community engagement in higher education is for professors to give students assignments requiring them to use knowledge obtained in a particular course to assist members of a surrounding community to solve a problem identified by the community. This usually requires students to interact with community members by sharing their expertise individually or in small groups in the community setting. This is often labeled service-learning. There are many definitions of service-learning. They all have in common that it is a strategy addressing core curricula objectives while meeting real community needs (Alliance for Service Learning and Education Reform, 1995). Bringle and Hatcher (1996) note service-learning should also include reflecting on the experience to foster more understanding of course content, a broader appreciation of the discipline, and an increased sense of civic responsibility.

Other mechanisms for community engagement include community service, community outreach, community-based participatory research, training and technical assistance, coalition building, capacity building, and economic development. Noticeably missing from this list are formal courses and programs. The model used for course and program development reported herein adds another vehicle to fulfill a university's commitment to community engagement.

In this report addressing the *Informal Science Institutions Environmental Education Graduate Certificate Program* (ISI Program), the format for community engagement was the creation of four university graduate courses articulated, sequenced, and linked together into a graduate certificate program as a vehicle to solve a problem identified by a segment of the community, the informal science education (ISE) providers in the Tampa Bay region. Admittedly, this process is extremely time consuming and burdensome for faculty, but it is equally as rewarding. The courses individually and the certificate program were accredited by the university's governing bodies. The inservice training was assessed by the extent to which the participants and their ISE institutions reported positive impacts facilitating their missions. Assessment indicators are listed in a benefits section.

Literature Review

The relevant literature review for this theoretical framework addresses science education, scholarship of engagement, communities of practice, and learning theory.

Science Education

The relentless rapid pace of change in science and technology drives change in a democratic society and continues to stimulate vehement calls from numerous segments of society for a scientifically and technologically literate population (Epstein & Reagan, 2011; Glenn Commission, 2000). This context has led to the longest-lived reform movement for science education in the United States. It began in 1982 and continues today. The documents guiding the reform were Benchmarks for Science Literacy (American Association for the Advancement of

Science, 1993), the National Science Education Standards (NRC, 1996), and the Next Generation Science Standards (National Research Council, 2013). These documents and many succeeding national reports require systemic reform, use of community resources for teaching school science, and continuous development of teachers from preservice learning in institutions of higher education through inservice learning (professional development) while working in schools (Mundry et al., 1999). These calls for scientific and technological literacy are echoed throughout the world. Countries like Japan, Korea, Taiwan, Malaysia, Canada, Australia, the European Union and more have embarked on their own quests for improvements in their science education following the ideas proffered by the United States reform documents (European Commission, 1995; Sulaiman et al., 2014).

The primary voices heard target reform of the K-12 enterprise as the mechanism to achieve scientific and technological literacy for all. It has been, however, documented that much, if not most, of the science knowledge in the population is derived from learning opportunities outside the formal K-12 enterprise through what is referred to as ISE or *free-choice* education (Falk et al., 2007). Schooling is necessary but not sufficient for lifelong science and technology literacy (Falk et al., 2007). Thus, educators and scientists who provide ISE opportunities have enormous potential to contribute to the scientific and technological literacy of society. These professionals work in a multitude of different types of settings often with minimal connections and communication among them. The diversity of settings, or sectors, of the ISE field include film and broadcast media, science centers, museums, zoos, aquariums, botanical gardens, nature centers, digital media, gaming, science journalism, community centers, after-school programs, government agencies, research laboratories, and civic organizations. Organizations providing ISE are often referred to as informal science education institutions or informal science institutions (ISI).

ISI professionals have little opportunity to be educated specifically for their jobs as ISE providers or for their own professional development once on the job (Bell et al., 2009). Given the amount of science learned by the public from informal sources, the need to focus on the quality of ISE and its integration with K-12 reform is equally as important as K-12 reform to attain the goal of scientific and technological literacy for all.

In spite of the diversity of types of loosely knit organizations providing ISE in the United States and lack of coherence among them, it is still appropriate to label them a community.

> From a sociological perspective, the notion of community refers to a group of people united by at least one common characteristic. Such characteristics could include geography, shared interests, values, experiences, or traditions. John McNight, a sociologist, once said that if one were to go to a sociology department in search of a single, simple definition of the word community, one would never leave. To some people it's a feeling, to some people it's relationships, to some people it's a place, to some people it's an institution. (Olodo, 2008 p. 19)

All the providers of ISE share an interest in and value development of scientific and technological literacy for all the American population.

Scholarship of Engagement

The idea that institutions of higher education should fulfill their missions by conducting business in concert with the community outside the Academy was made public by Boyer, president of the

Carnegie Academy for the Advancement of Teaching and Learning, in 1990. He labeled the concept, engaged scholarship. Barker (2004) described Boyer's (1990) concept this way:

> The scholarship of engagement, . . . consists of (1) research, teaching, integration, and application scholarship that (2) incorporate reciprocal practices of civic engagement into the production of knowledge. It tends to be used inclusively to describe a host of practices cutting across disciplinary boundaries and teaching, research, and outreach functions in which scholars communicate to and work both for and with communities. . . . The scholarship of engagement suggests a set of practices that cuts across all aspects of the traditional functions of higher education. (p. 124)

The labels community engagement or community-engaged scholarship are used by many institutions to describe initiatives in which the three traditional dimensions of academia (research, teaching, and service) are integrated to work toward resolving an issue of significance to people in a region around the institution and leading to reciprocal benefit for both the university and the community. The label community-based participatory research is sometimes used expressly for research initiatives in which the focus is specifically on university personnel and community partners generating new knowledge collaboratively. The nature of the interface of the university with the community has continued to emerge. Currently it includes a focus on students interacting with the community in diverse ways as a planned part of their college experience. Such interactions provide active learning and have been reported to contribute to student success and retention. They are labeled, high impact practices. Among them are service-learning, community-based learning, internships, undergraduate research, learning communities, intensive writing, and more (Association of American Colleges & Universities, 2015; Kuh, 2008).

Communities of Practice/Inquiry/ Learning

Commonalities of these communities include sharing among people for a common purpose, incorporating shared values, and commitment (Furman, 2002). This is not typical of university classrooms in which a professor makes the management decisions about the structure and content in a course (teacher-directed). In a student-directed/centered classroom, the learners and the professor work together to make decisions for structure and content. This is compatible with research on how people learn and consistent with the concept of community engaged scholarship. In student-centered courses (e.g., in the ISI Program), learning opportunities are member generated and agreed upon, tested, and require feedback within the group to determine next steps. A development-testing-research cycle is established. In the ideal student-directed classroom, all the participants work on a level playing field, engage in inquiry, and function as a community of practice. The class unit functions as a learning community (Senge et al., 1994).

The model in this case study emerged from a student-directed program incorporating communities of practice. Experts and novices interact in such communities with experts serving as mentors and facilitators. The instructor is an orchestrator, balancing student generated and instructor-generated topics (Richards, 2010). Communities of practice must be nurtured and must have a committed leader (Garfield, 2016). Trust among community members is essential to engage in the honest, multifaceted dialog needed for success. Dialog includes technical knowledge and skills, open disclosure of problems, supportive advice, consideration of feelings, and valuing each other (Wenger et al., 2002). Such relationships go through developmental stages and take time (Richards et al., 2007). Communication that is honest, caring, other-oriented, and non-judgmental is called interpersonal communication (Beebe et al., 2005).

Learning Theory

Participants engaging in interpersonal communication are learning in accord with Novak's (1998) theory of education which empowers learners to take charge of their own meaning making from experiences by integrating thinking, feeling, and acting. According to Kolb (1984), "Learning is a process whereby knowledge is created through the transformation of experience." (p. 38). He described the transformation process with a four-stage model involving metacognition. Kolb labeled the stages concrete experience, reflective observation, abstract conceptualization, and active experimentation. The concrete experience stage is the activity stage during which a person is doing something, living an experience, and feeling it. During the reflective observation stage, a person engages in watching, thinking, and reviewing the experience to ascertain its value, both cognitively and emotionally. Often a person shares reactions and observations with others and processes patterns and dynamics with others. During the abstract conceptualization stage, a person concludes what has been learned from the experience. This involves constructing generalizations into concepts, principles, or rules applicable to his/her world. During the active experimentation stage, a person tries out what has been learned. This involves planning effective use of the learning and testing its veracity through application to new situations, actions, and experiences. The emergent model for community engagement herein illustrates Kolb's experiential learning cycle.

Reflection "slowing down our thinking processes to become more aware of how we form our mental models" (Senge et al., 1994, p. 237) throughout the learning cycle, provides necessary processing time for learners to incorporate new knowledge into their existing cognitive frameworks containing many mental models, both short and long term. It follows that changes in short-term everyday mental models accumulating over time will gradually be expressed as changes in long-term, deep-seated beliefs (Senge et al., 1994). Changes in beliefs often bring about changes in behaviors. These changes lead to questioning, collecting more data, and evaluating. Learners become autonomous and increase their self-efficacy. ISI Program participants increased self-efficacy while testing learnings from the program in their work settings and moving into new roles within their institutions and the developing ISI network.

Methods

Empirical Model

This is a retrospective emergent design qualitative evaluation study. The initial questions were, (a) *How does the emergent model from developing the ISI Program illustrate community engagement and engaged scholarship?* and (b) *What were the benefits to stakeholders (learners in the ISI Program, the ISI community, the community-at-large and the university) from developing and pilot testing the ISI Program?* Bogdan and Biklen's (2007) emergent design qualitative research process, an inductive process, was used to answer these questions. In this research process, categories emerge from the analysis of data from each source and are refined iteratively. Iterations generate additional questions. Categories are then triangulated among sources to generate an emergent hypothesis, theory, or model. This process is flexible and enables the evaluator to understand an event from the perspective of the person living the experience. This enables one to learn the extent to which program participants' real needs are being met, instead of focusing on whether the official stated program goals are being attained.

Sample

The sample consists of the professor and 15 participants who were students in the ISI Program. These participants had diverse science and education backgrounds. They varied from second-year ISI staff to seasoned ISI executives, and novice and veteran teachers in school settings, along with some scientists who were interested in and involved with outreach programs. They were recruited from science education stakeholders in the region.

Data Sources

The data sources consist of the professor's participant observation notes and materials, published and unpublished, written by participants in the ISI Program. Some of the materials were research papers and original data, while others were items written for use within and among ISI organizations.

Data Collection

The professor and the students in the ISI Program conducted community-based participatory research. They collected data through participant observation during formal class meetings and out of class meetings; electronic recordings of class sessions and online postings of open-ended reflections; unstructured and open-ended face-to-face group interviews and individual interviews; site visits to participants' organizations; and examination of artifacts collected during the face-to-face pilot. They documented what happened during the year leading up to the pilot test, throughout the two years of the face-to-face pilot test, and the ensuing three years after the program was completed. The studies and their original data were housed in the professor's office archives and available for review.

A description of the ISI Program from which data were collected and analyzed follows:

> *The Informal Science Institutions Environmental Education Graduate Certificate Program* was composed of four three-credit courses: (a) *Methods for Interpretive and Transformative Standards-Based Education, (b) Community Resources for Environmental Education, (c) Environmental Site Explorations, and (d) Survey Update of Environmental Research and Management Policies.* Designated face-to-face meeting times (180 hours) were augmented by frequent one-to-one meetings with the instructor or small group interactions among student participants. The program was intended to educate ISI providers in ways to enhance their ability (a) to become productive partners in a systemic approach to forwarding STEM education reform, (b) function effectively in ISIs, and (c) develop meaningful, mutually beneficial relationships among ISIs and with formal education institutions. The target audience for this program included ISI educators and other ISI personnel, formal K-12 classroom teachers, university science education professors, and university and corporate scientists and engineers interested in education. This audience possessed a variety of knowledge, skills, and abilities representative of novices and experts.
>
> The course syllabi originally included information in the following areas: (a) how people learn science, (b) how to interface effectively with science teachers in K-16 schools, and (c) updated scientific research and policy. From this baseline, the content evolved through an iterative process based on the needs and concerns of the participants. The program was learner-driven. Issues, events, and projects with which participants were engaged at work were used as case studies. Other professional experiences, such as attending professional conferences and developing grant proposals were also fodder for learning. Timing and sequencing of learning opportunities were based on learners' expressed need to know. Some face-to-face classes included on-site experiences in a variety of informal science institutions. These experiences provided first-hand opportunities to construct a holistic view of the informal science education industry, its

> organization, career paths, management concerns, unique niches, and the nature and relationships among programs and partnerships.
>
> Designing learning opportunities in collaboration with the students (community participants) led to course and program features consistent with communities of practice, learning communities, and communities of inquiry in which the participants developed emotional, intellectual, and practical support systems. The knowledge constructed enabled participants to resolve issues in their own institutions and the ISI community throughout the program. Thus, the program itself fostered further community engagement.
>
> The pilot test cohort was aware they were expected to wear two hats during their time in the program: One was as learner, and the other was as program developer for future distance-learning cohorts. The flexible order of the learning opportunities during the pilot test facilitated scaffolding based on learners' prior knowledge, in contrast to the professor's logic. For example, the community-building design group selected *Community Resources for Environmental Education* as the first course in the sequence. Six weeks into the course, the pilot test cohort determined their discussions would be more fruitful if they first knew the information in the course *Methods for Interpretive and Transformative Standards-Based Education*. Thus, the seventh week of the first fifteen-week semester we began investigating topics from that course. The professor was able to ensure the concepts identified in the approved university syllabi were addressed by examining data from her own and group reflections, analyses, and abstract conceptualizations of experiences. She used Kolb's experiential learning theory (1984), Novak's (1997) theory of education, the National Science Education Standards (NRC, 1996), and Benchmarks for Science Literacy (AAAS, 1993) as her frame of analysis. (Spector, 2018, pp. 152-155)

Findings

The findings below describe the community engagement activities at the local, regional, and national level and the participatory process that resulted in the ISI Program and were subsequently generalized to a community engagement model for developing courses and programs. This is followed by the generalized model for community engagement emerging from this current study of the entire ISI Program from inception of the idea, through development, implementation, and evaluation. The findings conclude with the reciprocal benefits for the program participants, the university, and the community.

Community Engagement Activities

Community Engagement Model-Local Approach

This community engagement model was built on Spector's findings from studying 31 courses she developed over a span of 20 years. The amount and type of community involvement increased with each course resulting in a fully student-centered, directed model incorporating the philosophies and characteristics of the engaged scholarship movement. This particular model was an outgrowth of a set of five courses taught in a college of marine science titled: *Community Building in Ocean Sciences*. These courses targeted scientists and educators interested in working together to forward the mission of the National Science Foundation funded Centers for Ocean Sciences Education Excellence (COSEE) initiative. These courses were supported by the Florida COSEE.

As a result of this series of courses, a participant/stakeholder from a local ISI presented a concern in his organization. He indicated there was a need for his informal education staff to have ongoing professional development, citing their lack of expertise in teaching science within informal settings. Presenting this problem to the class cohort, they decided this was a problem within many

ISI's. The class initiated a data gathering plan to help resolve this issue. The first step was to bring together local ISI executives to explore this issue. Seven local organizational administrators were recruited to participate in a focus group to determine if they also perceived this need within their organizations. The focus group confirmed the need previously identified and generated a list of potential topics that should be addressed. From the discussion, the idea of formal professional development courses emerged. Two events helped to support the idea. First, the ISI organizations offered to donate resources in the form of human expertise, materials, and physical sites for teaching and learning. Second, the university was interested in developing certificate programs and was encouraging community engagement in courses. As an outgrowth of this focus group and these events, the ISI Program was born.

Community Engagement Model-Regional Approach

A subgroup of participant/stakeholders from the marine science community building courses developed a written survey to be distributed in Florida at various conferences to determine if there, in fact, was a need for ongoing professional development within ISI's and if organizational representatives thought a certificate program was a viable solution. The survey was distributed during three stakeholder meetings: Ocean's Day, Florida Marine Science Educators Association annual conference, and a Summit at the Florida Aquarium. It was also given to ISI representatives encountered through chance meetings. In this way, the survey was distributed to a cross section of stakeholders including: formal and informal educators, government officials, those with political ambitions, academicians, scientists, and engineers from the private sector, industry vendors, and representatives from the commercial and recreational fishing enterprises.

During the summit, sponsored by National Science Foundation (NSF) COSEE-Florida monies, the idea for the ISI graduate certificate program was presented to ISI attendees from around the entire Tampa Bay region. Original community building course members provided tentative syllabi for summit stakeholders' review. Discussion of professional development needs and syllabi feedback stimulated further elaboration. In addition, funding from COSEE-Florida for course development and tuition assistance brought the ideas one step closer to reality. Two questions were used to guide course development: a) *What do we need to know and be able to do to establish and sustain a viable network that capitalizes on the unique niches of each organization?* b) *What do we need to know and be able to do to create learning opportunities and interfaces with each other and with formal education institutions that will facilitate change consistent with the science education reform movement and national standards for science education?* As a result, the pilot (ISI Program) course participants (stakeholders and faculty) jointly generated answers to these questions and tested them as content in the courses.

Community Engagement-National Approach

Using existing network relationships, the availability of formal ISI professional development opportunities was explored at the national level. At a COSEE National Network meeting in Washington, DC, ISI educators were informally surveyed to get their views on the need for formalized professional development for ISI staff. Concurrently, Spector discussed the ISI ideas with colleagues from Oregon State University and Lawrence Hall of Science at Berkeley during a COSEE-California workshop. She was interested in collaborating with partners nationally. Spector and the initial ISI class participant met with the NSF Informal Science Education program officer

to obtain her perspective on the need. They agreed the problem was multifaceted. In general, there is not a direct career path to a profession as an informal science educator. Most people in these positions come from a science background with a bachelor's degree in a science field and have little exposure to, or experience in, communicating science concepts to the public. This puts in motion an ineffective and inefficient *learn on-the-job* system of training. Staff often feel ill prepared because they do not understand the needs of their audience or the management structure in which they function. This results in a drain on ISI resources as they endeavor to increase staff proficiency in a job that has high turnover due to low salaries and few or no benefits. Since science is a frequently changing field, not only do staff need help with pedagogy, but also with keeping their science knowledge up-to-date.

There is only a small knowledge base about teaching and learning science in informal settings. As a result, the idea of certificate programs consisting of formalized, sequenced, and articulated courses housed in universities is an attractive answer to this two-pronged problem: a) how to provide appropriate professional development for ISI staff seeking a profession rather than a job, and b) increasing the knowledge base pertaining to ISI teaching and learning to provide more effective experiences. As a result, ISI salaries may become commensurate with the rigor associated with people's education, and they would likely stay in this profession.

Further, encouragement to pursue the certificate program resulted from discussions with Faulk and Dierking, two researchers at the forefront of ISI research. Several fledging programs were identified: University of California at Berkley, Minnesota State University at Moorhead, and University of Oregon.

Another source of data about the need for this program came from the National Marine Educators Association conference in Portland, Maine where audiences responded positively to the presentations describing stakeholder experiences in the ISI certificate pilot test. Again, during the National Science Teachers Association Informal Science Day in Boston, the audience echoed the sentiment of previous audiences. Based on these data, the decision was made to put the ISI courses through the university's approval process, thus creating the courses and the graduate certificate. In addition, it was decided to offer the program distance-learning online.

Following this decision, the National Research Council substantiated the need in a report titled, Learning Science in Informal Environments: People, Places, and Pursuits (Bell et al., 2009) released by the National Research Council. This comprehensive report, documenting the needs and condition of the ISE enterprise was the first of its kind and validated the need for the ISI certificate program and the timeliness of its content.

Participatory Process

This ISI Program model represents a complete participatory process in which members act as equal and active partners in decision-making. Members were integral in all phases during which ideas were initiated, conceptualized, developed, tested, assessed, and evaluated. They also recruited participants, refined the courses and program to meet the needs of the stakeholder groups, and conducted course redesign for online learning.

Some of the original marine science community building cohort expressed interest in enrolling in the pilot ISI course. They recruited other participants from their networks involving stakeholder organizations not initially represented. This recruitment technique had a snowball effect as those invited to participate expressed interest and asked others to participate. The additional people participating represented employees of the first invitees or peers from their networks.

Through this process students studied themselves and their organizations to gather, interpret, publish, and disseminate findings, resulting in contributions to the research on the impact of learning in ISIs. Further, participants conducted case studies on their own organizations providing a dual perspective. They also engaged members of the community who were involved with other ISIs and asked them to write case studies of their organizations. These data have been used to build the body of educational research knowledge related to ISIs, provide a teaching tool for others to emulate, and share individual institutional strengths, as well as, contributing insights for effective network building.

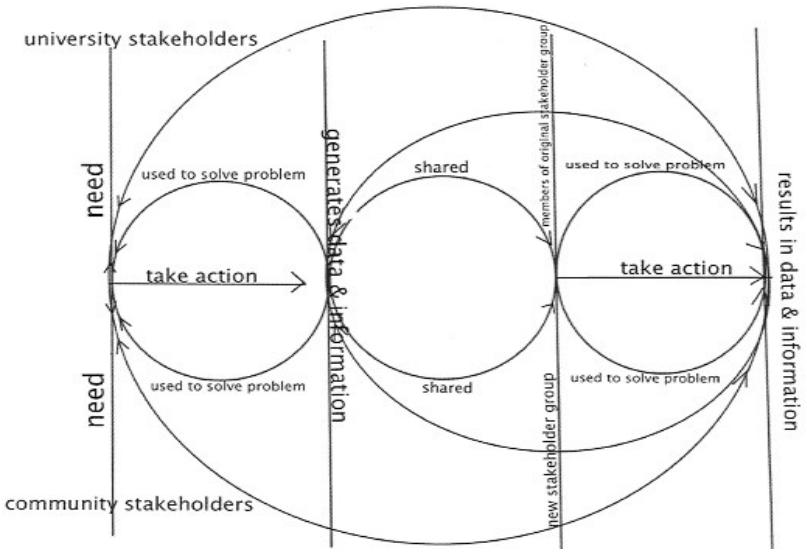
The findings of the data gathered took many forms. One study of the face-to-face pilot test and its impact on individual participants and their associated ISI organization culminated in a dissertation (Ball, 2012), which was a formal summative assessment. Similarly, a study of the online pilot test, conducted during the two years after the face-to-face pilot, culminated in an evaluation dissertation (Lake, 2017), which confirmed the earlier findings. Participants in the online program appreciated the asynchronous structure which enabled them to fit study time into their varied work schedules and saved travel time. Thus, online is more desirable than face-to-face for busy professionals (Lake, 2017). Neither of the studies identified any drawbacks to using this model beyond the length of time and amount of effort required of the faculty facilitator to engage in the process.

The steps in the emergent community engagement model for course/program development follow:

1. Identify an audience not previously served by the higher education institution.
2. Engage individuals from target audience in designing and conducting various needs assessments with related stakeholder groups.
3. Convene a focus group with target audience leaders.
4. Encourage and support leaders while they advocate for development of formal courses to meet the identified needs.
5. Involve prospective audience members and related stakeholders in preparing course(s) syllabi.
6. Share drafts of syllabi with extended target audience for feedback.
7. Pilot courses with a cohort from the target audience including novices and experts.
8. Assist the cohort to develop a level playing field and function as a community of practice.
9. Support cohort participants enabling them to enact roles of both learners and course developers.
10. Use learners' current professional experiences as content for study.
11. Provide guidance to participants while they apply their new knowledge to create change in their organizations.
12. Enable participants to conduct research related to their course experiences and the way they applied their knowledge in their own organization and related organizations.
13. Maintain involvement of organizational stakeholders through use of their resources for the cohort during the program, and keep stakeholders informed of participants' progress and growth.

Below is a diagram (Figure 1) that explicates the iterative nature of this process with an explanation of the steps.

Figure 1. Generalized Model Process



Community and university stakeholders identify overlapping needs. Both groups become equal and active partners in the process supplying both ideas and resources. During the initial stages, partners act at the local level to identify and explicate the problem and generate possible solutions. Next, partners gather input from the extended community through focus groups, conferences, events, and chance encounters. This information is used to generate data, which are then analyzed. Feasible solutions are then presented to another stakeholder group expanding input during each iteration creating a feedback loop. All participants fluctuate between the role of novice and expert as the process requires. Each successive cycle enlarges the partner groups, extending their reach from the local to the national level and increasing resources available. As data are gathered, they are used to refine solutions and earlier steps are revisited as partners act. Throughout the process, the veracity of the solution is tested until a satisfactory result is obtained. Then a new cycle begins. This model is consistent with Kolb's (1984) learning cycle: experience, reflection, abstract conceptualization, and action.

Benefits

This section describes benefits the ISI Program learners, the ISI community, the community-at-large, and the university received as a result of this community engagement process.

Learners' Benefits

Abilities, skills, and knowledge were fostered in areas which led learners to become more effective and productive ISI providers. They incorporated new information into their cognitive frameworks that enabled them to become more successful network builders within their own organizations, with other ISIs, and in partnering with schools and the university. This networking led to a decrease in duplication of services which had existed among members of the network and increased sharing of resources among them. One participant summed it up this way:

> Personally, the program had a huge impact on me and really helped to refine my educational practices and made me a better educator all around. I could now communicate more effectively with formal classroom

> teachers and access a wide network of community resources to provide high quality, meaningful learning opportunities.

Another participant, who was promoted to senior programs director as a result of his learning, said he sees himself as a bridge between scientists and educators, not just at his ISI now, but for outside teachers "to help them talk to the scientists, interpret the research."

Learners' Growth

These included: An awareness there was more to learn about the ISI industry and the learning process than they ever anticipated. Learners frequently exclaimed: *I don't know what I don't know! I had no idea there was so much to know about working in [an ISI]*! A participant mentioned:

> Oh, I definitely was exposed to a lot of stuff I didn't know about or kind of knew about but got more details and information. . . . I mean, one of the things that really stuck out for me, . . . close to 80% of what you learn doesn't happen in school. It happens in your outside activities!

In an exit memo, another participant wrote; "I got it . . . science is everywhere and there's a potential experience using an understanding of informal science education in many practice fields."

Skills Immediately Applied at Work

For example, a learner working with an ISI facilitating service-learning initiatives between schools and community organizations, changed the way the organization trained teachers. A didactic reductionist model had been used by the organization's trainer during a four-day teacher workshop. The teachers were lectured to about science content and procedures to guide their students through a six-step inquiry and action process. The ISI learner changed the workshop to active inquiry learning during which the teachers participated in the 5E's learning cycle process, which guides a learner to engage, explore, explain, extend, and evaluate an idea (Bybee, 1991). He used a variety of pedagogical strategies consistent with national standards and constructivist learning theory. These changes led to the development of active training models used locally and in similar centers throughout the country. The CEO of the national organization stated, "I am so grateful to your program. His training model is so much better than what we were doing before." (L. Bardwell, personal communication, August 21, 2012).

Networking Skills for Coalition Building

Recognizing organizational cultural differences is an important skill. Some of these differences include organizational motivations and rewards, structures, needs, and missions, as well as, understanding context specific vocabulary and language usage. A highly experienced participant stated, "After everyone participated, there were more concrete relationships developed and everybody understood each other's roles a lot better. . . . We became a more cohesive community ISI region."

Most learners became sensitized to recognizing human interaction patterns and relationships while improving their listening and other interpersonal skills. They discovered people's experiences influence their perceptual lenses through which they interpret their life. A participant wrote in a journal, "Everyone has misconceptions and preconceptions and different learning backgrounds

that really kind of shapes how they take in subject matter . . . definitely something new introduced to me."

The program contributed to an increase in self-efficacy and strategies to improve relationships, expedite collaborative work, and build organizational partnerships. For example, one learner organized a meeting of 40 ISE providers representing 25 ISIs in the local county to launch a countywide network and connect it with a larger national group. Another participant said, "This program gave me the confidence to say I am this other type of intelligence which is fulfilling my role here." Still another noted, "The network was very, very beneficial for me in terms of the mix of informal educators, managers, as well as formal classroom teachers and professionals."

Understandings and Skills Necessary to Enact Leadership Roles

Learners saw career opportunities and constructed new plans based on their new awareness of the number and kinds of existing ISI organizations. Members were encouraged to take on leadership roles in state and national professional associations. Several participants were elected to the following positions: one as secretary, four to boards of directors, and three as organizational presidents. Seven learners changed jobs or advanced in their organizational hierarchy as a result of their employers' awareness of their ISI Program participation. One vice president for education was explicit about why she promoted her employee:

> After the program she thinks more about the standards. What are the children learning back in the classroom? There is more of a thought process than just "Oh, you know what's cool? It's cool if we did a class on locomotion. Kids would love it." But what's your end goal there? What's the point of that? . . . She tends to think of a more realistic view of the educational process and what her role is here. (D. Stone, personal communication, March 10, 2014)

Motivation for More Education

Questions generated during the program stimulated a desire for more higher education. Three learners matriculated in graduate programs in science education and one matriculated in a nonprofit organization MBA program. Everyone expressed "I wish I could go on to a doctoral program" at some point.

Knowledge Integration

During the four courses, learners assimilated knowledge into their personal idiosyncratic framework to the point they could not distinguish between certificate content and what they *just do now*. Patterns and content in other university courses were easily understood by ISI Program participants based on the cognitive framework they previously developed. One of the participants mentioned "[Another participant and] I were exchanging knowing smiles in [Dr. X] course when all the students were confused by where he was going. It was obvious to us he was going into the paradigm we were using in the ISI Program."

ISI Community Benefits

Community growth was witnessed by the following: (a) an increase in the ability to create effective educational experiences consistent with learning theory and scientific research; (b) providing teacher in-service programs using the national standards for science; (c) professionalization of the

educator roles within ISIs by completion of accredited courses; (d) career ladder creation lessening administrative time investments for new hires; (e) collaborations among ISIs and between universities, schools, and ISIs; (f) potential for additional funding; (g) ease of resource sharing, and, (h) additions to the understandings of ISIs through research.

Community-at-Large Benefits

This Tampa Bay Region ISI Program established an infrastructure that enables (a) all community teachers to benefit from ISI services and resources to improve student learning both in school and outside of school, which creates a continuum of meaningful learning for school-age young people; (b) ISIs to engage in systemic change through interfacing with preservice and in-service teachers; and, (c) ISIs to help teachers in making meaningful and relevant learning experiences for their students.

University Benefits

The university benefitted from the participants' research in these ways: (a) ISI courses were refined based on the cohort's research findings, (b) community resources could be readily incorporated into teacher education, (c) an ISI infrastructure was established that can be included in grant proposals requiring partnerships, (d) publicity from published research findings highlighting the university's leadership position in an emerging national field, (e) increased graduate enrollment through extending courses to new audiences, (f) professors now have a model for a collaborative procedure to develop courses based on a new audience's need, and (g) a new context emerged for use by professors to study community engagement.

Conclusions

An alternative process for developing courses and programs derived from the case study of the ISI Program serves as a model enabling higher education institutions to forward their goals of community engagement and engaged scholarship. Even though this process is extremely time consuming and burdensome for faculty, it is equally as rewarding. The academic structure and expertise of the university were used to help a segment of the surrounding community ameliorate a problem they identified. Several procedures usually identified as community engagement, including capacity and coalition building, technical assistance and training, and community-based participatory research were used by program participants as they engaged in the steps to develop the ISI Program from initiating the program through testing it as distance learning. The university faculty worked together with all the partnering stakeholders on an equal playing field. Stakeholders derived benefits from their involvement in the ISI Program in four areas: ISI Program learners, the ISI community, the community-at-large, and the university. Partnerships and coalitions emerged to marshal resources, affect systems, transform partnerships, and catalyze practices, programs, and policies of the ISI community. Documented benefits indicated the ISI Program was a productive approach to mitigate the needs of a segment of the surrounding community formerly not served by the university.

Theoretical Implication

This study of the Emergent Community Engagement Model expands the scholarship of engagement literature base by introducing course and program development as a vehicle to fulfill

a university's commitment to community engagement. Additionally, the study expands the research base on science education by introducing a graduate certificate program to create a comprehensive formal mechanism enabling informal science educators to learn their craft and enhance their capacity to integrate their work with science in schools.

Practical Implications

The university increased its enrollment by engaging a previously unserved audience through the ISI Program**.** The Emergent Community Engagement Model used to develop the certificate program ensured the offerings by the university successfully met the actual and perceived needs of the new target audience. The program led to a community infrastructure establishing a seamless continuum of meaningful learning of science in K-graduate school and lifelong learning in institutions outside of school. Participants continued networking to share resources, obtain grant funds, establish programs, and participate in systemic reform initiatives after participation in the program.

Limitations and Future Research

The emergent model is a representation of the participatory process used to address a community's needs. The large amount of time required by the university faculty is a limitation of this participatory process. Further, having tested the model with a single audience limits the generalizability of the findings. There are two directions for future research. One is to use this model in a different higher education institution with an audience unique to its community in order to determine the transferability and efficacy of the generalized model. The second is to follow up with participants in this ISI Program to determine the long-term effects of their learning on both individual learner's careers and on the various informal science institutions.

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