

Teachers 'n Training: Building Formal STEM Teaching Efficacy through Informal Science Teaching Experience

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Abstract

The *Teachers 'n Training* (TNT) program is a collaborative series of immersion experiences and teaching opportunities for preservice teachers designed to increase their ability, comfort level, and competence to teach science, technology, engineering, and mathematics (STEM) concepts. Teacher candidates engage in meaningful experiences with STEM professionals who guide them in the development and implementation of inquiry-based STEM lessons in an informal setting. In this paper, we describe the TNT program, report findings from its first year, and outline plans for subsequent years.

Keywords: STEM, Conference Proceedings, Teaching Quality, Higher Education

Introduction

In the United States, there continues to be an increasing focus on Science, Technology, Engineering, and Mathematics (STEM) literacy as a critical component of public education and of the country's economic growth (Business-Higher Education Forum, 2011; National Research Council, 2011). The imminent release of the Next Generation Science Standards (NGSS) and their probable adoption by a majority of states gives further significance to STEM, especially for teachers. In fact, a sufficient supply of high-quality teachers is seen by many as the key to successfully achieving STEM literacy (Ledbetter, 2012). Higher education plays a significant role in teacher preparation and must provide effective STEM education programs to those aspiring to teach at any level. The elementary level, however, has some unique challenges. Many elementary teachers lack sufficient science content knowledge, hold negative attitudes toward science and science teaching, and have low science teaching self-efficacies (Bleicher, 2007; Cantrell, Young, & Moore, 2003; Rice & Roychoudhury, 2003). It seems clear that along with pedagogy, there is a great need for colleges and universities to provide elementary preservice teachers with content and experiences that will improve their interest, attitude, and self-efficacy toward science and science teaching.

Experiences in informal learning environments such as museums, science centers, after-school programs, and camps have been shown to impact the confidence and attitude of preservice teachers toward science and STEM (Jarrett, 1999; Kelly, 2000), but most university teacher preparation programs offer their candidates limited, if any, field experiences in informal settings. However, at Southern Illinois University Edwardsville (SIUE), a new 3-week summer program addresses this issue by providing preservice K-8 teachers with a STEM teaching experience in an informal learning environment. As a collaboration of the university's STEM Center and its School of Education, and with support from The Boeing Company, the Teachers 'n Training (TNT) program offers preservice elementary teachers the opportunity to work with university staff and faculty

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in the creation and implementation of innovative STEM lessons in a modified 5-E format (Bybee et al., 2006). Then, under the guidance of experienced inservice teachers, the preservice teachers teach their lessons as part of the university's summer camp program. Numerous opportunities for critical feedback and reflection enhance the preservice teachers' sense-making during the program. We hypothesize that preservice teachers who participate in the TNT program will significantly increase their self-efficacy in STEM teaching, improve their interests and attitudes towards science, and increase their understanding of inquiry-based STEM instruction, leading to improved STEM teaching and learning in K-8 schools.

Overview of the TNT Program

During the first week of the program, participants are introduced to content used during the summer camp, as well as research and best practices in STEM teaching and learning, with an emphasis on inquiry-based and problem-centered approaches. In week two, participants are paired with a cooperating camp teacher. They observe and assist with camp instruction and work with their cooperating teacher and TNT mentors to plan a lesson that will be implemented and videotaped during week three. In the third and final week, participants implement their lesson during camp. TNT mentors review the videotaped lesson with participants, discussing the successes and the challenges. Using a rubric, participants assess areas of strength and areas needing improvement and develop a mini-portfolio that documents the lesson and the reasons for their instructional decisions. Six preservice elementary teachers (1 male, 5 female) participated in TNT's first year.

Preliminary Analysis & Findings

To assess the participants' science teaching self-efficacy, the Science Teaching Efficacy Belief Instrument—Form B (STEBI-B)—a Likert-scale survey composed of 23 questions—was given pre and post. The STEBI-B is divided into two subscales: Personal Science Teaching Efficacy Belief (PTSE) and Science Teaching Outcome Expectancy (STOE). As a group, participants scored significantly higher on the STEBI-B after completing the program.

Data pertaining to interests and attitudes towards science were gleaned from pre and post interviews with the participants. Interview protocols included modified questions from the Views on the Nature of Science (VNOS) survey, as well as questions designed to gauge how familiar participants were with STEM subjects, how comfortable they were with teaching STEM subjects, and how important they thought STEM subjects were in the classroom. Initial transcript analysis indicates positive changes in science interests and attitudes, and an increase in comfort in science teaching. Follow-up interviews are planned for six months after program completion.

Participants' understanding of inquiry-based teaching was examined by interviewing participants before and after they taught their lesson to the camp children. Pre-interview questions addressed their plans to integrate the modified 5-E model into their lesson. Post-interviews assessed how the lesson turned out, how the different parts of the instructional model were used, and overall strengths and weaknesses. Another round of interviews are planned after the participants have completed their student teaching, and a complete analysis of all the interview data will take place at that time.

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Conclusions & Future Plans

This first year pilot program shows much promise for positively impacting preservice elementary teachers in areas related to STEM teaching. Analysis of the data continues, but initial findings support an increase in science teaching efficacy and an improvement in attitude toward and interest in science. As we move into year two, we plan to increase the involvement and input of the camp teachers, expand the program to include the university's summer engineering camp, and work more closely with education faculty to possibly include TNT as field experience for their science methods courses. Ideally, the TNT program could be a seed for a new STEM elementary education certificate program.

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