iSTEM: STEM Mentoring

Mentoring has been shown to be a useful strategy for increasing student success (Philip & Hendry, 2000). While all forms of mentoring are increasing, school-based mentoring has grown quite rapidly. In part, this is due to concerns about student performance and schools' efforts to implement programs that address students' challenges and foster academic success (Herrera, Grossman, Kauh, & McMaken, 2011). Outcomes from school-based mentoring have shown improvements in academic performance, (Diversi & Mecham, 2005), self-perception (Bernstein et al., 2009), school attitude/connectedness (Portwood & Ayers, 2005), and even variables such as peer and parent relationships (Karcher, 2005, 2008).

Past research indicates several variables related to effective mentoring, such as length of time mentor-mentee remain connected and strength of mentor-mentee relationship - with longer and stronger relationships yielding greater impacts (Herrera et al., 2011; Rhodes, 2005; Stevens, Bernal, & Ruiz, 2008). Research also shows that simply matching a mentor and mentee is not enough. The need for training and ongoing support of mentors, mentees and other stakeholders (e.g., teachers) is crucial to building and maintaining effective, meaningful mentoring programs (Henry, 1994).

STEM mentoring differs from more traditional mentoring practices, as it is used to engage and retain students in the STEM pipeline, often with a focus on minorities and females given their under-representation in STEM careers. For many students, socialization practices tend to instill a negative self-perception of their ability. Mentoring relationships help to alleviate anxiety and other common academic deterrents, including fewer networking prospects, insufficient preparation, and culture shock both as a student and as a member of a minoritized population (Brainard, Harkus, & St. George, 1998). Successful STEM mentoring programs have included peer mentors, professional mentors, and personal mentors (Dean, 2009).

The National Science Foundation funded project, ***An Innovative Hybrid Program for Diversifying and Building Capacity in the STEM and ICT Workforce (i-STEM***), is a collaboration between the University of Arizona, StrengthBuilding Parnters, the Pascua Yaqui Tribe, and three schools serving primarily Pascua Yaqui youth. The overarching goal of the program was to broaden and diversify the STEM workforce. To achieve this goal, the *iSTEM* project developed, and currently implements and evaluates a culturally-driven strategic hybrid program that combines in-school mentoring program with informal out-of-school science education experiences directed at Pascua Yaqui youth. The mentoring component of the program paired STEM professionals, Pascua Yaqui tribal members, UA students, and STEM Guides with 3rd-8th grade students from Lawrence Intermediate, Hohokam Middle School, and Valencia Middle School. More recently, the *iSTEM* program began using STEM Guides as mentors who partner with students as mentors. The *iSTEM* project provides an opportunity to examine the efficacy of different mentoring models for fostering

interest and success in STEM fields. This manual provides an overview of the mentor training model and program structure.

Mentor Training Model

Research indicates that mentoring can have negative effects on both mentors and mentees if mentoring relationships are ended prematurely, with enhanced success for mentees occurring most often when relationships last for a minimum of one year (Marshall et al., 2013; Strapp et al., 2014). It is therefore crucial to provide mentors with a clear understanding of reasonable expectations and the challenges of mentoring (Strapp et al., 2014). Mentorship training and supervision have been found to be very successful at combating unrealistic expectations among mentors that can lead to disappointment and prematurely ending the mentorship relationship (Marshall et al., 2013).

The StrengthBuilding Mentoring Program developed a curriculum for preparing mentors, which includes an initial three-hour orientation, followed by a series of workshops on various topics. These workshops have been designed based on the feedback of mentors and mentees who have participated in the program since 2002.

Prospective mentors receive a three-hour orientation before being matched with a student. The orientation aimed to provide mentors with a clear understanding of the philosophy behind mentoring, basic information on youth developmental processes, and information on how to make their interactions with mentees as beneficial as possible, illustrated with stories and testimonials from past mentors. The orientation concludes with a discussion of the nuts and bolts processes of visiting mentees at their schools and the signing of a mentorship agreement indicating their commitment to the program.

In addition to the initial program orientation, mentors are provided with the opportunity to attend periodic 1.5 hour topically focused workshops. The topic and content of workshops is based on the needs and requests of the particular group of mentors, as well as emerging research in the field.

Workshop topics offered to mentors during the course of the *iSTEM* program included:

- **StrengthBuilding:** StrengthBuilding is a model for individual and collective change developed by StrengthBuilding partners. This model focuses on helping individuals: identify and develop their own strengths; observe and value the strengths of others; and build more cooperative, respectful and productive relationships.

- **Multiple Intelligences:** The theory of multiple intelligences was developed by Howard Gardner based on cognitive research. This framework suggests that students learn, remember, perform, and understand in different ways.

Successfully interacting with and mentoring young people requires that mentors understand that not every child learns or understands in the same way.

- **Emotional Intelligence**: Emotional intelligence is the ability to recognize your own and other people's emotions and to use emotional information to guide your thinking and interactions with others.

- **Developmental Assets:** Developmental assets are the building blocks of healthy development that help young children grow up healthy, caring, and responsible. Recognizing what assets children have access to or are lacking is important for developing effective intervention strategies.

- **Mentoring the Middle School Child:** Middle school-aged children face unique challenges as they develop socially, physically, and emotionally. Understanding the unique characteristics of this age group is important for those who aim to positively influence them.

The initial orientation combined with periodic trainings provides mentors with continual support and opportunities to share challenges they are experiencing in a supportive environment where issues can be worked through. Using orientation and workshop evaluations completed by SBP mentors and information from staff interactions with both mentees and mentors, SBP refines the curricula to meet the continually shifting needs and requests of mentors and mentees.

Mentoring Program Structure

Research on effective mentoring shows that mentees benefit most when their interactions with mentors are consistent. Working to accommodate both mentor and mentee schedules is an important aspect of enabling consistency. Research on in-school versus community-based mentoring indicates that in-school mentoring programs benefit by having the added support of school faculty and staff to provide an additional layer of consistency (Kolar & McBride, 2011). Moreover, mentorship programs that target students from economically disadvantaged families with limited access to transportation also benefit from locating mentoring experiences at schools, removing the obstacles of transportation faced by many students.

The SBP mentorship model employed for the *iSTEM* project uses an in-school mentorship framework. Under this model mentors visit the school during the typical school day to interact with their mentees. A variety of technology intensive STEM-related activities are provided to mentors/mentee pairs and the mentoring classroom is available for use as well. Supplied materials and activities are intended to provide mentors with the hands-on tools to explore the natural world and scientific topics/themes with their mentee. Activities are also aligned with the informal out-of-school learning component of the *iSTEM* program and are based on the four Grand Challenges for Engineering themes—energy and environment; health; security; and learning and computation. The goal of the *iSTEM* program is to enable the mentors

to convey confidence, interest, and excitement about science to their mentees, while helping them learn together.

Importantly, the *iSTEM* program is structured so that mentors do not have to be trained scientists. Rather, all that is required is that they are interested in science and exploring the world around them and they have a desire to communicate that excitement to their mentee. The role of the mentor is to provide support, encouragement, and guidance; rather than "teachers", mentors are envisioned as co-investigators or partners in discovery with their mentee as they work together to examine topics of mutual interest.

From Community-Based Mentors to Guides as Mentors

During the first two years of the *iSTEM* project, mentors were primarily community members with STEM-related careers or an interest in science. While scheduling mentor/mentee interactions during the typical school day was beneficial for the mentees, it created logistical challenges for many of the community members who served as mentors. Many mentors would have to leave work in order to be present at the schools for meetings with their mentees. The challenges associated with balance work and mentorship responsibilities were more significant than anticipated for many of the mentors, resulting in a lower rate of interactions with mentees than desired.

In response to this scheduling challenge, a new mentorship model was adopted during year three of the *iSTEM* project. The new model includes "STEM Guides" who served as the primary mentors. The concept of Guides was developed based on traditional Native American educational practices and beliefs.

Native American tribes in the United States utilize differing forms of education – but all are alike in giving "informal" education through parents, other relatives, elders, and others. Some, such as Sun Chief of the Hopi Tribe, have had visions of their "Spirit Guide" and come to value learning from the ways of their past generations (Havighurst, 1957). The use of "Guides" is culturally appropriate for learning in many Native American tribes and communities and in particular with regard to education. The term "guide" is also used in science education and includes methods for facilitating science education and for providing "authentic real-world experiences" (Science Foundation of Arizona, 2015).

Within the context of the *iSTEM* program, Guides are University of Arizona undergraduate and graduate students and staff who carry-out twice-weekly STEM activities with 3rd-8th grade students during their lunch periods at their schools and, in doing so, serve as mentors to the students. Including Guides into the program model importantly supplements the one-on-one mentorship relationships by providing additional adults to serve as role models and networks of support for students.

The STEM Guides are able to develop relationships with student participants that were both consistent and close. The same Guides were generally present at activities each week for at least a semester (if not a full academic year). This provided a consistent point-of-contact for student participants and allowed for mentoring relationships to develop organically. At the same time, the addition of STEM Guides made it possible to engage students in STEM activities regardless of whether or not their community mentor was present.

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