

Engaging Social Justice in STEM Teaching

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Abstract

Teacher preparation relies primarily on classroom and field experiences including content and pedagogical practices. To comprehensively address areas which impact students' lives, a broader vision is needed. This means reaching out to community mentors and including them in the educational experience of the student and making them an integral and specific part that experience. By doing so we can truly impact social justice and develop life-long agents of social change. Community-Engaged Teacher preparation is the catalyst and essence of social justice.

Keywords: Social Justice, STEM Teaching, Preservice Teachers, Culturally Relevant Teaching, Teacher Preparation.

Introduction

The Noyce INSPIRES (Infusing Social Programs in Residential Education Scholars) and Students and Scholarships (S&S) Track I program, is funded by the National Science Foundation. The Noyce INSPIRES (aka S&S program) involves four principal investigators in coordinating a team of STEM content and education faculty, science representatives from the partnering high-needs school district and science and mathematics faculty from the participating community college to work together in recruiting science, technology, engineering and mathematics majors in the Noyce S&S program. These exceptional times require a deeper measure of commitment to the development of young people because they are participants in movements for social justice in ways that adults are not [1]. Student teacher programs must move far beyond present practices with our partnership schools.

Teacher preparation should be all encompassing and address every area that has an impact in the students' lives. Therefore, a broader, more intentional vision is needed. This all-encompassing mentality means reaching out to the partnering West Oso ISD Community Mentors and not only including them in the educational experience of the child but making them an integral and specific part of that education. It is in doing so that we can truly impact social justice and inspire social change and community-engaged teacher preparation can drive that change [2].

The Noyce INSPIRES community-engaged teacher preparation (CETP) piece is an innovative program to prepare socially just equity-focused teachers with the capacity to enact pedagogies that are culturally relevant, responsive, and sustaining. CETP is a means to intentionally address the persistent achievement gap between racially, socio-economically, and linguistically non-dominant and dominant students, preparing Noyce Scholars to reach as well as teach their students PRIOR to entering the classroom.

Texas A&M University-Corpus Christi is a Hispanic Serving/Minority Serving Institution that proposes to implement the high impact STEM Infusing Social Programs in Residential Education Scholars (Noyce INSPIRES) Noyce Scholarship and

Stipends (Noyce S&S) project. This project follows a successful National Science Foundation Noyce Capacity Building grant (2020-2021) which strengthened collaborations among the community college, university, and local ISDs. We propose to intentionally recruit, select and develop 26 Inspires scholars over four years who are prepared to teach in high-needs school districts. The Noyce S&S program recruits the most-qualified, highest-need, underrepresented candidates. Scholars are provided professional development opportunities and are integrated into the community and ISD throughout the program using the best research-based practices. The Noyce S&S team comprises faculty from the College of Science and Engineering (COSE) and the College of Education and Human Development (COEHD) and a local community college that offers the best in STEM education and education research to focus on science and mathematics teaching issues such self-efficacy, inclusivity, cultural relevancy, inquiry, and social justice issues relevant to South Texas, a region rich in diversity. This team has a strong track record of collaboration on numerous institutional and community initiatives involving science and mathematics teacher candidates and in-service teachers and students during the past 15 years as partners and researchers, including Grow Your Own (NSF partnership, 2019- present)) and ETEAMS (Elementary Teachers Engaged in Authentic Math and Science, NSF partnership, 2012-2015).

Literature Review/Background

The Problem with Attrition in STEM

The development of highly qualified experts in science, technology, engineering, and mathematics (STEM) is a top priority in Higher Education for effectively advancing our economy and preparing a technologically proficient workforce in the 21st Century. Nationally, we continue to suffer disappointing declines in the critical mass of college students enrolled and completing science and engineering programs [3], particularly those that want to become science, engineering and math teachers, leading to a dearth of skilled teachers within all STEM fields.

To help increase the number of teachers in the STEM workforce, the Noyce INSPIRES (Infusing Social Programs in Residential Education Scholars) project proposes research that informs

pedagogical strategies and environments in grades 7-12 for cultivating **self-efficacy** of teacher candidates with **social justice** in science, engineering, technology and mathematics disciplines, creating a model in teacher education and building the science and mathematics proficient knowledge base. Social justice perspectives include children's lived experience in the social, political, and cultural landscape, which moves beyond the school classroom and/or the university classroom. During the Noyce INSPIRES NSF Capacity Building grant (National Science Foundation 2019-2020), the Noyce INSPIRES team identified, invited conversations, and built relationships with the West Oso Independent School District (WOISD)– a low economic, primarily Hispanic and African American community) key community members (now referred to as INSPIRES Community Scholars). Noyce S&S includes the community mentors in the educational experience of INSPIRES Scholars and their students. The members of Community Scholars are predominately comprised of school district teachers, civic leaders, school board members, administrators, employees in various WOISD community industry and athletics, and are predominately African American. Their perspectives and contributions to our efforts in developing the social justice and community immersion piece in this proposal have been extraordinary.

Recruitment Through “Try Teach”

Creating Community: Infusing Social Justice

Noyce S&S program lends significant benefits to Noyce Scholars in understanding the context of WOISD's children's lives and surrounding community. Planning incorporates “courageous conversations” [4] where community mentors are invited to share their knowledge as Scholars work to process interactions and experiences that may be culturally unfamiliar. These social justice conversations provide a unique opportunity to engage in community expertise as INSPIRES Scholars work to develop curriculum incorporating culturally relevant topics including stories of activism and triumph as well as develop a tool kit for culturally responsive pedagogical methods. Much like the work accomplished by Zygmunt and Clark, “These experiences engender for candidates an understanding of the rich knowledge traditions of the community...they also provide important examples of how to work *with* rather than *for* a community to co-effect change” [1]. The planning of Noyce Scholars participation in these and other examples of critical service learning that are linked to community culture, traditions, history and other practices, directly informing the Noyce Scholars development as community teachers in important and lasting ways. Noyce S&S Scholars become part of the community and are invited into the WPOSD Community Mentors homes and their lives, building relationships with their future STEM students and the community. Noyce Scholars *know* the students before they teach the students and are teaching through reaching.

Critical Service-Learning

Critical service-learning is service provided by teacher candidates alongside members of the community and is deconstructed within frames of racism, classism, power, and privilege. Noyce S&S members participate in education experiences that implement critical service-learning projects, reinforcing STEM education for underrepresented groups in high-needs schools [5]. According to Zygmunt and Clark (2016) [1], the pedagogy surrounding Critical Service-Learning is a three- pronged approach. First, community learning component provides experiences with community members and mentors

that allow contextual cognizance to unfold. Second, community-engaged teacher preparation emphasizes the elevation of funds of knowledge and community cultural wealth. The power of community includes forging relationships between school district stakeholders, teacher candidates and key community members for teacher candidates to become agents of change in their communities. Salient social justice themes are identified and included in class discussions and composition assignments. Third, integrated curriculum involves topics that are explored thematically across content areas. Noyce INSPIRES includes planning genuine celebrations of diversity that extend beyond cultural celebrations by intentionally and deliberately bringing citizens from different backgrounds together. The Noyce program conducts weekly diversity planning meetings discussing culturally relevant teaching in the middle and high school classroom, literacy development, educational technology, teaching social studies/social justice, diverse book collection, and other activities that celebrate community multiculturalism [6]. These topics are specifically connected to STEM subjects [7].

Service Learning in the Community

A study by Wang (2013) [8] shows that a social justice approach to service-learning results in more complex thinking and reasoning skills than traditional service-learning courses. This progressive pedagogical orientation requires educators to focus on social responsibility and critical community issues. Service-learning becomes a problem-solving instrument of social and political reform [9].

Discussion

Building Relationships with Stakeholders

Learning how to learn about a community and to develop authentic and sustaining relationships are central to a program committed to teacher preparation through social justice. This model of community-engaged teacher education aims to develop candidates who practice culturally responsive pedagogy and who personify the moral conviction required to work toward social justice [1,10,11]. Currently, future teachers may earn their teaching credentials without ever stepping foot into a low-income school or community. Zygmunt and Clark (2016) [1] describe the concept of “guerilla teaching” – “going into unfamiliar schools, briefly depositing limited content to children whom they have never met, and testing theory in the absence of even a basic understanding of the community in which the school is situated” (p.3). Noyce INSPIRES provides opportunities for future teachers to become part of the community, and can proudly say, “I Am My Community.” The connections, relationships, and spirit of authentic caring and compassion experienced and consistently practiced within the WOISD community have become the focal point of the proposed project plan. Noyce S&S program provides perspectives and life circumstances of low-income and/or ethnic minority students, preparing future teachers to work in urban schools whose strengths, weaknesses, and institutional goals are often not experienced or understood by university students [1].

Noyce INSPIRES: A Replicative Model Creating Agents of Change

The Noyce INSPIRES program results in a model that can be replicated and synergistically strengthened for grades 7-12 STEM students by using the following goals and objectives in 7-12 STEM Teaching. The Lead-PI has been using science integrated with culturally relevant teaching curriculum and pedagogy for more than a decade in her career Texas A&M

University Corpus Christi and is involved with this curricula design [7]. The training goals and outcomes model for the INSPIRES Noyce INSPIRES program as developed by the Noyce INSPIRES leadership team are described in the following section.

Noyce INSPIRES provides training in teacher preparation and professional development to inspire teacher candidate advocates and agents for social justice [12]. In addition, the INSPIRES team prepares teacher candidates to meet the specific educational and community needs of the partnership(s) through community immersion using courageous conversations, multi-cultural events, relationship building and clinical field experiences by conducting inquiry and research involving an interdisciplinary approach as well as an intercommunity approach (i.e. community members, businesses, and churches), developing authentic relationships and infusing critical service learning as both a community component and a classroom component [13].

Teacher candidates and key community members create agents of change within the community through creation of educational projects centered on social transformation that may be emulated in a socially-just, student centered model for teacher preparation. Data collection measures changes in community members perspectives of program change through post-program STEM needs assessment in WOISD by providing authentic participation in formal and informal education experiences that implement critical service-learning projects including mathematics and science education for underrepresented groups in high needs schools. Noyce INSPIRES also creates spaces where the Professional Learning Community (teachers, mentors, administrators) can come together and discuss, develop, and assess curriculum, content pedagogy and other innovative teaching strategies, such as community teaching partnerships, further developing the model for teacher preparation [14].

Program Evaluation and Data Collection

In a major effort to advance the knowledge base of STEM teaching, evaluation of the Noyce INSPIRES project is focused on activities, project outputs, and outcomes to assess whether the project is meeting its goals and milestones as planned. The purpose of the evaluation is to (a) provide formative information regarding the development and implementation of the program, offering feedback for incremental change and improvement, and (b) provide summative information regarding the extent to which the project is successful in achieving its proposed goals and objectives. The evaluation team works with project personnel to develop and/or adapt data collection instruments to collect context, implementation, and outcome data on the project. Data sources includes program records. A mixed methods approach is used to analyze data, and results and findings from the evaluation study are included in interim reports presented throughout the timeframe of the project and in the final evaluation report presented at the end of the project period.

Detailed external evaluation questions are developed collaboratively among the external evaluator and project team members upon funding of the project. The overarching questions guiding the external evaluation are as follows:

1. To what degree has the Noyce INSPIRES project achieved its stated goals, objectives, and outcomes?
2. What unanticipated outcomes have emerged as a result of the project?

3. What is transferable, replicable, and scalable as a result of the project; i.e., what can be adopted by other teacher preparation institutions in the State, other Noyce projects, and the teacher preparation field in general?

Conclusion

Noyce INSPIRES is laying the foundation for future STEM agents of change teachers in our high need schools by mentoring future teacher-leaders. In an era of educational challenges and demands, the INSPIRES team is working to leave a legacy of broadly trained, socially just and caring teachers who become agents of change and future leaders in STEM education.

Noyce broader impacts increases underrepresented student participation in STEM teaching. Retention of science, technology, engineering and mathematics majors is a major challenge nationwide and at Texas A&M University -Corpus Christi. Research on student retention indicates that engaging students in the higher education community by developing formal classroom and informal student and teacher communities increases persistence, particularly in the first and second years where the greatest loss of students, especially science and mathematics majors, occurs (Tinto, 2012). The Noyce S&S program investigates and provides researched evidence regarding changes in students' self-efficacy in inquiry-driven science and mathematics content courses and provides a model for transforming teacher education through community-driven social justice. Further, the INSPIRES program setting among underrepresented populations makes the program well-positioned to illustrate how a student-centered, peer-mentored program with critical service learning combined with social justice can increase engagement in science, mathematics, engineering and technology education while contributing to academic achievement and the quantity, quality, and diversity of the STEM workforce.

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