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PRODUCING HIGHLY QUALIFIED MATHEMATICS AND SCIENCE TEACHERS THROUGH AN MAT PROGRAM AT A HISTORICALLY BLACK COLLEGE IN THE UNITED STATES

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Synopsis:

Xavier University of Louisiana, a Historically Black College, offers a Master of Arts in Teaching (MAT) degree for mathematics and science graduates to obtain teacher certification. This presentation will share with the audience the curriculum, strategies used to recruit and maintain qualified mathematics and science graduates, and success of the program thus far. The discussion will involve the various methods of funding the program and professional development used for the candidates.

Producing Highly Qualified Mathematics and Science Teachers through an MAT Program at a Historically Black College in the United States

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Paper Abstract

Xavier University of Louisiana, a historically black college (HBCU), offers a Master of Arts in Teaching (MAT) degree for graduate candidates working towards initial teacher certification. The coursework includes the pedagogy of teaching and specific content related to working with students with special needs. Candidates who complete the program receive certification in their middle school or secondary content areas as well as in mild/moderate special education. A focus has been on recruiting STEM graduates to pursue initial teacher certification. Candidates who enroll are involved in other professional development activities and also mentored during their tenure to further advance their skills. This paper will describe strategies used to recruit and maintain qualified candidates in the program, curriculum, professional development activities, and assessment tools.

Introduction

Xavier University of Louisiana is a historically black university (HBCU) in New Orleans, Louisiana. It was founded by the Sisters of the Blessed Sacrament as a normal school to train teachers and currently is the only HBCU that is also a Catholic Institution. For more than two decades, the university has been ranked first in the nation in graduating African American biologists, chemists and physicists. Xavier's curriculum is designed to help students (many of whom enter with low basic skills) learn mathematics and science through a highly systematic, student centered series of instructional experiences supported by out-of-class advising/mentoring, tutoring labs, practice sessions and counseling. Xavier also has been involved with mathematics and science education at the middle and high school level through its successful summer programs. For example, middle school students attend summer programs in Mathematics (MathStar), Biology (BioStar) and Chemistry (ChemStar), while high school seniors interested in pursuing the Sciences or Engineering at the university can participate in the Stress on Analytical Reasoning (SOAR) program. Middle and high school students interested in mathematics or science education can participate in the Future Mathematics and Science Teacher Academy (FMSTA). However, none of these programs have significantly increased the number of undergraduate students selecting STEM teacher education as a major.

Achieve (2008), an independent, bipartisan, non-profit education reform organization, reports that "In a study that examined math course-taking and later education outcomes, Rose and Betts similarly found that not only does taking math courses matter, but that the nature of the courses makes a difference as well. After controlling for demographic factors that also affect college entry (such as ethnicity, parental education and income, school size and demographics, and teachers' education level), 73 percent of students who took calculus during high school later earned a bachelor's degree, while just three percent of those who took "vocational" math (e.g. courses

labeled vocational, general, basic, or consumer math) did so. Among those who took “advanced” algebra in high school (that is, a course beyond Algebra II but not calculus, such as statistics or pre-calculus) 56 percent earned a BA. Thirty-four percent of those who took “intermediate” algebra (comparable to Algebra II), and just 13 percent of those who only took some algebra and/or geometry earned BAs.” (p.6)

Overall gains in the science achievement of the nation’s PK-12 students have not been realized despite measurable progress in these students’ mathematics achievement (Gonzales et al., 2008). Given the critical importance of teacher quality to student academic achievement, this problem is exacerbated by the number of new science teachers who leave the profession due, in part, to job dissatisfaction and lack of support and those who teach out-of-field or without proper certification. As many as 40% of secondary teachers certified in a given year leave the classroom within five years, and this percentage exponentially increases in high-need school districts (Ingersoll, 2000; Smith & Ingersoll, 2004). Such districts are limited in their ability to recruit and retain high quality science, technology, engineering, and mathematics (STEM) teachers, many of whom are recruited by suburban districts offering less challenging working conditions or higher salaries (Abell, Boone & Arbaugh, 2006; Darling-Hammond, 2007; Ingersoll and Perda, 2009). Consequently, the least-qualified teachers routinely end up teaching the lowest performing students. According to the National Center for Education Statistics (2010), 57.2% of middle school students and 27.3% of high school students in U.S. public schools are taught science by teachers lacking a major and/or license in the content area. The lack of appropriate major and/or license is considerably more acute when parsed by individual content area domain (e.g., biology/life science, physical science, chemistry). For example, more than 93% of middle school physical science teachers and 66% of secondary physics teachers lack a content area major and license (NCES,

2010). Thus, there is a resulting critical need to “cultivate, recruit, and reward STEM teachers that prepare and inspire students” (President’s Council of Advisors on Science and Technology (PCAST), 2010).

It is especially troubling that low-income and minority students trail their peers in mathematics and science achievement:

- While 54% of white 4th graders scored proficient on the most recent NAEP mathematics test, only 18% of Black students scored proficient; whereas 45% of White 8th graders scored proficient only 14% of Black students scored proficient. In Louisiana the difference is about the same with 40% of 4th graders scoring proficient and 13 % of Black students scoring proficient and 31% of White 8th graders scoring proficient with 9% of Black 8 graders scoring proficient (NAEP, 2013)

A recent review of studies on factors impacting student achievement by Goodwin (2010) suggests that the largest controllable factor in improving student achievement is teacher quality, yet low-income and minority students are the least likely to have high-quality, well-supported teachers. This is especially troubling in the New Orleans area which consists of student populations that are predominately African-American and low-income. Cowin (2013) reports that the Louisiana Board of Elementary and Secondary Education (BESE) data lists 42,637 students enrolled in public schools in New Orleans with 89% African American and 82% receiving free or reduced lunch which represents a larger disadvantaged population than the state and the nation (p.10).

After Hurricane Katrina in 2005, only 20 schools in New Orleans were allowed to remain under the auspices of the Orleans Parish School Board (OPSB). The Louisiana Board of Elementary and Secondary Education (BESE), citing low school performance scores, placed 114 schools in Orleans Parish under a state-run, Recovery School District (RSD). Although more schools have reopened since Hurricane Katrina, in addition to the OPSB and RSD there are 42 Charter organizations with 84% of public school students are now enrolled in Charter Schools (Cowin, 2013. p.7). Since Charter Schools, through their approved Charter applications, have

various approved procedures in place to hire teachers and determine salaries and other benefits, obtaining data on teacher qualifications is problematic. To meet the need for more teachers, schools have hired teachers through Teach for America and the New Teacher Project's Teach NOLA at "twice the proportion of new teachers in their first year than the state"(Cowin, 2013, p. 15). These teachers are early in their careers and need additional support. Given the reality that classrooms in New Orleans will have a high number of inexperienced, uncertified, and alternative certified teachers who may not have majored in mathematics and science, the need for more high qualified teachers in these STEM areas is critical. This reality was the impetus for the university to begin to review its program offerings and recruitment procedures in an attempt to prepare more highly qualified mathematics and science teachers through its MAT alternate certification program.

During the 2009-2010 academic year funds were sought from various sources to assist with the effort to produce more highly qualified mathematics and science teachers. The first effort was made by the university to continue its tuition reduction offered to candidates enrolled in the MAT program even though budget cuts were being implemented in other areas on campus. This demonstrated the university's commitment towards this initiative. Funds were requested from outside sources such as the National Science Foundation, ExxonMobil and other national and local organizations to provide additional tuition assistance, monthly stipends, and professional development activities specifically for the MAT STEM teacher education majors. Once additional funds were received, a strong recruitment effort began with outreach to surrounding campuses announcing the program.

Master of Arts in Teaching Degree Curriculum

Xavier's graduate programs provide opportunities that foster the core values of scholarship, service and societal improvements consistent with Xavier's unique mission which is "to create a

more just and humane society by preparing its students to assume roles of leadership and service in a global society”(Xavier University of Louisiana Catalog 2012-2014, p.1). Academic achievement, professional practice and ethics are stressed in each discipline. Scholarship, teaching and service are integral to the student’s educational experience at Xavier and beyond the classroom into the community. As part of the educational experience, Xavier graduate programs encourage faculty-student relationships in an effort to cultivate respect for the individual and foster human development.

Applicants are admitted to the Graduate Programs on a full-time or part-time basis. Candidates for admission must submit a formal application to the Graduate Programs accompanied by a writing sample; official test results from either the Graduate Record Examination (GRE) or the Miller Analogies Test (MAT); and official transcripts from all undergraduate and, where applicable, all post-baccalaureate institutions at which courses were taken. A degree from a regionally-accredited college or university which reflects an overall minimum undergraduate grade-point average of 2.5 is required. Candidates are also required to submit passing scores on Praxis I (Math, Reading, and Writing). Candidates are exempt from taking Praxis I if they have an advanced degree, received a score of 22 or higher on the ACT, or 1030 or higher on the SAT. Candidates must also submit passing scores on Praxis II (content area) as required by the Louisiana State Department of Education (LSDE).

The Master of Arts in Teaching program consists of thirty-six semester hours (see Table 1) designed for recent graduates of bachelor or graduate degree programs in mathematics or science content areas, as well as mid-career professionals who desire to make a change into teaching. Coursework may be taken in a one-year fast track sequence or a regular two-year sequence. The program has currently combined special education with its general education coursework such that

candidates earn dual certification in their content area of study and mild/moderate special education.

Table 1. MAT Degree - Required Courses

Course Title	Semester Hours
The Exceptional Child	3
Behavioral Approaches to Managing the Mild/Moderate	3
Methods of Teaching Students with Behavioral Problems	3
Vocational & Transitional Services	3
Foundations of Reading	3
Reading in the Content Areas	3
Diagnostic and Prescriptive Reading	3
Advanced Educational Psychology	3
Secondary School Curriculum	3
Survey of Assessment	3
Internship (two semesters) or Student Teaching (one semester)	3/3 or 6

In addition to introducing MAT students to the various levels of exceptionalities from the slow learner to the gifted, candidates learn about adolescence and their social development, how to select appropriate instructional materials, manage their classrooms when various levels of learners are present, and how to work with other teachers and members of the community to place these students correctly. Another focus is on the cognitive, linguistic, and affective processes involved in reading and practices and strategies which contribute to concept development and reading comprehension. Candidates leave the program with an understanding of secondary curriculum and an overview of the assessment process including pre-referral strategies, screening, and assessment. Candidates can choose a one semester student teaching component and work with a veteran teacher or a year-long internship where they serve as the teacher of record but continue to receive assistance from the Lead Mentor and at least one additional faculty member in the Division of Education and Counseling.

Professional Development

In order to prepare highly qualified mathematics and science teachers, the MAT STEM majors are provided additional professional development activities to enhance their content knowledge. These offerings have been made available through the procurement of grant funds and local and national partnerships including:

- **The NSTA New Science Teacher Academy** - co-founded by the Amgen Foundation, is a professional development initiative created to help promote quality science teaching, enhance teacher confidence and classroom excellence, and improve teacher content knowledge. The NSTA New Science Teacher Academy endeavors to use mentoring and other professional development resources to support science teachers during the often challenging, initial teaching years and to help them stay in the profession.
- **The Mickelson ExxonMobil Math/Science Summer Teacher Academy** – combines the pedagogy and content knowledge of mathematics and science. The Academy’s focus is to: (1) deepen understanding of mathematics and science content in the areas of data and statistics, measurement, and force and motion; (2) build expertise in facilitating student learning through problem solving and inquiry; (3) demonstrate the interconnections between mathematics and science that enhance student learning; (4) provide an understanding of how children learn and how to translate that knowledge to instruction; (5) increase knowledge and use of instructional resources to support student learning; and (6) encourage school teams to network with other math and science education professionals.
- **The National Board of Professional Teaching Certification Process** - is an advanced teaching credential. It complements, but does not replace, a state’s teacher license. It is valid for 10 years, and renewal candidates must begin the renewal process during their eighth or ninth

years as a National Board Certified Teacher (NBCT). National Board Certification is achieved upon successful completion of a voluntary assessment program designed to recognize effective and accomplished teachers who meet high standards based on what teachers should know and be able to do. As part of the certification process, candidates complete 10 assessments that are reviewed by trained teachers in their certificate areas. The assessments include four portfolio entries that feature teaching practice and six constructed response exercises that assess content knowledge. MAT STEM majors receive guidance from a designated NBCT mentor.

- **Workshop Way®** – is a system of human growth for education that sets up conditions in which the students learn to learn, learn to think and learn to manage academic life. It deliberately sets up a dual management system for learning and teaching for both the teacher and the students. Workshop Way® uses a unique way of building on the unique relationship among the teacher, the student and the content being mastered. It is in the conditions for learning effectively and efficiently that makes this way of teaching uniquely successful. Creative, scientific learners move the discipline beyond basic skills into intuitive creativity and inventiveness. After three years of experience implementing Workshop Way®, participants will be eligible for application into the teacher/consultantship program with the possibility of becoming licensed consultants. This is a leadership incentive that enables the participant to teach the system to other professional groups.
- **Core Elements** –is a Greater New Orleans STEM Initiative that strives to educate and prepare K-12 students in the region in Science, Technology, Engineering, and Mathematics by offering teacher professional development, by supporting the use of inquiry-based science and math curricula and by promoting STEM academic enrichment activities. Training is provided for chemistry and physics teachers to experience the Modeling Instruction Program developed by

Arizona State University with funding from the National Science Foundation. Some additional activities include weekly summer training sessions that focus on major science concepts with strong math and literacy components and science and math education modules that have been nationally recognized to raise student achievement on math and science standardized tests.

- **National Science Teachers Association: Urban Science Education Leadership Academy** – is designed to positively affect student achievement through the development of leaders who will help guide reform of the learning, teaching, and assessing of science in elementary/middle schools. Leaders are driven by personal experiences, knowledge of the change process, use of research, relevant data, and the leadership skills developed in collaboration with others.
- **Global Learning and Observation to Benefit the Environment (GLOBE)** – is a hands-on, school based science education program for primary and secondary levels. Through a partnership with NASA Stennis Space Center, MAT STEM majors are able to receive GLOBE training. As stated at globe.gov, GLOBE is described as promoting collaboration on inquiry-based investigations of the environment and the Earth system working in close partnership with NASA, NOAA and NSF Earth System Science Projects (ESSP's) in study and research about the dynamics of Earth's environment. Participants not only receive training, but also supplies that can be used in their classrooms.
- **Attendance at Local, Regional, and National Conferences** – MAT STEM majors are provided funds to attend a variety of conferences sponsored by organizations such as: the Louisiana Middle School Association, Louisiana Applying Teaching for Mathematics, Louisiana Science Teachers Association, Audubon Nature Institute, the National Science Teachers Association, the National Council of Teachers of Mathematics, NASA Stennis Space Center, and the National Board of Professional Teachers.

- **Summer Academy for Future STEM Teachers** – MAT STEM majors coordinate the Future Mathematics and Science Teacher Academy (FMSTA) which is a summer program for middle and high school students interested in mathematics and science education. It is designed to assist these students with mathematics and science knowledge and to encourage them to pursue STEM teacher education as a career choice. MAT STEM majors teach in the program and can receive funding to start a FMSTA club at their school sites.

Through ongoing funding assistance, continuous professional development has been provided even after candidates receive the MAT degree.

Mentoring Component

According to Barlin (2010), for more than a decade, clear and consistent research has shown that the quality of teachers is the most powerful school related determinant of student success. Incorporating mentors to assist novice teachers produces effective teachers. Through this MAT STEM program, all candidates began teaching in high-need schools around the greater New Orleans area. The Lead Mentor provides non-threatening continuous, intensive mentoring and coaching to the MAT STEM majors during the academic school year. The Lead Mentor provides support to the teachers in their new roles as novice teachers with the responsibility for student achievement. She listens and helps these novice teachers problem solve as they enter the day to day routine of a first year teacher. She serves as a role model by developing lessons plans and conducting demonstration lessons. Classroom observations are ongoing throughout the school year to help develop the skills required of an effective teacher.

Another component of mentoring established is through assigning a National Board Certified Teacher (NBCT) to assist each MAT STEM major through the initial NBCT *Take One!* process. The NBCT mentors also provided Saturday workshops for the MAT STEM majors in

order for them to gain meaningful understanding about the Five Core Propositions of what teachers should know and be able to do. Teachers were to submit one entry portfolio, which involved developing a video that showed implementation of a lesson in their classrooms that demonstrated effective instruction. It also entailed a detail description of the knowledge of their students, the lesson plan, and a reflection on the video. The NBCT mentors provided detailed feedback to the MAT STEM majors and assisted them with the development of their portfolios through continuous review and refinement of their materials.

An additional component of mentoring provided was through collaboration with university STEM faculty. Through classroom observations of these novice teachers, university STEM faculty were able to see first-hand how mathematics and science curricula were being taught in the public school system. The observation tool being used is the Reformed Teaching Observation Protocol (RTOP). It was developed by the Arizona Collaboration for Excellence in the Preparation of Teachers (ACEPT) thru funds from the National Science Foundation in 1995. The RTOP instrument is a holistic measurement of the presence/absence of specific teaching strategies in science and mathematics classrooms divided into five- subscales (lesson design and implementation, propositional knowledge, procedural knowledge, student-teacher classroom interaction, and student-student classroom interaction). Using this tool, university STEM faculty are able to provide constructive feedback to these new STEM teachers. Initial RTOP results indicate 97% of the MATH STEM majors achieving 3 (partial attainment) and one achieving full attainment of successful implementation of teaching strategies in their classrooms during their second semester of teaching.

Results

With the change in the MAT curriculum requirements and additional funds received from various grant sources including the National Science Foundation and ExxonMobil, more graduate students were recruited to enroll in the MAT program and major in mathematics and science education either at the middle or secondary levels. The option of receiving dual certification was selected by the majority of the candidates (9/11 who finished the program in 2013 and 14/16 candidates who finished the program in 2014). Table 2 lists the increases in the graduates as a result of this funding initiative.

Table 2. MAT STEM Teacher Education Graduates 2010-2014

MAT STEM Major	2010-2011	2011-2012	2012-2013	2013-2014
MS Mathematics/Spec Ed		2	1	4
MS Science/Spec Ed		1	1	4
Biology Ed	2	1		
Biology/Spec Ed		1	5	3
Chemistry Ed	1	1	1	
Chemistry/Spec Ed		1	3	3
Mathematics Ed	4	1		1
Mathematics/Spec Ed			1	1
Physics/Spec Ed			1	
Yearly Graduation Totals	7	8	13	16

Discussion and Recommendations for Further Study

Since this program was implemented and additional funds received to provide incentives for MAT STEM majors, there has been a consistent increase in the number of graduate candidates who enter and complete the MAT STEM program. In addition, the option of obtaining dual certification in the STEM teaching content and mild/moderate special education has overwhelmingly been selected. Efforts will continue to seek funds to not only provide additional incentives to MAT STEM majors but to also provide continued professional development

opportunities beyond graduation. Ongoing research will also be done to assess the impact of these new highly qualified STEM teachers on student achievement.

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