Title of Submission: NSF Robert Noyce Project at Newberry College – REMAST – Year 3

Topic Area: STEM Education – Teacher Preparation – Teacher persistence and retention – Teacher Effectiveness

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Abstract: With NSF Noyce Phase I funding, the RE-MAST program met the goal to more than double the STEM secondary-certified teachers over a five-year period. Based on the findings from the RE-MAST Phase I program, the REMAST Phase II program goals are 1) recruit STEM majors into teaching; 2) provide educational support; 3) provide professional development (PD) opportunities; and 4) pursue an innovative research agenda that involves tracking the Phase I participants. **NSF Award Number: 1439839**

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Introduction

For a small college (980 students in fall 2009; 1100 students in fall 2017), Newberry College already prepared a higher number of teachers in these critical need STEM content areas than some of its larger counterparts in SC. Prior to 2009, in the STEM areas, a biology secondary education program and a math secondary education program were in place to prepare high school teachers. Furthermore, 98% of the student body receives financial aid. In addition to financial challenges, approximately 1/3 of the student population is first-generation college students. The College has a 28% percent minority student population, of which 25% is African-American. Most Newberry College students are from rural, poverty-dense areas of SC and maintain SC residency upon graduation. Many Newberry College STEM majors pursuing teaching as a career will have graduated from high need school districts themselves, making them uniquely positioned to teach STEM content in high need schools.

Initially, many of our students entered STEM majors with the intention of pursuing professional programs upon graduation or liked science and were undecided what career avenue to pursue – secondary education never entered their minds while at Newberry College. The students decided on secondary education during their junior or senior years and due to the amount of time to complete the degree, and many were advised to and elected to enter the PACE program after graduation with their content degree. PACE was the alternate certification program in SC for those teaching in high need areas. Very few students graduated with STEM secondary education degrees (see Figure 1).

STEM and Education faculty teamed up in 2008-2009 and devised a plan in 2008-2009 to change this culture. The main elements of the plan were as follows along with the status of each item in italics:

1) Learn about other STEM education programs. *Research was conducted and a UTEACH conference was attended.*
2) Write a proposal to add chemistry secondary education at Newberry College. *The proposal was written and approved by the state. In 2009, a chemistry secondary education program was added to prepare high school chemistry teachers.*
3) Learn about potential funding streams. *An informational NSF workshop on the NOYCE Scholarship program was attended in Atlanta, GA.*
4) Submit funding proposals. *A grant proposal to the NSF Noyce Phase I program was submitted and funded 2009-2015. ($900,000)*
5) Seek additional funding to continue the work started through RE-MAST (Recruit and Engage Math and Science Teachers). *A grant proposal to the NSF Noyce Phase II program was submitted that would provide scholarship funding and learn about factors for STEM teachers' persistence and what attributes contribute to effectiveness in the classroom and funded 2015-2020. ($800,000)*
6) The information obtained from this NSF Noyce award was to provide the data for another Phase I proposal – potential award 2020-2025.
7) This plan was to provide $2.5-3 million dollars to the program over 15 years.

An NSF Noyce Teacher Scholarships Phase I Grant (DUE-0934802) was awarded to Newberry College entitled "Recruit and Engage – Math And Science Teachers (RE-MAST)". $900,000; 2009-2015. The major goal of the RE-MAST project was to more than double the number of STEM secondary teachers certified by Newberry College over a five-year period. Specifically, RE-MAST prepared bachelor's level biology, chemistry, and mathematics secondary education majors. The major activities of the project were as follows: **(1) internships** for freshmen and sophomores to explore the STEM teaching profession; **(2) professional development** opportunities to develop excellent STEM teachers; **(3) scholarships** to assist students with degree completion; **(4)** cooperation with **mentor teachers** to prepare for teaching in these areas; and **(5)** academically rigorous **content degrees** aligned with professional standards for the content area.

With RE-MAST funding, Newberry College met the goal to more than double the STEM secondary-certified teachers over the five-year period: during 2000-2005, 8 graduates were produced and ten years later during a comparable span, 2010-2015, **20 graduates** were produced. Figure 1 compares the first half of three decades of Newberry College STEM education graduates.
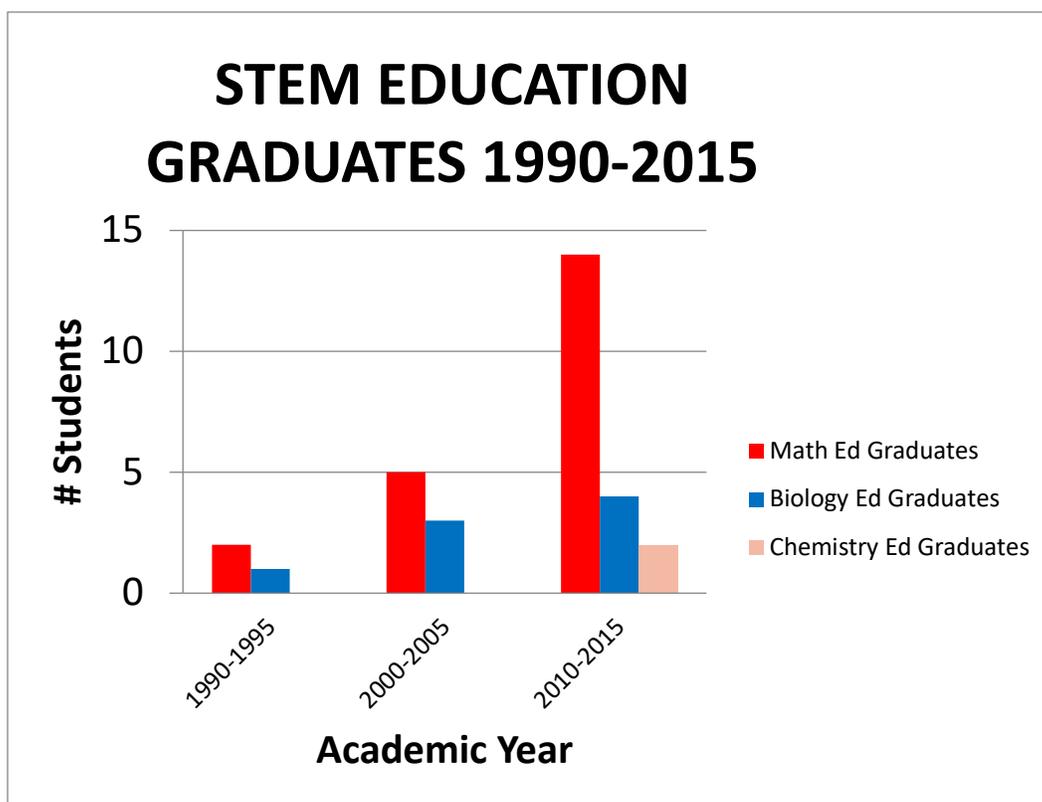

Figure 1: Comparison of Newberry College STEM Education graduates: data from first five years of three decades

NSF Noyce Teacher Scholarships Phase II Grant (DUE-1439839) was awarded to Newberry College entitled "Recruit and Engage Mathematics And Science Teachers (REMAST), while Conducting a Longitudinal Study of Factors Influencing Effectiveness". $797,823; 2015-2020. Based on the findings from the RE-MAST Phase I program, the *REMAST Phase II* program will 1) recruit 9 to 16 additional STEM majors into teaching; 2) provide educational support for Scholars; 3) provide professional development opportunities for grant participants; and 4) pursue a rigorous and innovative research agenda related to teacher retention, or persistence of math and science teachers in the teaching profession.

Ongoing educational support has been provided to scholars through the following: 1) academic advisement, 2) field placements with Mentor Teachers, 3) Mayterm classes geared specifically toward Science and Math students – Course 1: Technology; Course 2: Content Literacy, 4) Praxis II content preparation material, 5) three professional development sessions per semester, 6) a summer professional development session, and 7) discipline specific conference attendance opportunities.

Methods

Year 2 of Grant served as a baseline of data for the study. Before reporting the data collected for Year 2 each of the research questions were presented in Table 1, a short introduction of the Methods used to create the PLC under study in REMAST Phase II was presented. This included a description of the activities pre-service teachers (hereafter Scholars) were required to take part in, and some data from the ongoing evaluation of those activities.

Method of PLC Creation. While a RE-MAST Scholar, our students were exposed to a variety of different leadership development and research-focused exploration activities through the institution. Scholars were required to attend monthly professional development meetings, and were encouraged to attend professional conferences in their area of content specialty. Teaching Fellows were provided resources and incentives to continue attendance at the meetings and activities outlined below to encourage the strengthening of the PLC.

College-Led Professional Development. The professional development opportunities offered by the college span a variety of topics. Activities have included presentations by current Teaching Fellows about technology used in the classroom, presentations by Mentor Teachers regarding accepted publications, roundtables presented by Teaching Fellows for Scholars, and graduation celebrations for Scholars who completed their degrees. These opportunities have provided time for the REMAST community to learn

new techniques to apply in their own classrooms, to exchange classroom control and activity ideas, and to share wisdom gained from service with other Teaching Fellows and Scholars. The PLC has provided a support network if a Scholar or Teaching Fellow struggled with for example – classroom management.

Table 1. *Data Plan for Year 2 of Grant as Completed Year 1 by Team*

Year	Measure to Answer Question Listed	Question Addressed from Original Grant Data Plan
2	1. Collect 1 Video with Lesson Plan per student per year (for EQUIP & in-house assessment) (iPad and 2 Swivels Ordered) 1. Collect pass/fail ADEPT Data from Teaching Fellows (as Completed by Teaching Fellows in their Third Year) 2. PD as Undergraduate in REMAST (2013-Records); PD after graduation through REMAST; Yearly Personal Survey 3/4. Administer Leadership Survey	1. How does research-focused, multi-level leadership development increase math and science teacher persistence and effectiveness? 2. How does participation in a research-focused, multi-level professional learning community increase math and science teacher persistence and effectiveness? 3. What leadership development is possible and appropriate for math and science educators when focused on research and working at pre- and in-service levels 4. What aspects of research-focused, multi-level leadership development have the most impact on math and science teacher persistence and effectiveness?

Regional and National Conference Attendance. REMAST is committed to equipping our Scholars and Teaching Fellows with the most recent advances in the field of Education, including pedagogy instruction and technology. While Scholars, all the current Teaching Fellows attended at least one Regional or National Conference, and many of them took the opportunity to attend more than one. These conferences included Regional and National *Noyce* meetings, national meetings such as the meeting of the *National Council for Teachers of Mathematics*, *ChemEd*, regional meetings of discipline-specific conferences such as the *Association of Southeastern Biologists*, *Southeastern Meeting of the American Chemical Society* and conferences based on pedagogy and instructional techniques such as *Learn. Teach. Lead.* & the *Upstate Technology Conference*.

Targeted Instruction. The college also has provided our Scholars, Teaching Fellows, and Mentor Teachers with Continued Education training. An example of this was the Learning Focused training that was held at the Newberry College campus during the Summer of 2016. This offered the group the opportunity to become certified in a specific area, as well as provided an opportunity for our grant evaluator to collect more information from the group regarding the operation of the grant, and whether it was meeting the needs of the Scholars, Fellows, and Mentor Teachers.

REMAST Scholars who graduate from Newberry College have obtained a degree in their content area specialty (Ex. Mathematics) with a concentration in Secondary Education. Additionally, REMAST faculty provide instruction in teaching methods regarding content specialty, during required Education coursework. As such, our graduates have been prepared with strong content and pedagogical knowledge. This strength of the program was reflected in strong pedagogy scores on the Praxis exams (19/20 passed; one recent graduate has yet to take the test), with graduates achieving on average a 10.3% increase over the score needed to simply pass the exam. Content scores were also strong for the graduates who have passed their respective content exam (17/20), with scores an average of 10.0% higher than the required number.

REMAST Scholars & Teaching Fellows. The program currently has 20 scholars considered RE-MAST trained (20 Teaching Fellows). The data collection for Phase II is drawn from our current Teaching Fellow pool. When this data was collected (2015-2016 AY), there were a total of 16 graduates that were in service. Data collection during the initial (and subsequent years) excluded the recruitment of Teaching Fellows in their first year of service for all aspects of collection but the End of Year Survey. This was done to allow the Teaching Fellows a chance to further develop their skills, and effectively manage their time during their first year of service. All Teaching Fellows (phase I and phase II) are invited to participate in data collection any time after their second year of service, with an invitation letter from the research team. Therefore, a pool of 16 Teaching Fellows were available for recruitment from the first year of data collection for the second year of data collection.

Grant Year 2 Participants. Of those eligible to participate, six Teaching Fellows completed all portions of the study during the first year of data collection. Of the Teaching Fellows taking part, four with mathematics backgrounds, and two with chemistry backgrounds. To increase participation in the second year of data collection, the research team increased stipends for participation.

To measure the representativeness of the sample, GPAs at graduation for all Teaching Fellows vs. those participating in the study were tested, and were not found to be significantly different ($p = 0.26$). Additionally, the scores on the Praxis Content and Pedagogy tasks were not significantly different between groups ($p > 0.68$ on both). Thus, it appeared that the sample of students whom agreed to take part in the first year of data collection was not qualitatively different from the overall student body.

Measures. The initial grant proposal (REMAST Phase II) indicated that data would be gathered using reliable and validated measures of proficiency, growth, and persistence of teachers trained in a research-based program. Year 1 of the Phase II grant finalized in the data plan that these measures included the Electronic Quality of Inquiry Protocol (hereafter EQUIP; an inquiry-based evaluation procedure from Clemson University), reports from the South Carolina system of Assisting, Developing and Evaluating Professional Teaching (hereafter ADEPT) protocol; and performance on the Comprehensive Assessment of Leadership for Learning (hereafter CALL) survey. Data collection such as Conference Attendance, Leadership Activities, performance on the

Newberry College Lesson Plan, and a Year End Survey were gathered to supplement these validated assessments to address our research questions.

EQUIP and Scoring Mechanism. Inquiry in Motion's, EQUIP (Electronic Quality of Inquiry Protocol) template was used to evaluate the quality and quantity of inquiry-based instruction and learning in K-12 math and science classrooms. While several sections of the EQUIP template were omitted, due to grant restrictions, participants were evaluated on four categories, summative views of instruction, discourse, assessment, and curriculum, with a score of 1-4 given to each category. Each categorical score corresponds with the perceived level of inquiry achieved. Participants overall score on EQUIP was achieved by averaging the subcategories.

The protocol information was found at the Clemson University EQUIP website: https://www.clemson.edu/education/inquiry-in-motion/research-evaluation/equip.html

ADEPT AND SAFE-T. To continue teaching in South Carolina, teachers must go through both *Summative ADEPT Formal Evaluation of Teachers* (SAFE-T) and *Assisting Developing and Evaluating Professional Teaching* (ADEPT) certification. The certification depends on the years that the Teaching Fellow has been teaching in the classroom, with SAFE-T protocol being measured during the first year in the classroom, while ADEPT must be completed by the end of the third year of classroom teaching. In our data, we have reported SAFE-T (where applicable) as well as ADEPT Pass/Fail rates. ADEPT consists of a set of standards for teaching professionals to demonstrate their knowledge of, and continual application within their classrooms. There are four domains that contain a total of ten performance standards which are assessed within ADEPT that are central to Student Achievement: 1) Planning, 2) Instruction, 3) Classroom Environment, and 4) Professionalism (SC Department of Education, 2017). If a Teaching Fellow successfully passes ADEPT, the Teaching Fellow was able to continue teaching in the Public-School System in South Carolina. For Teaching Fellows teaching outside of South Carolina, ADEPT Pass/Fail information was reported for all Teaching Fellows who are in service where the assessment is used. The protocol information was found at the following: http://ed.sc.gov/educators/educator-effectiveness/adept-evaluation-system-2006/adept-overview/

Praxis Scores. Teaching Fellows Praxis scores were reported in two different areas, required for South Carolina licensure, Principles of Learning and Teaching (hereafter Praxis Pedagogy), and the test in their specific subject area (hereafter Praxis Content). The information regarding what was required of our South Carolina Teaching Fellows was found at the ETS website: https://www.ets.org/praxis/sc

Year End Survey. The Year End Survey (Appendix I) was designed to continue communication with all REMAST graduates (including Teaching Fellows not participating in the study), as well as obtain the reactions and responses from Teaching Fellows to the effectiveness of the REMAST program throughout the year. As our Teaching Fellows continue their years of in-service activity, their needs may change, as may their location. The Year End Survey has allowed us a way to monitor attitudes toward the program, and

ensure that the Teaching Fellows are getting the support needed, as well as keep track of their activities.

NC Lesson Plan. The Newberry College lesson plan (Appendix II) was developed by the Newberry College Teacher Education Department. It utilized best practices in Learning Focused strategies and Inquiry Based learning. The Lesson Plan format for teacher candidates at Newberry College was developed from many resources concerning best practices for teaching and learning. These included conversations with highly qualified teachers in the districts that partner with Newberry College as well as research by Robert Marzano, Madeline Hunter, Learning Focused Solutions, and the Intel Teach to the Future Program. Major components included the following:

> Goals, objectives, and essential questions
> Materials, tools, and technology
> Procedures, student activities, ongoing formative assessment
> Summarizing, closure, and summative assessment
> Reflection

Student teachers were scored on their Lesson Plan and Reflection that accompanied their recorded classroom video.

Results and Discussion (Year 1 and 2)

During **Year 1 of Noyce Grant Award:** The Data Management Plan was developed (Table 1), and three scholars were recruited into REMAST. The goals of the REMAST Phase II grant included exploring the creation of a Professional Learning Community (hereafter PLC), and the effects of this PLC on leadership and persistence in the profession of teaching STEM at the secondary education level.

During **Year 2 of Noyce Grant Award:** The Research Assistant was hired. IRB consent forms were developed, reviewed, and approved for various school districts. The Data Management Plan was implemented including videos, surveys, reflections, and lesson plans. Academic Year 2015-2016 data for six RE-MAST phase I scholar-graduates (referred to as Teaching Fellows) was collected and analyzed for a baseline, and two scholars were recruited into REMAST. The REMAST website (http://www.newberryremast.com) was established. The REMAST website has provided information on the REMAST program's purpose, goals, results, application procedures, and contact information.

1. **How does research-focused, multi-level leadership development increase math and science teacher persistence and effectiveness?**

Historical data was obtained regarding Teaching Fellows' participation in regional and national professional development opportunities, as well as current data regarding the Teaching Fellows' leadership positions in their schools and any additional certifications sought. During their time as Scholars or Teaching Fellows, all six of the participants attended a regional development conference at least once. Additionally, five of the six attended at least one national conference during their time with REMAST (see Table 2).

The continual pursing of higher education (4/6 of our enrolled participants, and 8/13 REMAST End of Year Survey respondents) suggests that our Teaching Fellows are well equipped to manage their time, and are interested in furthering their knowledge within education. All reported programs were in the field of education. Additionally, Teaching Fellows held school leadership positions. Teaching Fellow 1 was a program advisor; Teaching Fellow 2 a sports coach; Teaching Fellow 3 currently holds a district position in addition to belonging to 4 additional committees; Teaching Fellow 4 advises two school programs, and participates in two others; Teaching Fellow 5 is not a member of outside committees; and Teaching Fellow 6 holds two coaching positions. Professional Development attendance listed was the number the Teaching Fellows have attended since 2013.

Also of note, since graduation, all Teaching Fellows participating in the study have also been continuously employed.

Additionally, in Year 2, during the first year of data collection, the plan was to obtain measures from participants on a leadership survey. Anticipation that the number of Teaching Fellows participating in the study during the second year of data collection should increase, this measure was postponed to Year 3 of the grant, and Year 5 for the second collection.

Table 2. *Leadership Data as of 2015-2016*

Teaching Fellow	National Conferences	Regional Conferences	College-Led PD	Pursuing Masters'
1	0	2	9	-
2	1	6	3	X
3	1	8	7	-
4	2	2	2	X
5	1	3	5	X
6	1	3	9	X (achieved)

2. **How does participation in a research-focused, multi-level professional learning community increase math and science teacher persistence and effectiveness?**

A strong indicator of the REMAST graduates' success and effectiveness in the classroom was their ability to pass both Praxis and 3rd year certification markers (ADEPT) (see Table 3). Praxis Pedagogy and Content data was presented as the percentage above passing score that the Teaching Fellow obtained. For example, if passing was 157, and the Teaching Fellow obtained 157, then their percentage would be 0. However, if the

Teaching Fellow obtained a 165/157, then their percentage would be 5.10%. Since the Teaching Fellows took Praxis during different years, and in different content areas, passing scores were not identical. Percentages were therefore presented to standardize data. Content area was not identified for each Teaching Fellow to protect privacy.

At the time of data collection, all REMAST scholars who had attempted ADEPT had been successful and continued teaching. This included 5/6 Teaching Fellows who took part in the current year of Phase II data. One was not yet eligible for ADEPT.

Scores on EQUIP had great variability within the sample, ranging from 1.33-3.14 (4 point scale). However, it appeared that GPA at Graduation could be a potential predictor of EQUIP scores ($r(10) = 0.64$, $p = 0.16$). This correlation will be tested again during the second year of data collection for reliability. It should also be noted that the NC Lesson Plan Score generally agreed with the EQUIP score—such that lower scores were rated Developing, and higher Proficient. This indicated that the Lesson Plan Score was also a valid indicator of effectiveness; a conclusion further strengthened by the correlation of the Praxis covering Pedagogy with the higher Lesson Plan scores. This measure will also be verified in next year's data collection to further establish the validity of the instrument. It should be noted that the "NA" recorded for Teaching Fellow 1 was a failure to use the established lesson plan (instead substituting current schools) so the rating was not comparable.

Table 3. *Effectiveness & Content Knowledge Data, 2015-2016*

Teaching Fellow	GPA at Graduation	EQUIP	NC Lesson Plan Score	Praxis Pedagogy	Praxis Content
1	4.00	3.14	NA	10.19	20.61
2	2.85	1.51	Developing	5.73	19.85
3	3.95	2.08	Proficient	15.29	3.57
4	3.73	1.59	Proficient	15.29	3.70
5	3.62	1.33	Developing	3.82	5.34
6	4.00	2.93	Proficient	10.83	0.00

3. **What leadership development is possible and appropriate for math and science educators when focused on research and working at pre- and in-service level?**

REMAST provided a variety of leadership development opportunities for both Scholars and Teaching Fellows by providing ongoing support for regional and national conference attendance. Additionally, REMAST provided on-site development opportunities at least once per month, with a variety of specific training being offered at a yearly summer conference.

While a variety of leadership data was reported in #1, it would be remiss if we did not add here that Teaching Fellows appear to juggle a variety of Leadership responsibilities quite well, while continuing to pursue additional opportunities. This suggests that there is a possibility that time management skills were refined as an outcome of the variety of experiences REMAST Scholars are required to take part in.

The impact of the various leadership activities was attempted for Teaching Fellows on their scores on EQUIP, (i.e., Conference Attendance, reported activities, Master's programs), the low *N* for the study in our first year of data collection meant that these predictors did not reach statistical significance, which is why our data was presented descriptively at this point in sections #1 & #2. We will elaborate on this question during the second and third year of data collection.

4. **What aspects of research-focused, multi-level leadership development have the most impact on math and science teacher persistence and effectiveness?**

A variety of pre- and post-service measures were collected and used to predict scores on EQUIP. These included Undergraduate GPA at graduation, Praxis Content and Pedagogy scores, and regional and national conference attendance as a Scholar and Teaching Fellow. For the six participants who consented to have their data collected for Phase II during Year 1 of data collection, the average GPA at graduation was $M = 3.69$ ($s = 0.44$), average percentage above Praxis pass level was $M = 10.19\%$ for Pedagogy, and $M = 8.85\%$ for Content, with conference attendance reported in Table 2.

Again, as the participant number for the current data report was low, we focused on testing only specific relationships between the data, and as we reported above, the strongest relationship in the data thus far is the relationship between GPA at Graduation and score on EQUIP. This may be a telling indicator, as GPA for our students contains a majority of science or mathematics heavy content courses, as our students obtain their degrees within their primary major, with a concentration in Secondary Education. This data will be compared to the data obtained in the second and third year of data collection.

Discussion (Years 1 and 2 of the grant: year 1 data collection)

Our first year of data collection focused on gathering baseline information from our Teaching Fellows regarding the measures identified in our Year 1 data plan. In addition to obtaining that data, a few modifications were needed to our grant proposal for our data collection program going forward, including adjustment of the time frame for some of our data collection, and adjustment of the the incentives for our Teaching Fellows.

Thus far, we believe that two of the most important indicators of success for our Teaching Fellows include dedication to coursework during pre-service training (as measured by GPA), and instruction in Pedagogy (as measured by Praxis Pedagogy Score, and GPA). These two measures separated themselves from our remaining measures in our first year of data collection as potential predictors of success in the classroom as measured both

by EQUIP and the Newberry College Lesson Plan Rubric, and offer questions to pursue during the ongoing data collection.

Results and Discussion (Year 3 of the grant: year 2 of data collection)

During Year 3 of the Grant Award: Five Scholars were recruited. For the academic year 2016-2017, data collection involved six RE-MAST phase I scholars. Currently for the academic year 2017-2018 data collection is in progress and involves a potential of 13 RE-MAST phase I scholars. The total REMAST phase II scholars to date is ten of which four are Math secondary education, five are Biology secondary education, and one is Chemistry secondary education. Dissemination of grant results has begun through the REMAST website, publication, and conference presentations. Additionally, four REMAST phase II graduates have entered the teaching profession. Further study of successive academic years is expected to provide information as to STEM teacher persistence and effectiveness. This project is likely to impact the base of STEM teacher knowledge of persistence and effectiveness.

Additionally, per Year 3 of the Data Plan (Year 2 of Data Collection) created in Year 1, the goals of the REMAST grant were as follows, as excerpted from the full Data Management Plan (see Table 4).

Turning to focus on the research questions, we provide an update on the data collection to answering each of these questions, with the understanding that Year 3 focuses on questions 1 & 2 in the data plan.

Table 4. *Data Plan for Year 3 of Grant as Completed Year 1 by Team*

Year	Measure	Completed By	Question Addressed from Original Grant Data Plan
3	1. Collect 1 Video with Lesson Plans per student per year 2. Yearly Personal Survey 3. Literature motivated response--detail what we have done to create cohesiveness amongst the groups, the steps in Phase 1, ongoing PD responses	Video scored by hired data screeners; Data Collected by Grant PI Team	1. How does research-focused, multi-level leadership development increase math and science teacher persistence and effectiveness? 2. How can a cohesive professional learning community of math and science educators focused on conducting research and made up of both pre- and in-service teachers across multiple schools be created?

1. How does research-focused, multi-level leadership development increase math and science teacher persistence and effectiveness?

Information from our Scholars and Teaching Fellows was recorded as 1) professional development each year, 2) activities outside of teaching, 3) pursuance of other goals, such as graduate degrees, and 4) current school location (Table 5). Additionally, our goal

when the grant began was to capture additional leadership data, beyond their reported positions in the classroom and activities with our professional learning community (PLC). In addition, each year in the field, our Teaching Fellows recorded a lesson using a Swivl robot camera allowed our data analyst to evaluate their performance using the validity and reliability tested EQUIP; Inquiry in Motion's Electronic Quality of Inquiry protocol developed by Clemson University. EQUIP was selected because it became clear that data collection would need to be collected remotely and digitally due to the geographical locations of our Teaching Fellows. Inquiry in Motion's, EQUIP template was used to evaluate the quality and quantity of inquiry-based instruction and learning in K-12 math and science classrooms. This measure provided an assessment of teacher performance in the classroom, and can be administered multiple times. Additionally, since our grant protocol has our Teaching Fellows submit a recorded lesson, at the end of the grant duration a second scoring session will be done to assess a single graduate's scores on the assessment over multiple years, as a validity check for our year-by-year assessment entry. This will allow us a chance to provide inter-rater reliability measures.

Some key themes have emerged within our data (Table 6). First, the Teaching Fellows in the field that have struggled when taking the Praxis exam have tended to require more resources when in service. Additionally, for Teaching Fellows that have provided us two years of EQUIP data, for the group as a whole, scores have tended to increase, with the first year, $M = 1.885$ ($s = 0.64$), and the second year, $M = 2.01$ ($s = 0.56$), although with our small sample size this increase was not significant. Additionally, it should be noted that we are comparing Teaching Fellows against their yearly scores for this analysis, as our first-year data collection teachers have tended to perform worse on EQUIP than our Teaching Fellows that have been in the classroom for multiple years.

Table 5. *Leadership Data as of 2016-2017*

Teaching Fellow	National* Conferences	Regional* Conferences	College-Led PD*	Masters'
1	1	4	5	no
2	0	5	10	pursuing
3	0	2	12	pursuing
4	1	2	6	pursuing
5	1	2	10	MEd
6	0	1	7	no
7	3	1	6	MEd

*The conference attendance recorded was sponsored through REMAST. The Professional Development (PD) sessions were conducted through REMAST.

Table 6. *Effectiveness & Content Knowledge Data 2016-2017*

Teaching Fellow	GPA at Graduation	EQUIP	NC Lesson Plan Score	Year Teaching	ADEPT[#]	Praxis^ Pedagogy	Praxis^ Content
1	2.85	1.80	Developing	5	Passed	5.73	19.85
2	3.95	2.59	Proficient	4	Passed	15.29	3.57
3	3.94	1.65	Proficient	2	Passed	12.10	14.38
4	3.62	1.65	Developing	3	Passed	3.82	5.34
5	4.00	2.63	Proficient	3	Passed	10.83	0.00
6	3.97	1.50	Developing	2	NA	17.83	10.63
7	3.73	1.39	Proficient	3	Passed	15.29	3.70

#ADEPT certification is required for South Carolina continued instruction. ^Since each Praxis passing score varied year to year and several STEM areas are compared, the number reported was the percentage above the passing score both for Praxis Pedagogy and Content.

2. How does participation in a research-focused, multi-level professional learning community increase math and science teacher persistence and effectiveness?

This question ties in to the previous question, and relates to our awardee's persistence in the field in general. We have been fortunate in that the vast majority of our program completion in-service teachers have stayed in the field. In terms of overall persistence in the field, 19 of our completed 22 are in the field, for an 86% retention rate. Of the students who left the field of teaching, one is pursuing higher education opportunities in graduate school full time, one did not pass ADEPT (a certification process required in South Carolina, and one of our measures of persistence), and one is working as a data analyst. Two of the individuals who left the field graduated from the college in 2012, and one in 2014, and did not make the 5-year mark within the profession. Of these Teaching Fellows, the one who left to pursue a graduate degree was a regular REMAST PLC attendee, while the other two were not post-graduation.

3. What leadership development is possible and appropriate for math and science educators when focused on research and working at pre- and in-service levels?

While our data plan initially called for us to administer the CALL survey, we are currently exploring other options that were brought to our attention by our grant evaluator, Greg Rushton. The CALL survey, while able to be administered online, required the survey to be administered site-wide for maximum validity and reliability, a constraint that was not feasible in the current project as our Fellows are in approximately 6 different districts. Initially, a representative from the CALL survey indicated that they would be willing to work with us on developing a usage for individual students. That being said, we are reviewing options in coordination with our evaluator to determine a substitution.

Based on his continued feedback after scholar, Teaching Fellow, and mentor teacher discussions, we question whether it is possible to meet the needs of all of the members our grant serves when considering leadership development, so we have decided to focus on those described below. First, we have focused on extending opportunities in the classroom for our current scholars, as our previous ones have indicated that they would have appreciated more field experience opportunities before student teaching at the secondary level. Opportunities have been provided as Supplemental Instructors (SI), Science Olympiad judges, Lab assistants, tutors, and leaders during informal science activities. In addition, Scholars have been provided on-line practice PRAXIS tests in their area of content. We focus our leadership development efforts with our Teaching Fellows by providing them PLC activities to present at conferences as the lead discussant as well as mentor current scholars and discuss their classroom protocol at the college's professional development meetings.

4. What aspects of research-focused, multi-level leadership development have the most impact on math and science teacher persistence and effectiveness?

Once again, this ties heavily to the previous question. The vast majority of our Teaching Fellows have been to professional conferences during their time as Scholars, and the majority of them also have taken advantage of at least one of the opportunities provided post-graduation. They have said anecdotally that these opportunities provide them an occasion to refresh, and new ideas to utilize in their classroom. Additionally, the Teaching Fellows that attended our college professional development sessions as students are also those that choose to participate more fully in the research aspect of the grant. Thus, seeing members of the team and each other on a regular basis also appears to be important to maintaining enthusiasm.

One issue that has become apparent within our data collection time was that our Teaching Fellows appear to have some level of dissatisfaction with the schools that they are working in. We have had several Teaching Fellows continually maintain employment in the field, but switch the schools that they are working in. While up until this point it has not affected their persistence in the field, there is a high possibility that if a Teaching Fellow doesn't find a school where they "click", it will eventually affect persistence in the field.

Summary

The goals for the REMAST Phase II program were outlined in the grant proposal as follows: 1) recruit 9 to 16 STEM majors into teaching; 2) provide educational support for Scholars; 3) provide professional development (PD) opportunities for grant participants; and 4) pursue a rigorous and innovative research agenda related to teacher retention, or persistence of math and science teachers in the teaching profession that involves tracking the Phase I participants. During Year 3 of the REMAST Phase II program, an update of goals 1-3 were performed in addition to the longitudinal research study (goal 4):

Goal 1 - recruit 9 to 16 STEM majors into teaching**:** To date, ten scholars have been recruited through the phase II duration. The current status and content area are as follows:

1) Scholar-Graduate 1: In Service Mathematics
2) Scholar-Graduate 2: In Service Mathematics
3) Scholar-Graduate 3: In Service Biology
4) Scholar-Graduate 4: In Service Biology
5) Scholar 5: Pre Service Biology
6) Scholar 6: Pre Service Biology
7) Scholar 7: Pre Service Biology
8) Scholar 8: Pre Service Chemistry
9) Scholar 9: Pre Service Mathematics
10) Scholar 10: Pre Service Mathematics

Additionally, during the January 2018 application period, 1-3 more scholars are expected through recruitment.

Goal 2 - provide educational support for scholars: Ongoing educational support has been provided to scholars through the following: 1) academic advisement, 2) field placements with Mentor Teachers, 3) Mayterm classes geared specifically toward Science and Math students – Course 1: Technology; Course 2: Content Literacy, 4) PRAXIS II content preparation material, 5) three professional development sessions per semester, 6) a summer professional development session, and 7) discipline specific conference attendance opportunities.

Goal 3 - provide professional development (PD) opportunities for grant participants: During year 3, grant participants (Scholars, Teaching Fellows, Mentor Teachers, and REMAST team members) attended and/or presented at discipline specific or education state, regional, national, and international conferences.

Goal 4 – pursue a rigorous and innovative research agenda related to teacher retention, or persistence of math and science teachers in the teaching profession that involves tracking the Phase I participants.

As we continue to collect data from our Teaching Fellows, much of our data analysis and preparation is in an ongoing state, per the longitudinal design of the study. We have found it useful to collect descriptive data from our Teaching Fellows, regarding their individual experiences in the field and how they are responding to challenges that they have met within their administrations and classrooms. Additionally, the challenge of getting "in-vivo" data from our Teaching Fellows is something that is likely shared by all Phase II programs, and we highly recommend the utilization of video-taping lessons. We believe that this removes some of the observer effects we may otherwise see in our classroom data from our teachers. In the upcoming year, our focus will be on ensuring that we collect leadership data from a valid and reliable survey, and are working with our grant evaluator and outside consultant to make sure that goal is met.

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Appendix I: End of Year Survey

Appendix II: Newberry College Lesson Plan