Work-In-Progress- SUNRISE: Schools, University 'N' (and) Resources In the Sciences and Engineering-A NSF/GMU GK-12 Fellows Project

Rajesh Ganesan, Donna Sterling, and Philip Henning
rganesan@gmu.edu, dsterlin@gmu.edu, henninph@jmu.edu

Abstract - **This WIP report is a continuation of the 1st and 2nd year work presented at the previous FIE conferences in 2008 and 2009 respectively. The WIP documents 4th year development, implementation efforts, and results of SUNRISE, a unique graduate Fellowship program at George Mason University (GMU) that targets graduate students working in the grade 4-6 school environment. SUNRISE is a new GK-12 project aimed at partnering STEM (Science, Technology, Engineering, and Mathematics) graduate students (Fellows) with school teachers from three different school divisions in Northern Virginia. The innovative practice aspect of the project is the construction of a framework that provides training, exchange of information, and integration of scientific research from diverse disciplines with teaching to make science exciting for students. A feature of SUNRISE that makes this project different from other GK-12 projects in the nation is that the project is housed in the School of Information Technology and Engineering which is unique in the nation. One of the contributions of the project is that it is focused on infusing Information Technology (IT) rich STEM concepts into K-12 education, which is also another unique feature. This WIP presents a summary of the project's impact on its key participants.**

Index Terms - Elementary and middle school, Fellow research and integration into K-12.

INTRODUCTION: THE SUNRISE PROJECT

A National Research Council panel [1] report urged the need for increased cooperation between universities and K-12 schools in teacher education and professional development for teachers of science and mathematics. The National Science Foundation's Graduate Fellows in K-12 Education (GK-12) program offers a unique opportunity to address the above need. SUNRISE is one such GK-12 program whose conceptual focus is to improve outcomes for elementary and middle school students in STEM subjects as identified and driven by the science needs at the schools in the participating school divisions. The objective of this project is to build a unique model of collaboration among elementary and middle schools, school division administration, and GMU to foster systemic efforts in implementing Information Technology (IT) rich STEM content-knowledge into grades 4-6 education by graduate Fellows, with the potential to enhance the delivery of science instruction and provide long term professional development for teachers. The WIP presented at FIE 2008 and 2009 focused on expected outcomes and samples of Fellows research that have been integrated into the Grade 4-6 curriculum respectively. This WIP documents the impact of the project on its participants. The project serves as one source of evidence that demonstrates the importance of the process of building partnerships among university's STEM departments, schools of education, and the K-12 STEM education that would strengthen the nation's educational enterprise.

IMPLEMENTATION

The 4th year implementation started with the recruitment of Fellows and teachers in April 2010. The program supported 8 Fellows from STEM disciplines who are paired one-on-one with 8 teachers, one pair per school. The schools chosen were those with high percentage of minorities from low socio-economic backgrounds. Fellows came from engineering, computational sciences, environmental science, physics, mathematics, and microbiology. 25% of the Fellows were women graduate students and 33% from other ethnic minorities. The fellows were given a two-month long training program by the project co-PI from the College of Education and Human Development. The training included an understanding of the Virginia State Science Standards of Learning (SOL) [2], preparing and delivering of sample lessons, and discussing general topics on pedagogy particular to elementary school teaching. The Fellows worked out a schedule with the teacher at the Fellow-Teacher meeting just before school reopening in September 2010. The Fellows began their visits to classroom, identified the science needs with the teacher and began contributing to the enrichment of the lessons and discussing the science behind the lessons. The Fellows were introduced to the children as Scientist, Researcher, or an Engineer. Thus, a strong foundation was laid for a long-lasting partnership between the school and the university.

PROJECT'S INNOVATIVE PRACTICE APPROACH

The salient features of the project's approach to infuse cutting edge STEM topics into K-12 curriculum are as follows.

- Regular classroom assistance in both preparation and teaching by the Fellows along with teachers
- Fellows serve as resources for the teachers and work toward improving the content of science and mathematics taught in their classes
- Fellows lead the post-experiment discussion about the science behind the experiments
- Fellows encourage the use of Technology for teaching, incorporate the use of graphics and computer based models, to increase level of perception.
- Develop new IT rich STEM modules and lessons from Fellow research areas and infuse them into elementary school environment through hands on experiments
- Engage in after school programs, Discovery clubs, School science days, Judge County Science Fair projects, answer questions dropped off in the "Question Box", and participate in field trips.

PROJECT IMPACT

Evidence of innovation in lesson development and the integration of graduate fellow research into the classroom presentations were found in classroom visits by the evaluator, fellow interviews and surveys and in reports and papers produced by the fellows and as verbal reports at project meetings attended by the evaluator.

Fellow professional growth: Fellows report self-perceived gains in building strong teacher collaborations, ability to work on heterogonous teams and in developing teaching skills. It is reasonable to assume that gains in these areas will spill over into the professional lives of the Fellows as they assume responsibilities in teaching, on research teams and in building interdisciplinary collaborations in both academia and in industry after they have completed their degrees. Fellows also report strong gains in teaching and working in teams as a result of designing and delivering the annual summer camp. Fellows, teachers, and Fellow's research advisors strongly agree that there have been strong gains in the ability of Fellows to both communicate science and specifically their research in the schools and to present research in departmental seminars and other university settings.

Teacher Professional Growth: Teachers continue to describe real gains in their own professional growth and STEM content development that is directly attributable to the activities of the Fellows. This high quality of teacher professional development is a highlighted finding for this project. The project model of sustained, weekly visits by the Fellows to the same classrooms over the year has paid high dividends in the depth and quality of the professional collaborations that have developed. Openness in communication between Fellows and teachers and the project staff has strengthen these bonds as well. The quantity and quality of Fellow-developed inquiry based hands on lessons and the enthusiasm of Fellows in delivering these lessons has had a significant effect on the middle school students in the participating classrooms as evidenced by teachers' comments on the teacher survey. The quality and innovative nature of these Fellow created lessons is a highlighted finding of this report.

Impact of Project Activities on the K-12 Students: Teachers saw a positive impact on students as a result of their participation in the project. The Fellows continue to develop new innovative lessons of a high quality and to modify lessons in the existing curriculum. The variety, innovative quality and depth of these Fellow created lessons indicate that the students are being provided with engaging STEM activities. As the teachers are most likely the best judge of their students' learning, it seems reasonable to infer that the project is having a strong positive effect on student STEM learning.

FELLOWS RESEARCH AND INTEGRATION INTO K-12

Fellows have brought their research and advanced STEM topics into their classroom in the form of lessons. The examples of lessons include: 1) studying properties of most superconductors in which students are shown how the fundamental, underlying properties are used in Electronic Structure calculations to help explain and predict the quantum mechanical superconducting trend, 2) the environmental triggers and public policy regarding breast carcinoma, 3) stochastic modeling and a lesson on the statistics based prediction, 4) identification of molecular targets for Francisella biofilm formation, 5) noise reduction for improved Cathelicidins: A Family of Antimicrobial Peptides, 6) computers in Mathematic "Synthesis Cells", 7) hydrodynamic model of atmospheric capture by Charon with applications to Extrasolar Giant Planets, and 8) population structure of river herring. Additionally, fellows also enriched several lessons from existing curriculum.

REFERENCES

[1] Brunkhorst, H., and W.J. Lewis (co-Chairs), Educating Teachers of Science, Mathematics and Technology: New Practices for the New Millennium, National Research Council, in press, 2000, http://books.nap.edu/catalog/9832.html.

[2] Virginia State Science Standards of Learning (SOL) URL:http://www.pen.k12.va.us/go/Sols/home.shtml

AUTHOR INFORMATION

Rajesh Ganesan Assistant professor, Systems Engineering and Operations Research, Project Director of SUNRISE, George Mason University, rganesan@gmu.edu.

Donna Sterling, Professor, College of Education and Human Development, George Mason University, dsterlin@gmu.edu.

Philip Henning, Adjunct associate professor, Project evaluator, James Madison University henninph@jmu.edu