Ret Site: Inspiring Educators in Rural America through Research

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INTRODUCTION

The main objective of the South Dakota School of Mines and Technology (SDSM&T) Research Experience for Teachers (RET) Site: "Inspiring Educators in Rural America through Research" is to provide an authentic research experience to practicing middle and high school science, math, and technology teachers. It is our goal that from this research experience the teachers can take back to their classrooms experiences, knowledge, and demonstrations which they will readily share with their students. After having completed two summer sessions and subsequent workshops of our RET program we feel very confident in endorsing this model of professional development as effective and noteworthy. We will review the program and summarize lessons learned.

The objectives of the SDSM&T RET Site are:

1) to provide ten (10) sixth through twelfth grade teachers (RET Research Assistants) the opportunity to work side-by-side with undergraduate students, graduate students, and faculty mentors in the exciting enterprise of research;
2) to provide RET Research Assistants an experience from which they can draw ideas and develop skills that they can then transfer to their own classrooms;
3) to provide an environment to develop methods to transfer the excitement of research to 6-12th grade students; and
4) to provide an opportunity to form lasting professional relationships and collaborations between teachers and between teachers and mentors; e.g., course material development on-campus field trips, summer research and visiting scientist and engineers to middle and high schools.

The primary vehicle to attain our goals is the "on campus" research component. During this five week intensive, on-campus immersion in research the RET Research Assistants (RA) are expected to be an integral part of the research being undertaken by faculty and select graduate and undergraduate students assigned to their particular project. To prepare RET RA's for this relatively short research window, prior to coming on to campus RET RA's take part in an Advanced Preparation (AP) component of the program. During the AP experience the RET RA's are expected to become familiar with the literature provided by their faculty mentor and to ask questions via email or face-to-face as logistics allows to begin the professional dialogue on the topic. When RET RA's arrive on campus a short amount of time is given to orientation activities and introductions and then it is full speed ahead on the research tasks to be explored. Besides the research there are a number of activities scheduled both during the on-campus experience and after. These are designed to enrich the core research experience (See Table 1).

Table 1 Activity Timeline.

Activity	Purpose	Coordinator	Timeline
Summer Research Preparation	Provide RET RA's with research background; assess needs of faculty mentor; assess ability and understanding of RET RA's; on campus visits	Dr. Winter Mr. Miller	May-June
SDSM&T Orientation	Campus orientation; library facilities; computing facilities; research instruments; safety procedures; entrance survey	Dr. Winter Mr. Miller Library Staff	Week 1
Scientific Instrumentation Seminars	Learn purpose of instruments and develop operating skills	RET Faculty and SDSM&T Staff	Weekly
Internet and Library Search Seminar	Learn to use the Internet for research searching	Dr. Winter Mr. Miller Library Staff	Week 1
Formal and Informal Meetings	Research presentations by RET RA's to share experiences; open-ended discussions on relevant topics	RET RA's Mr. Miller Dr. Winter	Weekly
Brainstorming Sessions	Identify methods to transfers freshly gained knowledge into 6-12 classrooms. Strategies and techniques will be discussed from two texts, Understanding by Design by G. Wiggins and J. McTighe; and Concept-Based Curriculum and Instruction by H. L. Erickson.	Mr. Miller	Weekly
Brown Bag Lunch Discussion Series	To discuss research topics to build camaraderie	Mentors and Guest Scientist and Engineers	Weekly
Social Activities	To build camaraderie between RET participants and faculty	Dr. Winter Mr. Miller	Bi-Weekly
Final Presentations/ Research Symposium	Poster and written reporting of research experience for immediate and future presentations	Dr. Winter RET Mentors	Week 4
Exit Interviews	To assess participants' perceptions of the RET experience; survey	Dr. Winter	Week 4
Workshops	Assist in developing lesson plans; Develop student assessment instruments; review student assessment results	Mr. Miller Dr. Winter	Fall term and Spring term

LESSONS LEARNED

Advertisement/Recruitment It is likely that issues regarding recruitment will have regional nuances that are peculiar and need to be addressed. We will review lessons that have been learned that are both specific to this program and have general application. To frame this discussion it is important to identify major factors which influence 6-12 teachers' decision to participate in such a program. Such factors include: 1) residential versus non-residential; 2) location; 3) pressures from competing professional development activities; 4) topics available; and 5) bettering professional practice versus down time in the summer.

The SDSM&T RET Site is a residential program that is located in western South Dakota. The region we wish to impact includes South Dakota and adjacent regions of North Dakota, Montana, Wyoming and Nebraska; hence the region includes a radius of approximately 400 miles. In its short history the SDSM&T RET has established itself as the premier summer professional development program in the region. In regards to topics a

conscientious effort has been made to attract faculty mentors and hence projects from a broad array of sciences and engineering.

Within this framework we have found that advertisement of the program must begin in the fall. This has been accomplished by mailing informational postcards to cognizant administrators and teachers and presentations to the South Dakota Science Teachers Association conferences as well as to individual school districts where applicable. To attract teachers of Native American students, an emphasis of the SDSM&T RET Site, we hold informational meetings at regional tribal colleges, middle and high school schools, and events which attract teachers of primarily Native American serving schools, for example the Lakota Nations Invitational.

Mentor and Project Selection Careful selection of faculty mentors and projects is necessary to maximize the impact of the research experience on the RET RA and on the research project. In regards to the selection of the mentor we have found several criteria that will enhance the success of the program. These criteria are: 1) the mentor must be willing to engage the RET RA as mature learners and teachers; 2) the mentor or her/his designee must be available each day for consultation whether face-to-face or via electronic medium; and 3) the mentor must be willing to carefully design a project that has sufficient introduction and yet ramps up quickly to allow the RET RA a chance to become actively engaged in the research enterprise.

We have found the RET RA's to be highly motivated and curious and from a diverse background. The projects that have been provided to the RET RA's do not necessarily directly connect with the subject area that the RET RA is responsible for when they return to their home institution. For example, the friction stir welding of titanium is a project that does not directly connect with a subject taught in 6-12. However, this has been a strength, in that it provides a new area for the RET RA to explore while presenting to the RET RA an opportunity to gain intimate insight into the fundamental steps of research. The criteria for the selection of a successful project include: 1) a carefully planned and outlined research agenda; 2) sufficient background information which, must be assembled to kick-start the effort during the Advanced Preparation phase of the program; and 3) the willingness of a faculty mentor to commit time and resources to a RET RA during the course of the five weeks on campus.

Research Experience Coming into the RET program, RET RA's are unsure of what their actual role in the research will be. After their participation in the summer research experience the RET RA's share that they anticipated and expected to do mostly observing and discussing of what they observe, developing lesson plans (which is part of the program) and generally acting as a guest in the various research labs scattered around campus. In reality the RET RA's find that expectations are high and they are welcomed into the research environment being called on to conduct research as a valued member of a team or in some cases as the sole researcher under the guidance of the faculty mentor. The RET RA's have access to and receive training on all necessary research instrumentation that is needed to accomplish their research objectives. It is because of this access and expectations that the RET RA's experiences to this point have been so rewarding from their point of view. From both the faculty mentors and from the RET RA's perspective they are truly receiving an authentic research experience with all the successes and setbacks that come with the enterprise. From this experience RA's go back to their secondary classrooms rejuvenated, confident, and eager to transfer their experience to students.

RET RA's are expected to develop and instructional unit to be carried out in their classroom during the year following their research experience. Because of the high level concepts' being dealt with in the on-campus research it can be difficult to directly transfer these concepts to the secondary classroom. With this being said, many instructional units explore some of the basic conceptual underpinnings of the research and or the basic premise of research and the scientific method. For example, eletrophoresis is a valuable tool to utilize in biology for genetic engineering. One RET RA, after having learned to use eletrophoresis, developed a laboratory module utilizing electrophoresis to demonstrate the concepts.

CONCLUSIONS

To date the following are key lessons learned and contributing factors that we have found contribute to a successful 6-12 RET Site program:

- Early and targeted recruiting is necessary to attract the most motivate cadre of RET RA's. Their task will be daunting and it is necessary to attract those with the interest and motivation to persevere.
- The need for clearly stated and attainable goals and objectives – In our particular situation we have RET RA's on research projects throughout campus. Each project is at a different point in its progression. Some are in the conceptual stage and some are in the "well oiled machine" data collecting, defined protocol stage. Because of these differences we asked our faculty mentors to develop goals and objectives for a five week experience with the understanding of the backgrounds (i.e. secondary science teachers) that the RET RA's were bringing to the table. With clear goals and objectives in place this allowed for a much more efficient progression through the five weeks.
- Faculty mentor or the equivalent availability – It is important for RET RA's to have resources either a phone call away or a short walk down the hall away to answer questions and guide when necessary. Roadblocks will occur and when they do a contact protocol should be in place to eliminate down time in the lab with either the faculty mentor themselves or graduate or undergraduate student contact information available. Even though the RET RA's are professionals in the classroom and often times have an extensive undergraduate research background, they will be hesitant to proceed at times without clarification.
- Partner with likeminded faculty – It is important to partner with faculty that see the value in outreach efforts as well as treating RET RA's as an integral part of the research they want to conduct.

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