RURAL TEACHERS LEARNING BIOANALYTICAL ENGINEERING: DESIGN AND DEVELOPMENT OF LEARNING, TRANSFER, AND COMMUNICATION SUPPORTS FOR RURAL SECONDARY MATH AND SCIENCE TEACHERS

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Professional development opportunities provide teachers with enhanced learning experiences, deeper subject knowledge, and improvement of their teaching practices, all for the goal of increasing student achievement (Nelson, 2009). Unfortunately, most rural teachers have much less access to professional development opportunities compared to their urban and suburban peers (Hardré, P.L., et al., 2014). A Research Experience for Teachers (RET), which is a National Science Foundation (NSF) funded program, was created for rural high school math and science teachers in collaboration with the University of Oklahoma and the Center for Bioanalysis. As participants, teachers applied and were accepted to participate in a seven-week summer research experience to connect bioanalytical engineering and their research experiences into their classrooms and to stimulate their students' critical thinking skills. The following narrative and analysis chronicle the teams' design, development and learning experience in redesigning the seven-week professional development for rural science and math teachers.

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INTRODUCTION

Professional development opportunities provide educators with new strategies to improve student learning within their classrooms (Hardré, Nanny, Refai, Ling, & Slater, 2010). Unfortunately, rural teachers often have limited access to professional development opportunities due to geographical isolation and limited access to internet technology (Hardré & Hennessey, 2013). Furthermore, they may find it challenging to utilize generic professional development activities designed for urban and suburban classrooms (Hardré & Hennessey, 2010). Compared to urban and suburban educators, rural teachers face unique differences, such as teaching multiple courses or grades, having students focused on local industry as their career pathway, and extreme resource and technology limitations. Finally, rural teachers often struggle with rural students' perceptions that advanced science and math topics are abstract and disconnected from their daily lives and life experiences. Therefore, it is critical to design professional development opportunities in advanced math and science topics that are logistically accessible to rural secondary teachers and are readily relatable to rural activities, careers and communities.

This professional development program specifically targeted rural secondary science and math educators, a group often overlooked or missed by traditional professional development opportunities (Hardré, et al., 2010; Poats & Taylor, 2015). The goal was to provide an authentic research experience and pedagogical support for educators, as well as increase student achievement and interest in math and science.

Within the boundaries of the National Science Foundation (NSF) Research Experience for Teachers (RET) grant construct, a team of graduate students from the instructional design and technology program worked closely with faculty experts (in education and science/engineering) to redesign and develop the strategic instructional and support materials for the participating rural teachers. The overarching goal of this program was to increase rural teachers' knowledge and interest in advanced applied sciences like bioanalytical engineering, and to increase their instructional practice skills, so they could transfer this knowledge and interest to their students. The secondary goal was to provide an authentic experience for education graduate students in the instructional design program.

PARAMETERS FOR THE DESIGN

Since the NSF RET grant was already funded and operational for over a year before the graduate student team began their redesign and development of the professional development strategy and structure, they had to work within the boundaries imposed by the established goals and target outcomes of the grant. The RET program was created to specifically serve rural teachers who lived more than 50 miles from a major urban area or large university. It was difficult to find comprehensive and nuanced demographics on rural teachers in this southwestern state; therefore, most learner information came from the data and experience of the Primary Investigator (PI), Dr. Patricia L. Hardré, who has conducted extensive research with this state's rural schools and districts.

The NSF grant provided a seven-week laboratory research experience in bioanalytical engineering where each rural teacher was partnered with a university faculty member as a research mentor. During this period, the rural educators conducted research in the faculty member's laboratory, and engaged in pedagogy workshops, seminars, and industry field trips. Within these parameters, the RET instructional design team was responsible for the content, design, development, implementation, and evaluation planning of the professional development activities. The team consisted of five graduate students in Instructional Design and Technology; Shaida Morales, Regina King, Shichen Guo. Qianyun Peng, and Hui Xu. A few were already employed in design and technology professional jobs, one, Laura Lewis, was a secondary science teacher, and several others had been K-12 teachers in their previous careers. Their diverse and practical experiences gave them valuable insights regarding the perspectives and needs of rural teachers. The design team was supervised by Dr. Patricia Hardré, one of the PIs on the grant and a Professor of Instructional Psychology & Technology, in the College of Education.

TEAM STRUCTURE AND COLLABORATION

This exercise provided six graduate students (i.e., authors three through eight) with an authentic experience in instructional design that included key tasks and roles familiar from their previous graduate courses, as well as responsibilities and duties associated with professional instructional design careers. The design team met once a week to discuss the progress of assigned tasks and to troubleshoot problems. Between meetings, communication occurred through a shared Google document folder specific for the program. In the folder, documents concerning the task timeline, problems or questions, meeting notes, and goals of the program were posted. Regina Kenton, the knowledge manager, maintained meeting notes while the project manager, Shaida Morales, updated the timeline as tasks were accomplished.

The design team collaborated and worked with other entities at the university. Figure 1 illustrates how each entity collaborated on the RET program.

The Center for Bioanalysis (CBA) provided the program with expert knowledge and research mentors along with state-of-the art labs and facilities. CBA was created for researchers and bio-scientists to collaborate on transformative research to benefit the university and global communities (http://www.ou.edu/cba/). The rural high school science and math
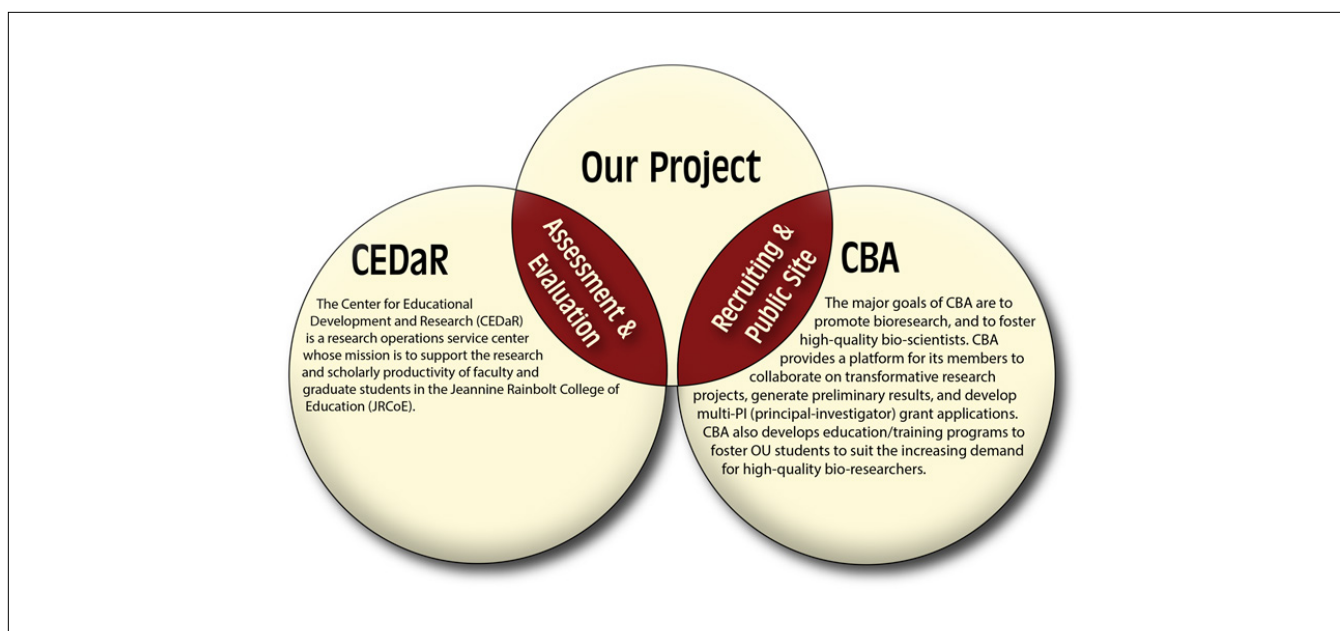
FIGURE 1. RET III support sites and roles.

teachers spent a large part of their on-site time with research mentors in the CBA laboratories. Recruiting, organizing and managing people and information from CBA was led by the other program PI, Dr. Mark Nanny, a Professor of Engineering with expertise in Bioanalytical Engineering.

The Center of Educational Development and Research (CEDaR) was contracted to develop and manage the program evaluation. CEDaR staff provided technical support to the design team on some major technology tools: the Learning Management System (LMS) and the survey and assessment tool (Qualtrics). CEDaR housed the teacher applications and conducted ongoing data collection for the RET program.

The RET program's two PIs, Dr. Patricia L. Hardré and Dr. Mark A. Nanny were the subject matter and strategic experts (SMEs) leading the design team in their redesign. The PIs have experience with teacher professional development programs and were leaders in the three previous RET grants. Dr. Mark A. Nanny was the program's liaison with the CBA and developed RET's focus on Bioanalytical Engineering, a blending of engineering with bioanalysis. Dr. Patricia L. Hardré has spent more than a decade conducting research in rural education and motivation, creating the SUCCESS model for design, an essential learning component of this RET program.

PROGRAM FRAMEWORK

The RET program included four major components: 1. Rural teacher recruitment conducted through the CBA, 2. On-site research and pedagogy programs at the university and CBA laboratories, 3. Rural school classroom program (off-site), and

4. Establishment of a community of learners networked by the learning management system (LMS). Figure 2 depicts the program components and sequence.

Recruitment included emails to principals of rural schools to invite the target population or rural science and math teachers. Later, the emails became more targeted as two team members, Regina King and Laura Lewis, began to compile a teacher email list using information on school's public websites. The emails included a flyer detailing the basics of the program as well as a link for a more detailed description of the program. Emails were sent multiple times during the recruitment process.

The on-site experience of the RET program utilized classroom, laboratory, and online learning. While on-site, educators engaged in team-based laboratory research and a web-based community of learning and practice (via the LMS). The decision to use a combination of face-to-face learning and the LMS-based learning community was because teachers were in separate labs across the university campus during the on-site experience and since they would be spread throughout rural areas during the year-long, off-site experience.

In the laboratory research groups, rural teachers worked with expert mentors to learn the core concepts of bioanalytical engineering along with developed skills for a host of research methods and tools. In the labs, the research mentors (who were experts in various areas of bioanalytical engineering), served multiple critical roles as coaches, lead lab researchers, and expert guides for the rural teachers. As a cohort, teachers engaged face-to-face in structured pedagogical workshops that provided tools, strategies, and

practices for transforming their teaching. These workshop topics included inquiry-based learning environments, action research, and the SUCCESS motivational design model.

As applied evidence of their learning and transfer of their research experiences into their secondary classrooms, each teacher developed a Transfer Action Research Project (TARP), which included: 1) a curriculum integration (lesson, activities) for their students based upon their RET summer research, and 2) data collection as evidence of their students' learning and development as a result of the RET curriculum integration. TARPs were facilitated through weekly workshops and individual meetings with the PIs, providing instruction and practice in grant proposal writing as an integral skill. The TARPs also allowed teachers to develop a budget to purchase materials and equipment for their proposed classroom activities that were financially supported by the RET program.

DEVELOPMENT OF INSTRUCTIONAL MATERIALS

The design goals for the instructional materials focused on facilitating rural teacher professional development with the potential to improve math and science instruction in rural secondary schools, by implementing engaging, authentic activities and research projects. The program consists of four components as seen in Figure 2. The design team for this iteration of RET (in its ninth year) was tasked with the following objectives:

1. Close gaps in understanding of bioanalytical engineering and its impact in the math and sciences with rural educators.

2. Redesigning the role of mentors and educators to strengthen the learning community on-site and across future and past programs.
3. Design generative and relevant resources to support knowledge transfer from the program to the classroom.
4. Develop assessments for program evaluation that better measure learning from all domains (affective, cognitive, and behavioral).

Due to the project scope and lack of expert knowledge in Bioanalytical engineering, the team focused on the objectives 2-4 while supporting content creation when necessary. Program content also included workshops on skills necessary for the successful transfer and integration of research experiences into curriculum activities in the classrooms which included pedagogical content such as the SUCCESS model as well as content in the area of Bioanalytics. In addition, the instructional design team developed a course using the university's LMS for organization and management of materials, communication and support (Figure 3). The LMS was designed for long-term use so to build access and communication among a larger network of shared expertise through the multi-year (multi-cohort) community of learners (i.e. rural teachers, faculty research mentors and the program PIs).

To accomplish these design goals, the professional development instructional materials had to be authentic and aligned with clear goals, constant collaboration, student engagement as a focus, and individual choice allowing teachers to tailor their instruction (Garet, Porter, Desimone, Birman, & Yoon, 2001). The professional development specifically focused on the teacher's rural communities and environment by connecting bioanalytical research experiences to
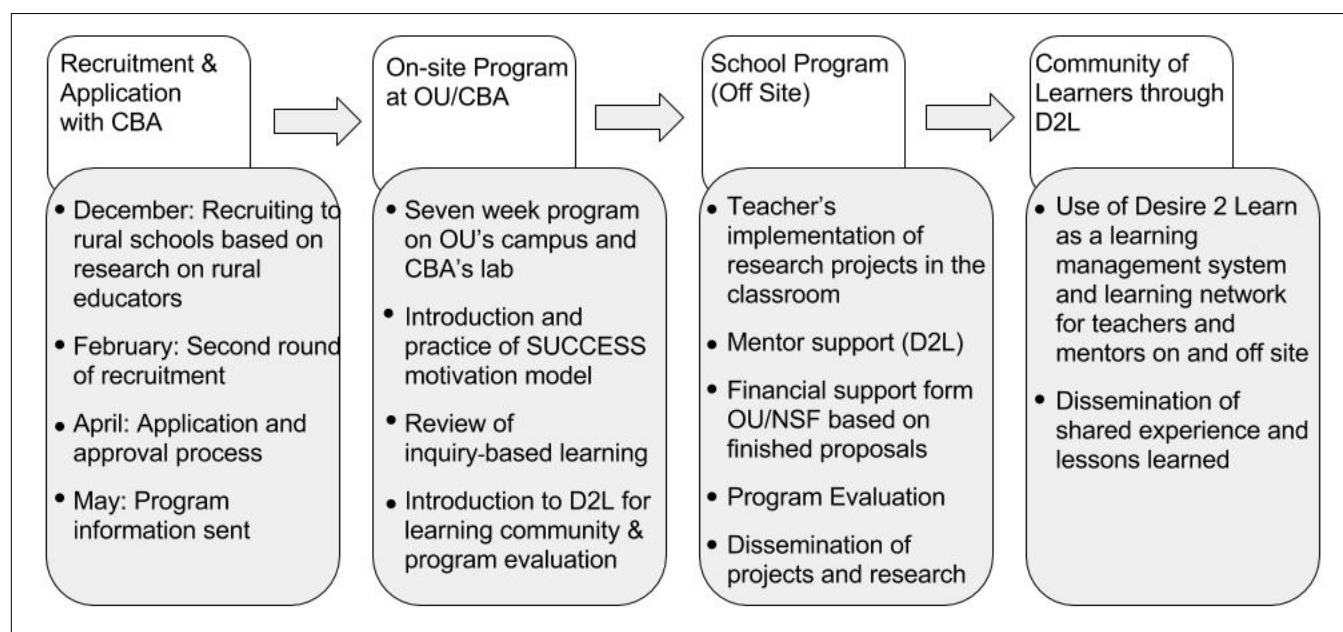

FIGURE 2. Theoretical Framework for RET III program and its components.
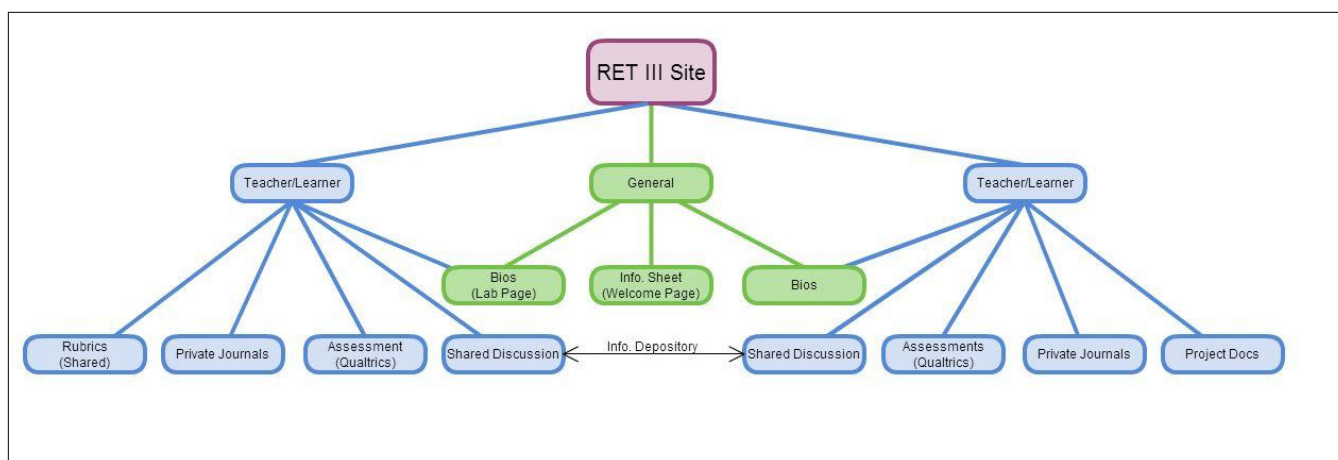
FIGURE 3. Organization of the learning management system.

the state's predominant rural industries of agriculture (wheat, cattle, cotton, and nuts), and energy (gas, oil, and increasingly wind). Educators explored the economic drivers in their communities, attended field trips, and collaborated with guest speakers. The team developed relevant content and learning experiences to connect Bioanalytical Engineering to local industries. The goal was to explore innovations that could address local projects and future community issues and development.

The workshops and transfer tasks required fully scripted presentation materials, plus job aids to facilitate learning and transfer. Each content and task component also required incremental and outcome assessments. While the team worked together to finalize and critique materials, some task were assigned based on specific skills. For example, Shichen Guo who worked for CEDaR, was familiar with the assessment tool, Qualtrics, so she designed the assessment tools for the research component of the program. Because of her technology skills, Shaida Morales the project manager, developed the images and the D2L site. For each workshop, the assigned team member researched the topic, interviewed subject matter experts, and developed the PowerPoint presentation, instructor's manual, the participant manual, and job aids (handouts or fact sheets with just-in-time information). Once completed, the workshop materials and assessments were critique and approved by the entire team.

The design team brought diverse design experiences and skills to RET program development. Design templates were created to keep consistency of style and formatting across workshop content and materials. Alignment of instructional materials both print and online with a master template helped produce deliverables that maximized participants' learning effectiveness through the organization of information and minimizing cognitive load (Mayer & Moreno, 2002). Educators could focus on the content and text rather than how each handout or slide presentation was different in

style and writing Figure 4 shows the approved templates of the materials and the LMS site.

To collaborate effectively, the team met synchronously each week and frequently communicated by email, text, and via online chat. Continuous communication each week provided focus on continuity in design and opportunity for knowledge management to stay up to date.

The design goal of developing assessments for program evaluation was made possible through the partnership with the university's Center for Educational Development and Research (CEDaR). Informational workshops, lab projects, lesson writing and project development all required incremental and outcome assessments. While the team worked together, the project manager utilized each team member's individual strengths. For example, Shichen Guo who worked for CEDaR, was familiar with the assessment tool, Qualtrics, so she designed the assessment tools for the research component of the program. Because of her technology skills, Shaida Morales the project manager, developed the images and the D2L site. Other team members each developed at least one of the workshops and/or the job aids. For each workshop task, the assigned team member researched the topic, interviewed subject matter experts, and developed the PowerPoint presentation, instructor's manual, the participant manual, and job aids materials. The team came together to evaluate and approve the coherence of the materials and overall program content.

UTILIZING D2L AS AN LMS AND COMMUNITY OF LEARNERS

The LMS used for the RET project was Desire2Learn (D2L) which was the university's LMS. Teachers were trained on utilizing D2L during the first week of summer on-site program orientation. Within the D2L space, participants engaged in guided and open discussions, completed assessments, and uploaded project journals and documents. Mentors
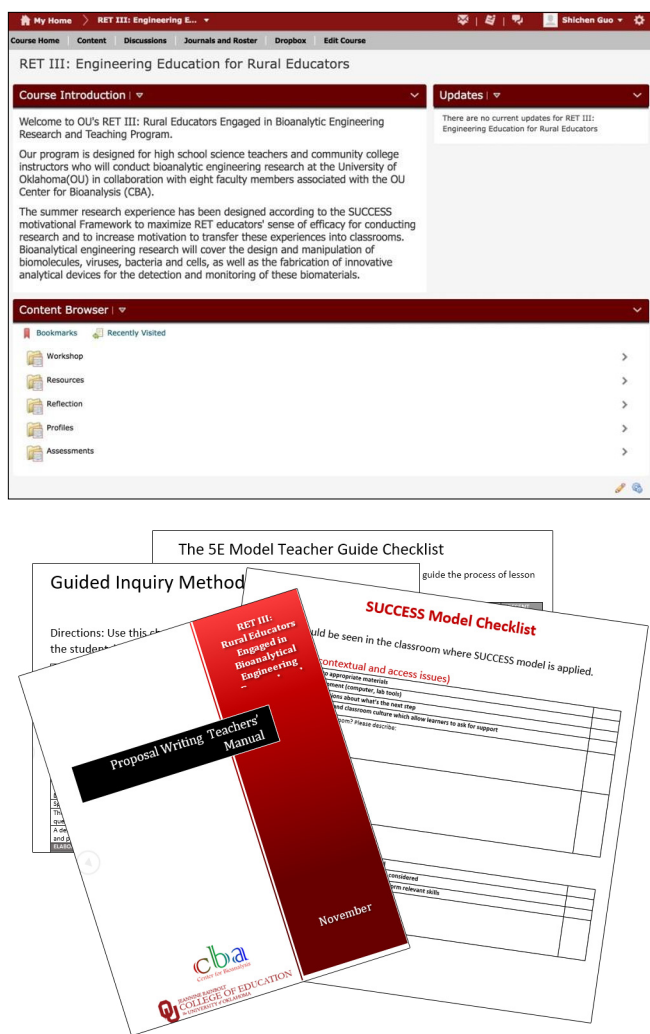
FIGURE 4. RET III D2L home page and handout.

communicated with participants and accessed participants' journals, discussions, and assessments, and provided feedback documents (rubrics). D2L was a comfortable platform for mentors to engage and the design team had access to redesign the space to look more like a community rather than a college course. Certain element of the LMS like exams and assignments were revised to accomplish this.

In addition to the program information and instructional content, mentors and participants shared their biographies on the home page of the RET program on D2L. The goal was for mentors and participants to build relationships with each other. This accomplished an instructor-learner and learner-learner interaction in the online environment. (Garrison, Anderson, & Archer, 2010). Making connections early (before the learning began) would create community and identity related to the explicit program goals of instruction and expertise development, in addition to building trust and comfort. The trainers noted how conversations regarding

information in peer bios led to participants sharing their social media sites and following up in broader contexts.

Sources of participant information and knowledge shared within the learning community included: workshop content and commentaries, journals, open and guided discussions, idea-sharing and feedback, progress assessments and data management. As learning opportunities, these sources benefitted from sharing and feedback at various levels (i.e., research mentors, teachers, and team members), however this dynamic feedback could potentially alter their nature as fixed data points for program assessment and evaluation. In some cases, the timing of feedback, or exactly who provided it, could impact effects on learners and learning, or on evaluation outcomes. The design team continually weighed these tradeoffs as they made design decisions about what to share with whom and when. The ongoing processes of analyzing nuances in design of communication and feedback within a digital learning community presented a continuous exercise in design thinking for the team.

After completion of the on-site RET program, rural teachers continued participating as they transferred their on-site learning to their students in their secondary rural classrooms. At the time of this writing, rural teachers were implementing this transfer phase. In addition, teachers used the LMS to complete incremental assigned assessments and receive continual on-line support from mentors.

From the outset of the design exercise, even before the rural teachers applied, the design team had to imagine years ahead, considering not just what teachers and mentors would need and want in their on-site experience, but also what they would need and want to stay in continual contact and to facilitate effective and efficient collaboration through the entire off-site year of the project. This effort included all the implementation, assessment and communication activities needed to transfer, and then document this transfer to properly perform the required grant evaluation and to assist in reflective design improvements. These tasks were complicated by the participant teachers being distributed across remote rural areas of the state, some of which suffer from a substantial lack of technological and internet resources. As teachers moved through the off-site phase of the project, the team had to monitor what was working well and not so well, managed any small, workable adjustments, and made notes of larger refinements for future years.

REFLECTIONS

Issues with Information Technology (IT)

A critical design strategy (and resource) of RET was D2L, the LMS where all instructional content, assessments, and activities were housed or linked. Its design was strategic and sound, based on both published research and our team's experience with previous teacher professional development.

The RET design team spent about three months creating content and customizing D2L. Content setup was largely within the team's control, but teacher access (the final, transitional step) turned out to be more complicated than previously indicated compared to prior RET projects that utilized D2L due to administrative issues and process to get the participants access.

For research and program management purposes, the RET design team expected to have easy access at the administrative level to collect and organize mentors' and participants' inputs on D2L including discussion, journals, and assignment submissions. We also determined the teachers would also prefer to have a printed form of the workshop materials as suggested by Laura Lewis because of her experience of teaching and attending professional development. This decision became critical as an issue developed with the LMS. Due to recent institutional policy changes and shifting roles in IT-related administrators, enrolling non-student participants in the D2L system morphed from a simple process to a time-consuming, procedural nightmare. This resulted in teachers arriving on campus without access to RET materials posted on D2L for a week. In response, the design team enlisted CEDaR to bypass some institutional constraints, to distribute and collect program assessments from the teachers. The initial journal entries were also submitted through email submission to the RET graduate assistant. Unfortunately (and unlike previous RET participants) this cohort of teachers and mentors did not engage much in the discussion forums. We believe this lack of engagement was largely due to the lack of access during the crucial first few weeks of the program, so they never felt fully connected via the LMS communication network.

We knew our learners would need flexible (add-to) resources, and many of them preferred paper, because technology is not always reliable or well-functioning in remote rural school districts. A backup plan is always good to have to deal with unexpected challenges and ensure the program goes smoothly. Therefore, the RET team had already printed out hard copies for teachers to ensure they received the essential RET materials in time. Fortunately, this element of our advance design was adaptive enough to bridge the time it took to navigate the new policies-on-technology challenge that made it so difficult to get them engaged with the LMS.

Recruitment and the State Budget Crisis

As a result of a needs analysis and thoughtful design, the RET team set out to reach out to secondary math and science teachers in small and remote rural communities around the state. The grant explicitly excluded teachers in schools within 50 miles of large urban centers and large higher education institutions. This RET program commitment to truly remote rural schools and teachers constrained our recruitment beyond a specified sample. The boundary was determined

to focus on teachers who live beyond a 60-mile radius from the two major cities in Oklahoma: Oklahoma City and Tulsa. The program's GA Laura Lewis used a map as well as district information from the Oklahoma State Department of Education website to generate a rural school list to recruit rural high school science and math teachers.

An unexpected systemic event that occurred during recruitment was a set of massive state-wide budget cuts that hit hardest in the poorer rural school districts (Perry, 2014; Leachman, Albares, Masterson, & Wallace, 2016), forcing some schools to eliminate STEM programs while other districts closed altogether (Willert, 2016). These draconian budget cuts to education caused the state's educators to reverberate with anxiety over the future of common education. Schools were switching to four-day weeks, arts programs were disappearing, and teachers were being terminated (Habib &, Eger, 2016).

Several rural teachers expressed interest in participating, but after enactment of the budget cuts, they told us they didn't know if they would still have jobs next year, so they would not commit to a program that included applied practice in their rural school classes during the following academic year. Others said they already had been terminated by their current districts and were looking for new jobs, which might not be rural, or not even in the state. Because the state's financial landscape was a crisis of uncertainty, and teachers worried about their basic needs, an intensive professional development program like RET seemed a luxury they could not currently afford. The NSF RET grant was funded to support 12-16 teachers annually, but because of the state budget cuts, this year's cohort was only four teachers.

Despite these multiple challenges, teachers could still learn and collaborate together in activities that brought the entire cohort together (workshops, seminars) and in the whole-cohort digital interactions (discussions). However, having only 1-2 teachers in a research laboratory, instead of the desired number of 3-5 teachers, clearly limited the face-to-face team dynamics in the labs. In past RET programs, the group dynamics in the teacher research teams were repeatedly noted as one of the most profound and important learning experiences of the entire RET program (Hardré, et al., 2010). These research teams were instrumental in firmly establishing a long-term community of peers that was immensely supportive to these rural teachers during the off-site activities.

The design team created these features of the program for the grant-based (and funded) cohort size and for recruiting in a normative (not crisis-driven) political and economic environment. Recognizing that multiple things had changed, the design team had to reconsider those elements with the current difficulties, in contrast to what had been originally anticipated.

The team met at length about possible revisions to the design that could produce a greater cohesiveness among the RET participant cohort, so they have greater exposure to peer rural educators. They looked exhaustively at any idea that might address the needs of this suddenly small and potentially lonely cohort. They weighed the tradeoffs implicit in these possible changes against the value of consistency in the experience across time, if future cohorts returned to the expected size, or if other IT, economic or political factors changed. They considered the possible effects of their proposed changes on learner outcomes as well as other issues such as validity of assessment. They ended up not redesigning any of the substantive or procedural features of the program or instruction due to the risk of damaging the validity of the long-term evaluation process. However, this conversation, with its extensive analysis of short-term and long-term issues and outcomes, required tremendous depth and breadth in design thinking.

Building the RET Virtual Community

One of the challenges in building a virtual online community is identifying and using the most appropriate tool to create a flexible environment to reach intended users and one that will function effectively as a virtual learning hub (Hardré, 2011; Hardré et al., 2013). To function effectively as a learning hub, the system needs to be accessible and understandable, inviting and appealing, functional and usable, and attractive to users who will create content that draws peers in to participate with them.

In the case of RET, the design was intended to create the community space for a group of users who had already developed community in their shared face-to-face experiences during the summer research activities. Beyond the individual cohorts, the long-term intent was to provide a more public space (apart from that used for secure program activities and data collection) in which the various multi-year RET cohorts could continue community learning and sharing, building on what they had all experienced in common (albeit in different years).

Given that these goals are still viable and active for this year's RET cohort and have not been fully implemented yet for some of the most robust online activities, it is still uncertain how effective it will be overall. The small cohort is undeniably problematic, since it limits the scope of possible activity for this cycle. Fortunately, continued funding is available allowing a much more robust cohort for next year. In addition, the teachers will now have the information much earlier, and can plan on participating. That offers promise for a cohort that will authentically test the design intent of the community-building element.

Questions of Adaptation

The unfortunate convergence of several systemic factors that yielded a small cohort also initiated questions about the design's ability to adapt. Certain elements of the design were based on the premises of specific group sizes (in-labs, in-cohort), as appropriate for the activities created and the tasks expected of the teacher-learners. These assumptions were reasonably made, based on the grant, the funding, and the responses to past RETs recruiting.

However, for this year we had questions. What tenets are (or should be) put in place to assure teachers that their experience will be rich with new ideas and collaboration, when there are only a few people with which to collaborate? The mentors were experts, given autonomy to work with their teachers in their labs to support their learning of Bioanalytical Engineering research, but how could we design to better balance autonomy and accountability? How could we engage the mentors to increase cross-lab, interactive participation, for the benefit of the teachers, without reducing their autonomy? How could we adapt to changes without disrupting the evaluation design and data collection for a multi-year, federally funded program?

Design Learning and Future Revisions

Some implicit or underlying aspects of the project goals fell short of expectations. We attribute this in part to a certain degree of assumption by various stakeholders.

The degree to which we respected the mentors' expertise and autonomy may have cost in decreasing the teachers' developing linkages between their lab research experiences and their instructional development experiences in RET. Leadership gave the mentors all the materials and expectations, but some of them functioned relatively separate from the other program activities. This reduced the overall coherence of the program, and (apparently, based on feedback to date) its benefits for participating teachers. Plans for next year include more attentive mentoring of the mentors, closer monitoring and more accountability. While this is not the direct responsibility of the design team, it links to the success of their design and overall program effectiveness.

Though we strove to make the professional development materials specific to rural needs, the teacher feedback on diversity of those needs informed us that they need to be further developed to address the range of issues in the participating schools. A constraint on addressing specific needs is the huge range of issues in rural schools and communities around the state, and not knowing who will come. In this revision, we will need to balance between general (common/state-wide) rural needs and specialized (local, area-specific) issues. This is an ever-present challenge when designing highly contextualized instruction for a relatively diverse learner population or context-of-use.

Although research and thoughtful design aligned with Next Generation math and science standards were applied, alignment of the educators' needs and the bioanalytical engineering research projects could be improved. Helping teachers develop ways to enhance student engagement was an integral part of the professional development, but more connections and practice were needed to improve fluency for incorporation of entirely new strategic processes like the SUCCESS model.

Logistics became an issue that made the project work less efficiently than it might have. The design team had no previous experience with federally funded professional development and initially lacked information and knowledge from previous RET programs. This program's design and development, including logistical and management issues and lessons learned, have been documented in detail to smooth out logistics and provide better information for revisions over future years of the program. However, no matter how good we create our process and knowledge management, it cannot prevent institutional policy changes that we are not privy to or are totally unanticipated.

The team was volunteer and had many other high-priority factors in their lives. Given those demands, they lacked the kind of continuous communication that they would have had in a more synchronous, controlled environment (same office or more dedicated project worktime). They did find tools that supported their work, and refined task management, but that process required using limited project time with a hard completion deadline. Use of collaborative tools like Google Drive and maintaining up to date tracking of project tasks (such as with the Gantt chart) was imperative for efficient communication and task management. Building on these lessons, refining the design will be more efficient in the next year, optimizing time and expertise of human resources. One science teacher, Laura Lewis, came on board as a graduate research assistant late in development and helped bridge to support design goals to implementation.

CONCLUSION

Our purpose is to share this design experience with others who may be creating professional development for teachers and possibly doing so inside the institutional context of higher education, where change is constant, and sometimes important news catches us by surprise. From our experiences, others can be observant of these obstacles and successes, to be cognizant in developing similar programs. Modifications and adaptations will be needed as different geographic locations have different needs.

As a team, we recognized the limitations of the original program and have discussed modifications for the next iteration of this RET, and for design of future professional development programs for rural teachers. As with any design

implementation, there will be a need for flexibility and adaptions due to specific issues and needs emergent throughout the program.

Communication is key in success of the design, development and implementation of instructional material, and management of program logistics. Any miscommunication, lack of communication, or perception of either one can hinder the overall outcome of the project. Awareness of successes and problems as well as thorough documentation will develop programs that are more effective and beneficial to participants and the communities in which they live.

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