Using Modified Emerging Scholars Program Concepts In Professional Development for Tutors

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Abstract - **As one of the projects funded by the National Science Foundation Science Talent Expansion Program (NSF STEP) grant program, The University of Texas at Arlington undertook a five-year project designed to increase the number of graduates in STEM fields. The project, called AURAS (the Arlington Undergraduate Research-based Achievement for STEM), approached the task of increasing graduation rates by working to increase success rates in traditionally high-loss courses for science and engineering students, namely Pre-calculus, Calculus I, Calculus II and General Chemistry, and Chemistry for Engineers. The Emerging Scholars Program (ESP) model was used to develop courses that were then offered in these subjects. ESP takes a problem-based approach to learning, emphasis on community building, collaborative learning and small group interaction. Marked improvement in pass rates and decrease in drop rates characterized the outcomes of these AURAS courses. But the additional resources needed to sustain these gains may not be affordable by the institution on a long term basis. Since institutional commitment was still uncertain, we focused our attention on the training of tutors who staff clinics for mathematics, physics and chemistry, and a learning center for engineering. A content-intensive collaborative learning workshop was held last year for professional development of those assisting in the ESP classes, and the methodology of that 2-day training workshop will now be more widely applied to the improvement of tutoring in clinics. The goal of these efforts is the same: to increase success rates in the early STEM classes in an effort to retain and graduate more science and engineering majors. This extended abstract describes the content of the collaborative learning workshops intended as professional development for tutors and its relationship to the original research in the development of the ESP model.**

Index Terms - Emerging Scholars Program (ESP), NSF STEP, freshman courses, retention

BACKGROUND

AURAS, the Arlington Undergraduate Research-based Achievement for STEM, is a project developed at the University of Texas at Arlington (UTA) with funding from the NSF STEP grant program. Since the goal of the NSF STEP program is to increase the number of graduates in science, technology, engineering and math (STEM) majors, a necessary first step in improving graduation rates of students majoring in Chemistry / Biochemistry, Physics, Mathematics and Engineering rested in addressing success in these entry-level courses. Due to high drop and failure rates, the project intervention targeted freshman-level courses in mathematics and chemistry: Pre-calculus, Calculus I, Calculus II, General Chemistry I, and Chemistry for Engineers. The Emerging Scholars Program (ESP) model [1] provided the research base to develop courses that debuted for incoming freshmen in Fall 2010. The central features of ESP include a problem-based approach to learning with a focus on high-level work rather than remediation, a welcoming community with shared academic interests, collaborative learning and small group interaction, with an underlying goal of increasing diversity by increasing minority student successes [2]. In addition to the regular lecture and labs associated with the courses, AURAS ESP (A-ESP) students attended two two-hour ESP seminar/workshops per week for Pre-calculus and Calculus I, one two-hour session for Calculus II, and one four-hour ESP workshop per week for Chemistry.

Marked improvements in pass rates and a decrease in the drop rates for the participants in the AURAS classes were noted during the early semesters [3]. Since NSF STEP funding requires efforts to institutionalize funded initiatives, implementing various adjustments continue to evolve to make the AURAS classes less costly so that they could be sustained in the institution solely using funds generated from tuition of students retained. In an effort to retain elements of the intervention that require less institutional commitment of funds, we turned our attention to the training of tutors who staff clinics for mathematics, physics and chemistry, and a learning center for engineering. A content-intensive collaborative learning workshop took place last year for professional development of those assisting in the A-ESP classes, and the methodology of that two-day training workshop will now be more widely applied to the improvement of tutoring in clinics. The goal of these efforts is the same: to increase success rates in the early STEM classes in an effort to retain and graduate more science and engineering majors.

INTERVENTION

To move beyond procedural learning and toward conceptual learning, meaningful problem solving, and self-regulation required in STEM majors, traditional tutoring methods may not be adequate [4]. Effective tutors sense when to give information, withhold information, ask a scaffolding question, ask an extension question to check for understanding, and attend to a student's emotional and psychological roadblocks. These skills or aptitudes coincide with central concepts enacted in the ESP that involve collaboration, community, and mathematical challenge [2]. The AURAS project structured a professional development workshop for faculty [5] to meet the needs of peer-academic leaders (PALs), tutors, and other learning assistants and instructors. The focus of the professional development workshop (ESP-PD) centered on developing the skills, awareness, and dispositions to effectively incorporate, on a broader scale and in different settings, the ideas implemented in the teaching of A-ESP workshops.

The ESP-PD foundational ideas [2] arise from the underlying findings by Uri Treisman [1] that led to the development of the Emerging Scholars Model. Thus, to situate the participants in the underlying goals of the inquiry-based learning used in ESP, the ESP-PD begins with a session that reviews and underscores the central ideas and research-base of the A-ESP intervention (see Table I). Participants engage in a session describing the ESP model and the A-ESP adaptations followed by a session on the research supporting the ESP model [1], [6]-[7].

TABLE I
ESP-PD SAMPLE WORKSHOP SCHEDULE

Time	DAY 1
9:00-9:10	Welcome
9:10-9:25	Icebreaker
9:25-9:35	What is AURAS?
9:35-10:05	Research Supporting the ESP Model
10:05-10:15	Target Population and Student Selection
10:15-10:30	BREAK
10:30-11:15	Experiencing ESP
11:15-12:00	TA/PAL Roles
12:00-1:00	LUNCH
1:00-1:45	Lessons Learned from the ESP Classroom: TA & PAL Perspectives
1:45-2:15	Model Lessons
2:15-2:30	Debrief
2:30-2:45	BREAK
	Preliminary Worksheet Development
2:45-3:15	POGIL Model
3:15-3:45	Worksheet Development
3:45-4:45	ESP Alumni Panel
4:45-5:00	Wrap-Up
	DAY 2
9:00-9:30	Breakfast & Group Strategizing
9:30-11:00	Lesson Run Through for new TAs/PALs
11:00-11:15	BREAK
11:15-11:45	Cognitive Science
11:45-12:15	Classroom Challenges
12;15-1:15	LUNCH
1:15-2:15	Breakout sessions
	TAs: Worksheet Development II
	PALs: Effective Facilitation
2:15-2:30	BREAK
2:30-3:30	New TAs/PALs Practice
3:30-3:45	Survey Completion
3:45-4:00	Final Comments

Next, the participants, in small groups, engage in an open-ended or open-middle type task so that the facilitator can model the questioning techniques, appropriate scaffolding hints, and group facilitation in this setting. The task should be accessible for all in terms of the prior knowledge and facts needed to resolve the task, but the structure of the task must be rich enough to elicit meaningful problem solving to reach a resolution. For a STEM group, a "Rain Gauge Task" provides an appropriate mix of challenge and important entry points in problem solving [8].

After engaging in a mock ESP setting, the group reflects upon the behaviors of the facilitator via small group and large group discussions. This is followed by a structured reflection led by the facilitator(s) in which the participants discuss the roles of a tutor, an assistant instructor, and a PAL in promoting student learning and understandings. Next, a panel of experienced PALs and instructors addresses the group. Typically, the spontaneous commentary from the panelists echoes the experiences and discussions encountered by the participants during the first half-day of the ESP-PD. However, facilitators do prompt panelists to discuss particular issues if they do not arise, such as, "How do you motivate students to focus on conceptual understanding?" or "How do you monitor group work and now when to intervene or recognize appropriate interaction?" Discussion also centers on the important component of community in the ESP model. That is, helping students connect to peers engaged in the same majors and fostering a sense of belonging in their particular course, their major, and the university.

To provide a hands-on experience in recognizing engaging tasks and appropriate questioning and scaffolding, participants learn about the structure of the A-ESP worksheets and their development [5],[9]. This approach allows participants to attempt to generate tasks and materials that elicit active learning so that they can better evaluate tasks and formulate accompanying questions in practice. For example, in mathematics, they work examples of tasks modified using the Mathematics Task Enrichment Guide (MTEG) (see Figure I) [9]-[10] by seeing how an ordinary task emerges as a rich task by incorporating different strategies for improving the task for problem solving explorations. In addition to the materials typically used to train instructors to lead an ESP workshop, participants also learn about the Process Oriented Guided Inquiry Learning (POGIL) model and its adaptations for use in the A-ESP chemistry courses. Each of the participants receives an assignment to design a worksheet to be implemented in an A-ESP setting.

On the second day of the ESP-PD, participants continue to develop worksheets and experience sessions that highlight the benefits of small group learning and inquiry. They engage in practical experiences in implementing their lessons and practice questioning techniques related to facilitating active learning and deepen students' conceptual understanding. Key ideas from research in cognitive science and how students learn are introduced and linked to the experiences in the ESP-PD and the future work to be done by the participants. The facilitators strive to maintain an atmosphere of engagement and inquiry in the ESP-PD. The workshop closes with a panel of students who have experienced A-ESP. They comment upon the best aspects and worst aspects of the program as well as other ideas they wish to contribute. The final panel often validates the ideas and activities that participants have undergone in the two-day ESP-PD.

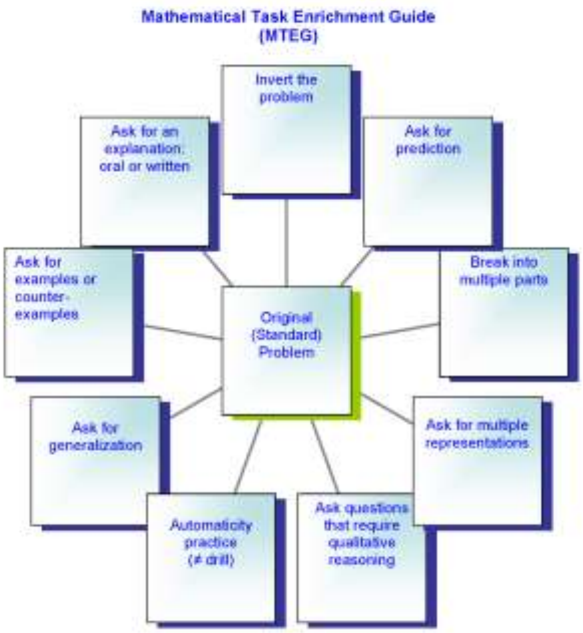

FIGURE 1
MATHEMATICAL TASK ENRICHMENT GUIDE

PALs and TAs who participated in this first iteration of the workshop tailored for students took these experiences into the A-ESP classroom and other settings and report phenomenal improvement in their ability to work with students.

FUTURE PLANS AND CONCLUSION

Many questions arise related to the ESP-PD model in development in contrast to known tutoring models that primarily focus on procedural knowledge in well-structured domains. Necessary future work and research remains to identify and refine best practices for tutors to engage in tutoring that leads students toward deeper conceptual learning and development of self-regulation skills in problem solving. We plan to continue to develop the professional development aspects of our work in an effort to reach not only the clinic tutors but students assisting in the teaching effort, e.g., undergraduate teaching assistants. An early fall semester ESP-PD workshop, as described above, that also incorporates experienced PALs in the facilitation several aspects of the training is planned.

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