AC 2009-341: NSF GRANTEE PRESENTATION: RESULTS OF AN INNOVATIVE APPROACH TO LEARNING VIA PEER-TO-PEER UNDERGRADUATE MENTORING IN ENGINEERING TECHNOLOGY LABORATORIES

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NSF Grantee Presentation: Innovative Approach to Learning via Peer-to-Peer Undergraduate Mentoring in Engineering Technology Laboratories

Abstract

The College of Technology – Computer Engineering Technology (CoT – CET) program at the University of Houston has implemented an undergraduate peer mentoring model as part of an NSF-sponsored program (grant no. DUE 0737526) examining the impact of incorporating concept mapping and undergraduate mentors on student learning at the freshman and sophomore levels. The training for this mentoring model has been adapted from a peer-led team learning program [1] and incorporates concept mapping as a primary pedagogical tool for increasing mentee understanding of key concepts. This paper discusses the details of the procedures followed to develop and implement the program which includes the special training to mentors on CMAPS, assessment activities survey instruments and the contributions made within the Computer Engineering Technology discipline.

Research Activities

The need for increased students' capacity to engage in real world problem solving in engineering technology continues. Various pedagogical tools and models including peer-to-peer undergraduate mentoring have been used to enhance student learning as well as retention. This paper presents the preliminary results of the development and implementation of peer-to-peer mentoring with concept mapping as a primary pedagogical learning tool.

The project has three components: CLABS for hands-on project based learning experience, concept maps as a tool to facilitate discussions between peers, and mentoring sessions that use the concept maps to create a peer-to-peer learning environment. Project activities started with available CLABS lab manuals in freshman ELET 1100 AC/DC Circuit laboratories. Mentors have been trained to use concept maps and also informed during a workshop on how to conduct peer-led team learning session. The training on concept maps has been conducted by the graduate research assistant (GRA). Workshop has been given by project faculty. The project has also provided the mentors with Peer-Led Team Learning workbooks as a reference. The mentors have been scheduled to meet with assigned students to meet every week for an hour. In addition, they met with the GRA weekly to discuss challenges and report their activities.

Training and development section of this report summarizes the training for concept maps conducted in the summer of 2008, the workshop on peer-led team learning, and other training activities in the project. Appendix 5 includes all presentation and training schedules as well as contributions to the training sessions by the project team.

We have an average enrollment of about 20 students per section of the CLABS. For each section of the lab, we have two mentors (UG students), and one graduate teaching assistant (TA). Each mentor and each TA typically work in two sections of a lab. In order to provide diversity of instruction for our students, the mentors and TAs may work in any combination of related labs. Concept maps are utilized as a tool of interaction between the mentees and the mentors. They provide an aid to learning and understanding and are developed throughout the respective semester as new insights are gained from the interaction.

During Fall 2008, a **pilot study** is conducted to start using concept maps during mentor-mentee sessions at UH. The pilot study began mid-semester. The following is a brief description of the schedule. **The week of August 25, 2008:** Mentor training program on peer-led team learning has been conducted in collaboration with the H-LSAMP. In addition, project faculty has conducted a special concept map training session for themselves during the summer of 2008 to support the work.

Table 1. Schedule of Activities Related to Concept Map Integration to CLABS Program – what has been planned and what has been achieved during summer 2008 and fall 2008.

Scheduled	Achieved	Activity
Mar '08	Aug'08	Prepare and conduct mentor training program
Apr '08	Sep-Dec 2008	- Perform concept map implementations during mentor-mentee meetings for 2 pilot labs from each of CLABS (ELET 1100, 1101, and 2103) for 6 experiments - Prepare a rubric to assess the concept maps developed by the mentees - Determine specific criteria outlining program expectations for mentors' performance in the labs - Conduct face-to-face meetings for every experiment between mentors and project faculty to discuss the ongoing work in the labs - Adapt an observation journal to be used by the mentors to reflect on their experiences interacting with students
May '08	Dec'08	- Present the pilot concept maps resulted from their mentor-mentee relationship during final project presentation day for CLABS - Evaluate rubrics for assessing concept maps with the specific performance criteria prepared in April 2008 (related to the ability of students to demonstrate and articulate the content of their concept maps) - Submission of a final mentor evaluation (by the mentees) assessing the specified set of performance criteria (e.g. communication skills, subject knowledge)
Summer '08	Dec'08	- All assessment results will be analyzed. - Based on the pilot implementation, improvements to the CLABS and mentor-mentee program will be identified. Mentor training program will be updated. - A full deployment plan for Fall 2008 will be created
Fall '08 – Spring '09	Dec'08 – Jan'09	Continuous assessment, program evaluation, program update, and outcomes assessment.

Summer '09	Continuous	- All assessment results will be analyzed. - Based on the first full implementation, improvements to the CLABS and mentor-mentee program will be identified. Mentor training program will be updated. - A revised deployment plan for Fall 2009 will be created
Fall '09	Continuous	Continuous assessment, program evaluation, program update, and outcomes assessment.

Assessment Activities

We can think of CLABS as a multi-part structure illustrated by Figure 1.

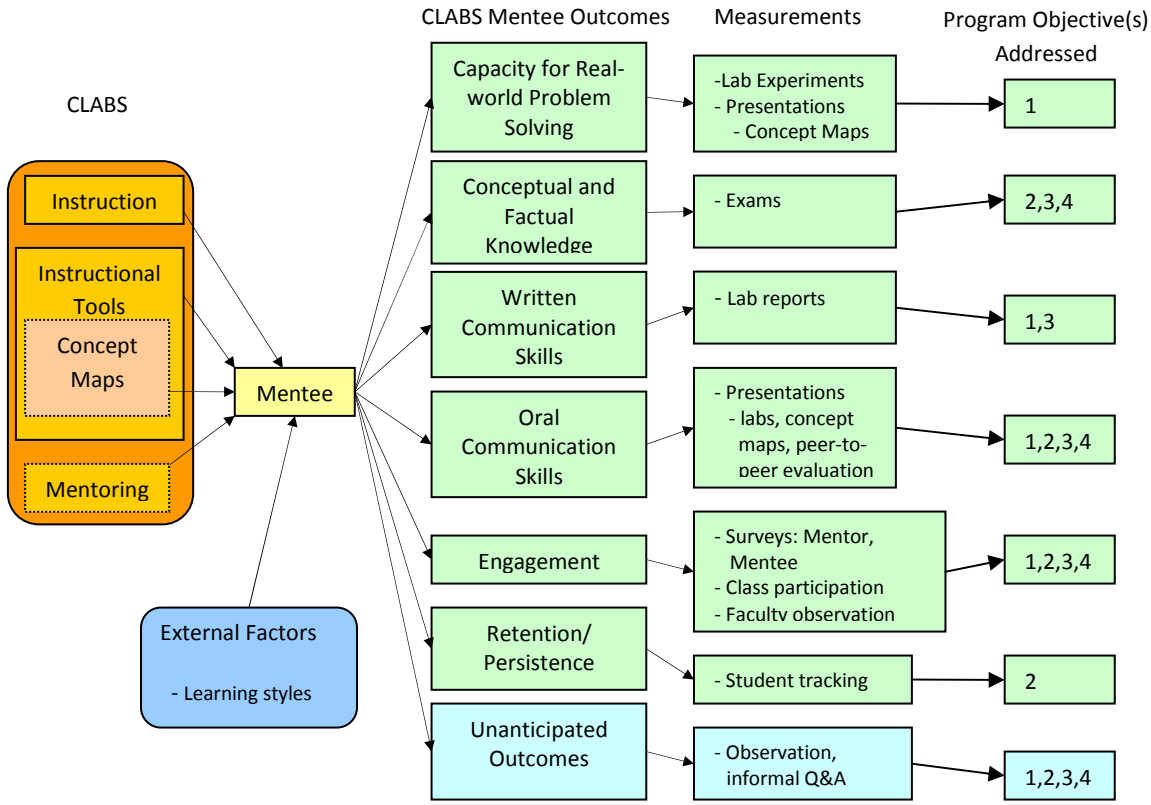

Figure 1. Relational Structure of CLABS

In this model, CLABS components impart knowledge, skills, and guidance to the student that in turn lead to positive outcomes as delineated by the program objectives. In addition, the project monitors the role of external factors and unanticipated outcomes through observation and inquiry. While the CLABS project team has continually assessed and evaluated the program in the past, the addition of concept mapping and mentoring calls for additional assessment tools to better gauge the impact of these new components.

The assessment plan utilizes a variety of measurement tools to gauge student progress relative to the program objectives.

Table 2. Relationship Between Program Questions and Measurement Tools

Evaluation Questions	Measurement Tool	Objective(s) Addressed by Data Obtained via Measurement Tool(s)
Are mentees increasing their capacity to engage in "real world" problem solving?	- Lab experiments - Presentations - Concept maps	- 1 (primary objective), 2, 3, 4
Are mentees being retained?	- Retention rates	- 2 (primary objective)
Are mentees engaged in the course?	- Course Evaluations - Mentor Evaluations - Exams - Experiments - Presentations - Faculty observation	- (primary objective), 1, 3, 4
Are mentees improving their written communication skills?	- Lab reports	- 3 (primary objective), 1
Are mentees improving their oral communication skills?	- Presentations	- 3 (primary objective), 1, 2, 4
Are mentees increasing their conceptual and factual knowledge of engineering technology knowledge?	- Exams - Presentations - Concept Maps	- 4 (primary objective), 3, 2

As illustrated by column three in Table 2, data collected by the measurement tools do not necessarily reflect a single program objective. Indeed, a single assessment activity may help evaluate student academic progress in more than one area. Figure 3 provides an example of this scenario.

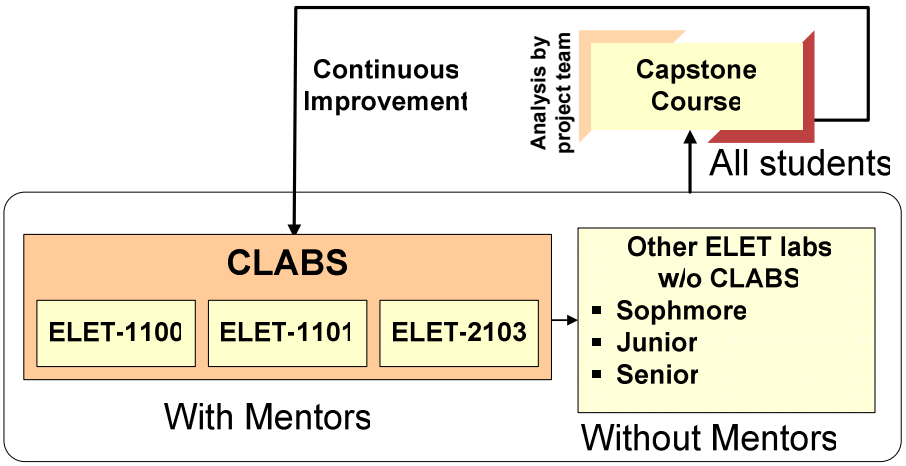

Figure 3. General Long-term Assessment Model

SURVEY INSTRUMENTS

The project utilized a pair of surveys to collect student information on a number of topics including background information, course expectations, and perceived skill level. The first survey was administered at the beginning of the course to compile baseline information on students. The second survey was administered at the end of the course as a point of comparison. Copies of these survey instruments are provided in this appendix. Please note that the survey versions presented in this section were administered to students enrolled in College of Technology courses at the University of Houston. A similar survey was administered to students at Texas A & M – Corpus Christi and Houston Community College with slight modifications in the introductory language to indicate the specific institution.

Research Findings

Research findings can be divided into two main categories: (i) logistic findings involving the implementation of the project; (ii) peer-led team learning experience related issues in the project.

Logistics during implementation: effective communication among the team members, room and schedule arrangements for mentoring sessions, and recruitment of effective mentors.
Learning experience: training of mentors on concept maps, instilment of team leadership and role model attitude, and hands-on project-based laboratory settings.

Logistics

1. Grouping the mentees in the different mentoring sessions was a daunting task due their stringent schedules.
2. Analyzing the schedules of mentors and assigning them to the different mentoring sessions.
3. There were some mentees who had never attended the mentoring sessions. Mentors and GRA were concerned about the absentees for the sessions. Hence a list of absentees was made. Team visited ELET 1100 class multiple times to interact with the students and motivate them for attending the sessions.
4. Team discussed the grades for the first midterm for ELET 1100. The mentors co-related the performance of each of the mentee in their session with their marks in the test.

Team leadership and role model

Mentors have been trained during a workshop to conduct mentoring sessions effective with the students.

Feedback given by mentors:

- Mentees were interested in the C Map drawing process.
- Active discussions led to in depth understanding of concepts.
- Reviewing and active participation led to thorough understanding of concepts.
- The students were motivated for the sessions.
- Some of the mentees were very thorough with the concepts and hence could draw the C maps quickly.

- Few other mentees were not clear with the concepts and hence sometimes the mentoring session had to be stretched beyond the scheduled one hour session as additional assistance had to be provided.
- The mentees know the concepts but cannot express them in a proper format.
- They make mistakes in simple algebra.
- Some mentees are very thorough with the concepts while others are slow in grasping the concepts. As the mentors waited for the entire group to complete the assigned task, the bright students felt restless and left out.
- The mentees made mistakes in making calculations on calculator.
- Some mentees were not sure about concepts.
- The mentors asked the students their take on the midterm. The mentees expressed that they found the exam to be tough.
- Few concepts were not clear with some students while a few were very enthusiastic about C Maps. Striking the right balance in the group was a task.
- Low attendance for the sessions was a concern. Making the mentoring sessions mandatory helped improve the attendance.

Training and Development:

The training for the participants in this project was divided in three workshops. The workshops were oriented specifically to the project members in the different stages of project. The focus of the first one was the PI's and lab assistants who worked in the initial part of the project. The second one was directed to the lab assistants who worked in the freshman and sophomores laboratories and the third one was aimed to the undergraduate mentors.

Concept Maps workshop (Initial Team Training)

Fundamentals of concept mapping were presented by invited faculties. Samples of concept maps created by current lab assistants were presented as well as possible improvements for future use in the pilot student group; one additional goal was the creation of a library of concept maps for CLABS. The gained experience with c-maps in embedded systems was shown, as well as, tools, literature review, and available resources (see additional document No. 1). The workshop was held on summer 2008 with the participation of all the team members as well as 9 lab assistants, and 4 students assistant.

Lab Assistant training:

At the beginning of each semester the Lab Management team and faculty offer a two-day laboratory assistant orientation workshop. Teaching techniques, Safety procedures, professional etiquette, and organization of laboratories were covered during the workshops. The concept maps workshop was part of the general orientation program and included the basic training and concept mapping learning techniques (see additional document No 2). The orientation session included sample concept mapping applications to various lower and upper division courses, software, and practical tips on concept maps. These samples were created in the junior class (see additional documents No 3, No 4).

The attendees were the general group of Lab Assistant (LA), Student Assistants (SA) and Under Graduate Mentor (UGM) although, this specific workshop was aimed to the LA's, SA's and

UGM who were involved directly on the ELET-1100, ELET-1101, ELET-2103 labs as well as their corresponding lectures. This training was held before 2008 fall semester starts with the participation of the project team, 22 lab assistants (LA and SA), and 5 faculty.

Mentor Training by PIs

The mentors were recruited in a carefully selection process where the most important skills considered were the leadership, technical background, creativity and pro-active attitudes. In addition to these important skills the mentors needed to have some knowledge and background on how to be a role model for their peers. During this workshop mock discussion sessions were prepared on real-life subjects such as learning, teaching and learning styles, ethics in workplace etc. The fundamental goal of this workshop was teach the mentors how to lead a discussion session with their mentees and conflict resolution. It was held at the beginning of 2008 fall semester with the participation of 4 mentors and the project team.

Contributions within Discipline

The mentoring session within the Computer Engineering Technology discipline highlights the many valuable contributions that mentors make in helping mentees understand the basic concepts and the importance of using CMAPS tools in building and retaining their knowledge. Moreover, the mentoring session included a friendly discussion on how a group of students can work together to expand their learning process. Specifically, the project contribution within the computer engineering technology discipline included the following:

- recognition of the relationship between mentors and mentees as a means of bridging the gap between student and instructor positions and creating long term sustainable communications

- promoted the value of including mentoring sessions as a powerful learning strategy in creating a stronger educational will and to increase the participation of mentees by more freely expressing viewpoints in their learning process

- enhanced their knowledge with respect to the development of CMAPS for practical case examples adopted from the lab modules

- enhanced their ability to discuss and analyze various CMAPS developed by mentees

- conducted competition among mentees in order to motivate mentees and to promote continued discussion for the best CMAPS development and hence better knowledge retention

- allowed mentees to actively participate during the regular lecture sessions

Contributions to Other Disciplines:

The current group of mentees includes students not only from the Computer Engineering Technology but also from Electrical Power Technology, Information Systems, Biology as well as students who have not yet decided their major.

We believe not only did they learn the subject well, but they gained a way of base knowledge retention using mentoring sessions and CMAPS tool that would be useful for their future choice of discipline.

Contributions to Education and Human Resources:

The project has created mentoring opportunities for three of our undergraduate senior students as well as one project coordinator position for one graduate student. The listed students have expressed their viewpoint that the project was helpful in expanding their performance, skills and even enhanced their interest for teaching career.

As part of the next phase of project current mentees will also have the opportunity to be mentors of the upcoming students. Most of the current mentees showed a great interest to become mentors for the next phase of freshman students. This will create opportunities to enhance their skills.

Bibliography

[1] Vicki Roth, Ellen Goldstein, Gretchen Marcus, “Peer-Led Team Learning: A Handbook For Team Leaders, 1/e, 2001.