AC 2009-344: PERCEPTION OF UNDERGRADUATE FRESHMAN STUDENTS ON ROLE MODELS AND CORRELATION WITH THEIR EDUCATION BACKGROUND

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Abstract

This paper reports the latest results of an NSF sponsored program to implement an undergraduate peer-to-peer mentoring model using concept mapping at the College of Technology-Computer Engineering Technology (CoT-CET) program of the University of Houston. Realizing the benefits of combining peer-to-peer mentoring with the use of concept mapping as a learning tool, the CoT-CET program launched a pilot program in fall 2008 to its freshman course in order to implement and assess the impact of incorporating the two models. The study compares skills reported by the students at the beginning of the semester with those collected at the end of the semester. It also presents the results of the performance achieved by the mentored students in the pilot group and the performance of students who were not part of the pilot group. In addition the report presents similar performance analysis from collaborating institutions – Houston Community College and TAMU Corpus Christi.

I. Motivation

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 focuses on the fundamental purpose of this program and the preparation to implement it. The Motivation section describes the objectives of this program. It details the different tasks initiated to achieve the objectives. It states the various assessment activities developed and implemented to track the progress of the project. The section two "Assessment" analyses the results of the surveys. It explains how the students were assessed in order to understand their academic background, their goals, their expectations from the lab and their idea of an ideal mentor. Extensive surveys have proved to be an appropriate groundwork for implementation of the pilot program launched in Fall 2008. It compares skills reported by the students at the beginning of the semester with those at the end of semester. It also compares the performance of the group of students who were mentored with those students who were not. It includes analysis performed by the collaborating institutions – Houston Community College and Texas A & M University Corpus Christi. The analysis evaluates the effectiveness of the program. The section three "Mentor Training Program" outlines how the mentors were trained so that they could communicate well with their group of mentees and maintain a supportive learning environment in the mentoring sessions. The next section "Implementation of the program" throws light on the way in which the program was actually implemented. It explains every minute aspect of the Concept Mapping program right from the workshop conducted for the mentors by the research assistant to the interpretation of the results analyzed. The final section "Outcome of the Program" summarizes how the objectives of the program were met. Thus the paper gives thorough overview of the methodology implemented.

The Concept Mapping (C Map) is a graphical representation of concepts which facilitates active learning process [2]. Such spatial arrangement of concepts leads to better retention of concepts. It also allows students to express broad range of related concepts in a condensed form. It helps in analyzing copious information in an organized manner as well as in presenting the findings of a task performed. The goal of this project was to assess the efficacy of the C Map technique through mentor-mentee interactions.

The primary objective of this project was:

1. Increase students' capacity to engage in "real world" problem solving: The fundamental goal of this program was to initiate critical thinking amongst the students. The students were motivated to apply the knowledge gained in the lectures during the laboratory sessions.

2. To better retain and engage underrepresented students: The mentoring sessions had mentees from diverse backgrounds and the mentors conducted the sessions with such a varied group and instilled the principles of equality, discipline and were role models for their mentees.

3. Improve students' written and oral communication skills: The interaction with mentors, creation of concept maps, presentation of concepts to peers and mentors, and project presentations in the laboratory created a framework for communication skill development.

4. Increase students' conceptual and factual knowledge of engineering technology: Concept mapping helped mentees interact with each other and their mentors in a technical context. The process matured the knowledge of the mentors while students gained by the structured, yet flexible, way of knowledge transfer amongst each other. Mentors interacted with their lower division peers and gained a deeper understanding in what they have learned and where/how it is applied. Mentors relayed the larger picture of fundamental knowledge to the mentees and gained an appreciation of learning and teaching.

Table 1 summarizes the goals of this program and the different activities undertaken to achieve them. It also includes the activities which were executed to assess the impact of the learning initiatives.

Table 1. Objectives of the project in relation to the learning activities and the corresponding assessment activities.

Learning Activities	Assessment Activities
Program Objective 1 - Increase students' capacity to engage in "real world" problem solving.	
• Participation in inquiry-based laboratory provided students with an opportunity to apply conceptual knowledge in a practical, work-like setting. • Students developed conceptual maps that illustrated connections between engineering technology concepts. • Mentors provided guidance on laboratory activities. This strategy has two learning components: 1) helping students improve their acumen in the lab and 2) helping mentors solidify their own understanding through a practice effect.	• Students wrote lab reports describing different components of the laboratory process. • Concept maps were assessed for accuracy. • Students submitted evaluations of mentors. • Mentors were asked to reflect on their experiences via an open-ended survey.
Program Objective 2 - Retain and engage underrepresented students	
• Students had consistent access to lab-based mentors as part of the lab experience. • Program selected mentors from a diverse student population thus providing role models.	• Students were asked to answer questions that provide impressions of the mentoring process as it impacts their perception of the course in particular and STEM topics in general. • The project will continue to track students over time to assess retention rates of those who participate in the lab/mentoring courses. • Faculty will evaluate qualifications of potential mentors to make informed selections. Mentors had periodic meetings with faculty to discuss on-going lab experience.
Program Objective 3 - Improve students' written and oral communication skills	
• Laboratory work has written and oral components giving students the opportunity to practice and improve on these skills. • Oral communication was a key part of the mentor's role in helping students understand and apply concepts in the lab.	• Written and oral skills were assessed using rubric-based evaluation of student performance (e.g. presentations) and products (e.g. lab reports). • The quality of mentor communication was evaluated via student evaluations of their performance as well as faculty supervision.
Program Objective 4 - Increase students' conceptual and factual knowledge of engineering technology	
• Lecture component of the course provided students with the basic conceptual knowledge for the lab exercises.	• Factual and conceptual knowledge was assessed using examinations and quizzes.

II. Assessment

The students participating in the pilot program came from different backgrounds, demographics with diverse learning styles, learning objectives, and educational preferences. In order to collect these details, extensive surveys were conducted. 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. This survey included elaborate information such as the reason the student choose this program, academic background, work experience, hobbies, short term and long term goals, expectations from the lab, area in which the student hopes to improve and the student's perception of an ideal mentor. The students were also asked to rate themselves in various skills such as research skills, writing, presentation, software knowledge, hardware knowledge, website creation, leadership, professional ethics, mentoring skills, etc. To get a fair idea of the schedule of the student, the survey included the credit hours for which the student had enrolled and their work commitments. This survey was thoroughly analyzed and documented. Graphs were plotted for relevant details and they helped in interpreting the data collected. Such an extensive survey gave a complete picture about a student's academic background, the goals and skills. This survey was also conducted in the collaborating institutions Houston Community College and Texas A & M University Corpus Christi. The surveys conducted in these institutions were also analyzed and documented.

Three out of the four primary objectives for the project relate to academic improvement. These are:

- Increase students' capacity to engage in "real world" problem solving
- Improve students' written and oral communication skills.
- Increase students' conceptual and factual knowledge of engineering technology

A key component of the survey relative to these goals is the student self-rating of perceived skills and knowledge. A cursory glance at the developed survey instruments highlights the focus on how students think about their own learning. The pre-post structure of the survey administration seeks to gauge any potential changes in how students perceive what they know. Coupled with faculty and laboratory instructors' assessments of student learning, a major purpose of the surveys is to help project personnel capture any program impacts relative to the three overarching academic objectives.

II.A. Analysis of Student Assessment

This project was based on earlier work known as CLABS [3,4, and 5]. 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.

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.

Table 2. Relationship between Program Questions and Measurement Tools. Objectives are referred to with their numbers as listed in Table 1 of this paper.

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

II.B. Preliminary Analysis of Student Outcomes from the C Maps/Mentoring Project

1) University of Houston – College of Technology

ELET 1100 (Electrical Circuits I Laboratory)

At the beginning of the course, students were asked to self-rate their perceived level of skill and knowledge in 11 areas. At the end of the semester, students were asked to rate the same areas. An examination of pre-post survey results in ELET 1100 reveals minor changes—both positive and negative—regarding student perception of their skills and knowledge. The pre- and post-course mean ratings for each administration and skill/knowledge area are presented in Table 3.

Note that the survey used a 10-point scale with 1 indicated low level skill/knowledge and 10 being the highest possible rating.

Table 3. Student Self-Rating of Perceived Skill Pre-Post Course

	N	**First Administration**	**Second Administration**	**Change**
Real Project Experience	16	8.00	6.25	**-1.75***
Customer Interaction	19	8.37	7.58	-.79
Research Skills	19	6.58	7.63	**1.05***
Writing Skills	19	6.84	7.58	.74
Presentation Skills	18	7.06	6.56	-.5
Software Skills	19	7.26	7.21	-.05
Hardware Skills	19	7.26	7.26	-.00
Website Creation	17	6.18	6.00	-.18
Leadership	18	7.61	7.44	-.17
Team Player	18	8.17	8.06	-.11
Professional Ethics	18	8.39	8.33	-.06

* $p < .05$

Paired-sample t-tests were used to examine response differences between the first and second administrations for each set of skills and knowledge. The majority of changes between the first and second set of responses were fairly small and did not register as significant differences. However, two areas did indicate significant change. The largest significant decrease in self-rating occurred around real-project experience where the average mean rating dropped from 8.00 to 6.25. The largest significant increase happened in the research skills area (6.58 to 7.63). Although these two sets of changes were flagged as statistically significant, it is unclear whether the differences noted have any practical significance. Faculty will have to monitor the instructional strategies and content of the course in the next iteration to determine whether there are any discrepancies that may account for some of these changes. More importantly, faculty will also have to reexamine their instructional processes to determine whether there are any areas that may have a stronger impact on these learning areas.

Table 4 compares final course grades (representing cumulative outcomes on several assignments) for students receiving mentoring (pilot) and students receiving traditional instruction. Results indicate that students in the pilot group scored over eight points higher on average than the students in the traditional group. However, a t-test of the difference between the means suggests that this gap is not significant. Thus, there is no evidence to suggest a relationship between participation in the mentor model and improved student performance.

Table 4. Comparison of Final Grades: Pilot vs. Traditional (mean is out of 100)

Group	**N**	**Final Grade Mean***	**Mean Difference**
Pilot	27	59.8	8.7*
Traditional	56	51.1	

* $p > .05$

In order to determine whether student self-ratings of skill and knowledge reflected actual course outcomes, a correlation analysis was conducted between the final self-ratings (second survey administration) and the final grades in the course. Table 5 summarizes these results.

Table 5. Correlation between Student Final Self-Rating and Final Grade

	Final Grade
Real Project Experience	.09
Customer Interaction	.08
Research Skills	.42
Writing Skills	**.48***
Presentation Skills	.47
Software Skills	.29
Hardware Skills	.22
Website Creation	.35
Leadership	.14
Team Player	-.04
Professional Ethics	.18

* $p < .05$

Overall, the correlation statistics indicate no relationship between student self-perceptions and their actual performance. However, student ratings of their own writing skills did have a significant relation to final course grades (in bold).

In addition to self-ratings, the surveys asked students to provide information about their work hours. Project personnel hypothesized that students with higher work demands would tend to perform poorly relative to others with fewer or no outside employment requirements. Although correlation analysis between work hours and course outcomes (final grades and project grades) revealed slight negative relationships between work and these two variables, the pattern was not statistically significant. (See Tables 6 & 7)

Table 6. Correlation between Work Hours and Final Grades

	Final Grade
Work Hours	-.19*

* $p > .05$

Table 7. Correlation between Student Work Hours and Project Grades

	Project Grade
Work Hours	-.21*

* $p > .05$

C MAPS & Mentoring

Few students responded to open-ended survey items about questions or concerns. However, among students who did respond (N=6), four either mentioned concern about the C MAPS process or indicated their desire to avoid it entirely. One respondent did applaud the usefulness of the mentoring session itself. The next step of the assessment process will be to focus specifically on the relative contribution (if any) of the mentoring component versus the C MAPS activities.

A review of mentor reports and written reflections reveal the need for more extensive mentor training and support as well as a consistent mentoring location. The mentors indicated that many students in ELET 1100 were resistant to the mentoring and C MAPS process. This observation is consistent with the few comments offered in the end-of-course student surveys.

Both the graduate assistant and the mentors mentioned the lack of some pre-requisite skills among the ELET 1100 students which made the concept mapping process more onerous. The skills missing were mostly related to a general understanding of how to express a concept in a coherent manner. This raises the possibility that mentors may have to spend time building or reviewing these foundational skills before they can guide students in the course topics. There may also be a need for a basic diagnostic test to gauge students' level of familiarity with key concepts necessary to begin the course in good standing.

ELET 1300 (DC Circuits Lecture)

A preliminary analysis of course outcomes for ELET 1300 reveal minor differences between students taught in a traditional format versus the pilot format. At each stage of course assessment process, students enrolled in the pilot program perform marginally better (as shown in midterm grades in tables 8, 9, and 10) than their counterparts in a traditional setting with the largest difference occurring between the final lab outcomes. However, a statistical analysis of these results reveals no significant discrepancies between the two sets of scores at each stage. This finding suggests that outcome differences are likely statistical artifacts rather than real performance differences between the two groups.

Table 8. Midterm Mean Comparison: Traditional Group vs. Pilot Group

	Midterm Mark Mean*
Traditional Group	17
Pilot Group	20

* $p > .05$

Table 9. Project Mean Comparison: Traditional vs. Pilot Group

	Project Grade Mean*
Traditional Group	53
Pilot Group	54

* $p > .05$

Table 10. Final Lab Mean Comparison: Traditional vs. Pilot Group

	Final Lab Grade Mean*
Traditional Group	63
Pilot Group	69

* $p > .05$

Additionally, the project examined the relationship between mentee attendance at mentoring sessions and course outcomes. Analysis of correlations between these two variables showed only a minor positive relationship.

Table 11. Correlation: Mentor Session Attendance vs. Performance Outcomes

	Project Grade Mean	Final Lab Grade Mean
Attendance	.18*	.31**

** $p > .05$*
*** $P > .05$*

Like the mean differences, however, the correlations were not significant. In other words, there was little relationship between student mentoring attendance and how they performed on course performance measures.

Although there are a variety of external factors that may explain this lack of a consistent relationship between these two variables, this cursory analysis does raise questions about the relative impact of the mentoring process on student learning. Project personnel will need to revisit the mentoring activities and determine what, if any, changes may improve the efficacy of the mentoring process.

2) Houston Community College System

Results from surveys and student outcomes from the Houston Community College System reflected the analysis from the University of Houston. In terms of student self-ratings, results indicated small but positive increases in self-rating over the course of the semester. Self-ratings of writing skills, presentation skills, and software skills did show significant changes over time.

Table 12. Student Self-Rating of Perceived Skill Pre-Post Course

	N	First Administration	Second Administration	Change
Real Project Experience	5	5.00	6.40	1.40
Customer Interaction	6	5.00	6.00	1.00
Research Skills	6	5.67	6.67	**1.00***
Writing Skills	6	5.67	6.83	1.17
Presentation Skills	5	5.00	6.80	**1.80***
Software Skills	6	5.00	6.33	**1.33***
Hardware Skills	5	6.80	5.60	1.20
Website Creation	4	3.00	4.00	1.00
Leadership	6	6.50	6.67	.17
Team Player	6	7.00	8.17	1.7
Professional Ethics	6	6.50	7.00	.50

** $p < .05$*

An examination of student performance in the course reveals slight differences between mentored students and traditionally taught students. When comparing these groups in terms of their midterm and final grades, students in the pilot group tended to outperform students in the traditional classroom. Similar to the pattern in the UH courses, these differences did not meet the threshold for statistical significance. Indeed, the actual point value was very small.

Table 13. Midterm Mean Comparison: Pilot vs. Traditional

Group	N	Midterm Grade Mean*	Mean Difference
Pilot	10	89.7	3.7*
Traditional	9	86.0	

* $p > .05$

Table 14. Final Grade Mean Comparison: Pilot vs. Traditional

Group	N	Final Grade Mean*	Mean Difference
Pilot	10	89.8	5.4*
Traditional	9	84.4	

* $p > .05$

3) Texas A & M University – Corpus Christi (TAMUCC)

Introduction to Engineering Technology

As of this writing, the student outcome data for TAMUCC is focused on the student self-ratings. Results of these ratings indicate little change over the course of the semester. No changes in the different skill areas reached the level of statistical significance. From a practical perspective, the largest change occurred in self-ratings of leadership with a 1.2 point increase between the first and second administration of the survey. These results are consistent with the outcome patterns found at the partner institutions.

Table 15. Student Self-Rating of Perceived Skill Pre-Post Course: Intro to Engineering Technology

	N	First Administration	Second Administration	Change*
Real Project Experience	10	6.60	7.70	1.10
Customer Interaction	10	6.90	6.80	-.10
Research Skills	10	6.40	6.90	.50
Writing Skills	10	6.50	7.30	.80
Presentation Skills	10	6.10	6.90	.80
Software Skills	10	6.30	6.40	.10
Hardware Skills	10	6.10	6.70	.60
Website Creation	10	3.40	4.00	.60
Leadership	10	7.10	8.30	1.20
Team Player	10	8.30	8.50	.20
Professional Ethics	10	7.80	8.50	.70

* $p > .05$

It is important to note that data for this analysis were collected for a course (Introduction to

Engineering Technology) that incorporates elements of Mechanical Engineering Technology as well as Computer Engineering Technology.

TAMUCC also incorporated the CLABS elements into two other courses. However, a small N (5 or less) prevented meaningful quantitative analysis. It may be necessary to utilize a more qualitative approach to these outcomes. There is also a need to conduct more in-depth interviews with students who participated in the pilot project to gain their perspectives on the mentoring process.

Summary of the Analysis:

Three out of the four primary objectives for the project relate to academic improvement. These are:

Increase students' capacity to engage in "real world" problem solving
Improve students' written and oral communication skills.
Increase students' conceptual and factual knowledge of engineering technology

Preliminary results from the project do not provide any evidence of a substantive program impact at any of the three institutions. There is at least some secondary evidence from the mentor reports and student course evaluations that the mentor process was contentious and inconsistent at times. Program personnel will have to review these mentoring procedures to determine whether modifications to the delivery process will help boost the efficacy of the program. The Houston Community College System delivery model seemed to be more reflective of a true mentor model in terms of the interaction between mentors and mentees. However, in this case, student outcome patterns were not radically different than at the other institutions (i.e. there was little change over time or real differences in performance between project students and traditional students). The next iteration of the project will necessarily see changes in the delivery process that are consistent with our findings. In addition, the project will review the effectiveness of the measurement instruments to make sure that project activities (including mentor processes and student performance) are being documented accurately.

III. Mentor Training Program

The success of this program relied on the effectiveness of the mentoring sessions. To ensure that the sessions were productive and the goal of this project was achieved, the mentors were given a thorough training. As mentioned earlier, this training was based on "Peer Led Team Learning: A Handbook for team Leaders" and its guidebook [1]. The student mentors were instructed that they were not supposed to be "instructors" but were to be experts in "learning" and not in teaching. They were going to be more like the teaching assistants but with more personal interaction with their group of mentees thus maintaining a congenial atmosphere in the sessions. The mentors were advised to combine their profound technical knowledge with their intrapersonal skills to create a supportive learning environment. The mentors were expected to have genuine concern for their students, providing them with continuous encouragement and displaying unfaltering belief in their work. The mentors were motivated to transform their group of mentees into a high performance team. Regarding the mentoring sessions, they were told to get the group started and keep it functioning well throughout the semester. The mentoring sessions were not supposed to be mundane lectures or tutorials but interactive sessions where collectively C Maps were created thus applying the knowledge gained in labs and lectures. The mentors were suggested to initiate discussion by making a skeleton C Map and then taking inputs from the mentees to complete it. Later on, as the mentees got a hang of constructing C Maps, they started to work in groups and later individually which would instill confidence in them.

For the optimum productivity of the mentoring sessions, the mentors were expected to be well prepared in advance. They were instructed to read the experiment and material covered in lecture prior to conducting the session. They were advised to make a quick summary sheet of main concepts to be covered in the session. The mentors were told to keep the sessions very organized and maintain regular attendance sheets. The mentors were submitting weekly reports, which included elaborate detail of every activity undertaken in the sessions.

The mentors were told to be ethical which was very important in the success of the program. They were expected to set an example for their mentees by being punctual and well organized.

The mentors were advised to be good trouble shooters where group dynamics was concerned. They were cautioned that there might be tiffs in the group as the mentees may come from different backgrounds and have diverse attitudes. It was their responsibility to create a comfortable and productive learning environment.

The mentors were informed about their responsibilities in the project which included conducting mentoring sessions, preparing for them and interacting with the project team.

Finally, the mentors were made aware of their position of being a "role model" for their mentees and instill confidence in them that everyone can succeed in the course with hard work and extensive practice. The mentors were assured that they would always be assisted by the project team, faculty of the course and NSF administration.

IV. Implementation of the program

The C Map program paves a path to a new approach to leadership in training. Under this initiative students from upper levels who had performed significantly well in their previous courses were selected as mentors for those courses after thorough screening and round of interviews. Each such mentor was given the responsibility of a small group consisting about ten students. The mentoring sessions for a group were held once a week.

To allot the mentees to the different mentoring sessions, it was necessary to get the daily schedule of the mentees. The daily schedules of the students were then analyzed and they were accordingly allotted to one of the four mentoring sessions. The mentees were requested to complete surveys and these helped in thoroughly analyzing their academic background, their expectations from the lab, their skills and their perception of an ideal mentor. After considering the availability of the mentors, they were assigned to two mentoring sessions. Leadership and role model ideal was taught to both the mentors and the research assistant before commencement of the actual mentoring sessions. The research assistant conducted meeting with the mentors at the beginning of every week. The purpose of this meeting was to keep a track of all the activities undertaken in the previous week, taking feedback from the mentors about the mentoring session conducted by them and discussing the agenda for the following week's sessions. These meetings helped in keeping the sessions organized and synchronizing the concepts covered in the laboratory experiments with those covered in the mentoring sessions. The mentors presented a brief outline of the tasks they proposed to carry out in the upcoming sessions. These were reviewed by the research assistant. Such a practice aided in ensuring that the mentoring sessions were being conducted in a right manner and at a correct pace. The mentors would express any difficulties they faced during the sessions which would be resolved during these meetings. The mentors would return scanned copies of the C Maps developed by their mentees in the previous session. These sample C Maps were reviewed by the research assistant and documented. Different methods of constructing C Maps (e.g. concentrating on one branch of the C Map and later organizing everything together, giving hint words) to make understanding the concepts easier for the students were discussed. Such discussions encouraged the mentors to try out effective styles of C Maps. The research assistant motivated the mentors to make the sessions interactive. The mentors were asked to make use of white board, markers, and projector to keep their mentees involved in the learning process.

Brief summary of the feedback given by the mentors is:

- Mentees were interested and motivated for the C Map sessions.
- Active discussions led to detailed understanding of concepts.
- Reviewing concepts covered in lectures and active participation of mentees led to thorough understanding of concepts.
- Few 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 knew the concepts but could not express them in a proper format.
- They made mistakes in simple calculations.
- 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. Striking a right balance in the group was a daunting task.
- The mentees were assured that every C Map is unique and that there was no specific “right answer” in this program. This helped greatly in boosting the confidence of the students and they showed inclination to explore the study material.
- The C Maps kept the students engaged with the study material and invoked critical thinking.
- Low attendance for the sessions was a concern. Making the mentoring sessions mandatory helped improve the attendance.
- The final project presentations by the mentees reflected their confidence gained in the course.

V. Outcome of the program

The mentees were made to fill in the same surveys that they completed at the beginning of the semester regarding their academics, skills and perception of mentors. These surveys were analyzed and compared with those done at the beginning of the semester. There was a marked improvement in skills (e.g. writing skill, research skill, presentation skill) reported by the students.

The performance of the pilot group was compared with that of the traditional group in both the mid terms and final exam. The pilot group outdid the traditional group in all the tests. They had better average test score and lab grades than the traditional group. This proved the effectiveness of the C Map program.

C Maps provide graphical presentation of concepts. As expected, the C Map technique aided the students in learning and helped them excel in the course.

The final project presentations done by the mentees were very impressive. They reflected the confidence gained by them about the concepts learnt. It clearly showed that the mentees had better grasp of the course material than the students in the traditional group.

The mentoring sessions were cordial and had supportive learning environment. The students felt free to express their thoughts and opinions. The students, who did not participate in classroom discussions, participated in the discussions held in small groups in the mentoring sessions. The group discussions held helped boost the confidence of the students.

VI. Conclusion and Future Work

The lessons learned from the implementation of the pilot program have helped the project team prepare for the Spring 2009 semester. As a measure to increase the interaction between the mentors and mentees, the mentoring sessions are reduced to one-to-one interactions with the mentors. Struggling students will be identified to meet with the mentors and receive mentoring on academic and personal life issues. The goal is to increase the level of the role of a mentor in a mentee's academic life. The hypothesis is that a role model might help increase retention. In addition, mentors will be attending lab sessions for a short period of time to help the students in their labs as a preparation and a personal introduction to socializing with mentors.

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