AC 2012-5125: UNDERREPRESENTED STUDENTS MENTORED LEARNING ENVIRONMENT

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Under-represented Students Mentored Learning Environment

Abstract

In engineering programs, under-represented minority students come from many segments of the nation and often experience problems with learning early in their degree programs. Their problems may be associated with inadequate study skills, insufficient prerequisite knowledge, an unfamiliar environment or a host of other things that a degree program can neither predict nor control. Regardless of the cause, the hurdles to learning must be quickly overcome for the student to progress in their degree program and be successful. For these students, identifying learning issues mid semester or later during an advising session that is focused on selecting classes for the next term is probably too late to effectively rescue the student in the current term.

A Mentored Learning Environment was established to provide the predominantly Hispanic civil engineering students at the University of Texas Pan American increased access to the faculty, upper division and/or graduate student mentors and a common study area. The environment is a deliberate attempt to get the new and at risk students to mingle with mature students and faculty without enrolling them in a "special" program. The program's key objective is to get students to teach each other with mentors available to intervene only when necessary. In the Fall 2011 term, the project was started with virtually no funding. Laboratory space that was only being used 20% of the time was made available to students to study in during the unused 80% of the class schedule.

The motivation for this program and its objectives are discussed. Data collected following the first semester of operation is presented and discussed. Conclusions are drawn regarding the programs impact on participating students.

Introduction

Students at every academic level are prone to fall behind during the semester. Underrepresented minority students, especially those entering students that are first generation college bound who's family is unfamiliar with the expectations of college programs, can experience increased risk. Key to "keeping up" is having adequate prerequisite knowledge to comprehend and implement new concepts as they are presented in class. When faced with spending time to refresh or maybe even learn for the first time what an instructor assumes is background information many students often elect to skip the review and jump into the new lessons. It only takes a couple of skips or a wrong turn for a student to be hopelessly lost. Initially, it doesn't seem like much and the student may get most of the introductory concepts. But without adequate preparation and foundation knowledge, the time soon comes when nothing is making any sense. At that point, learning has ceased.

Providing a Mentored Learning Environment is an attempt to place students in a situation where there are resources readily available to learn the little things that were assumed to be there, but

aren't, and to be available in a manner that they are comfortable using. The environment requires the availability of space and knowledge. The space is necessary to provide a study area with some level of comfort, structure and organization. The knowledge is to share. How does knowledge increase? By using it; and teaching is a practical use. Space is a scarce commodity on any campus but knowledge is abundant.

Students naturally look to the course instructor as the ultimate source of knowledge in a course. The typical classroom situation is an attempt to pass (possibly even force feed) the instructor's knowledge of a subject to enrolled students. The attempt to pass along knowledge may be accomplished by leading the class through a curriculum using discussions, lectures, slide shows, example problems, assignments, projects, etc. There are all kinds of tools to help with this. Devices like smart boards, document cameras, clickers, online recorded video, and even some old standards like chalk and books as well as a host of techniques such as lecturing, experience based learning, challenge based instruction, and numerous other methods (Kolb, 1984; Barr, 2007). All of the aforementioned have been used successfully all over the world; however, some students still just don't get it. They need a little more, some need a little one on one attention. In a large class, it doesn't take long for the instructor to run out of "one on one" time and regardless of when an office hour is posted, it's probably not at a time when many of those that need help, can get help.

To solve the problem, consider using the knowledge accumulated in the entire academic community, not just that of the instructor. Put students in a collaborative environment (King, 2004). Traditionally, a TA might be hired; graduate students cost less than an instructor and they can be persuaded to make more time available than most instructors just by paying them. They can be knowledgeable enough and it's good experience…for the TA. Hopefully, all those that passed the class the last time it was offered also qualify as "knowledgeable enough"! And many of these students may already have a social acquaintance with the current students. Even if they don't, developing one might be good…for the students and the program.

Situation

A civil engineering program was recently introduced in a college with five other well established and supportive engineering departments. The student population is over 85% Hispanic and more than 50% are the first generation in their family to attempt college. The civil engineering program immediately experienced unpredicted growth. After the first year the three new professors hired to facilitate the program found themselves trying to advise 237 declared majors at the same time they were learning all the ins and outs of a new campus, debug a new degree plan and prepare three or four courses a term. The time for helping students "one on one" quickly disappeared. The students were excited to be involved in a new major, but most had deficiencies of some sort and some enrolled in courses well above their academic ability.

A quick inventory of program resources revealed that lab space dedicated to 3 courses in the Civil Engineering curriculum was only used 9 hours each week. The lab and a conference/break room were located in the same hall as the Program Office and the faculty offices, and funding for one Teaching Assistant was available.

Identifying Student Needs

Nothing benefits a student more than having successfully completed a class. The pinnacle of success is having gained a working knowledge of the subjects studied and the confidence to use that knowledge independently. Passing a class instills confidence in one's ability to accomplish increasingly difficult subjects. On the other hand, few things are more demoralizing than failing a class. Students are advised to insure that they progress along an academic path with enough foundation knowledge to be successful, pass classes and continuously move toward graduation. Skipping steps in a degree plan almost always results in some kind of setback; therefore, it is essential that students be positioned at the correct starting point and not allowed to deviate from the plan. To accomplish this, regular advising and strict adherence to a degree plan is common in engineering programs. Similar measures need to be taken at the course level.

On the first day of class, are all of the students prepared to start? Do the students have the same expectations as the instructor? How does the instructor determine who is prepared to move on; who has arrived expecting to work at the level they will require? The instructor determines this by assessment. A mature teacher may be able to discern the preparation of a class by gazing out into the sea of glassy eyed faces on the opening day of class and "read" the disposition of each attendee. Others may rely upon some type of instrument, a survey or quiz that reveals the range of ability within the class. Identifying those students that shouldn't be in a class on the first day, the students that don't have the prerequisite knowledge to move ahead, should be a priority and the identified students should be advised of their deficiency. Those students need to give their immediate attention to acquiring the prerequisite knowledge. Some may be able to quickly review and build enough competence to continue in the class; others should take the time to repeat the prerequisite course, master the material and attempt the course at a later time.

It takes a great deal of effort and discipline to assess and sort the enrollment of a class on that first day and especially to set a student back; however, after assessing the class all of the students allowed to continue expect the instructor to provide an environment and experiences that will result in the class obtaining an accepted level of proficiency in course related knowledge. The students should also realize that they play an important role in the conduct of the course. They need to participate and do the assignments. There isn't a magic task to accomplish after the final grade is posted that will miraculously install the required knowledge and thus justify posting a passing grade. The knowledge is gained by working the assignments and for the engaged student, maybe by going a little beyond what is required in each, or at the least some, of the lessons. During the term, constant assessment is required to determine which students are progressing and which are falling behind. The students falling behind are the students that need

some degree of extra attention. However, if this group begins to dominate a class the progress of the course and completing the curriculum could be in jeopardy. Therefore, it is critical to identify those out of step and get them back in step as soon as possible.

Continuous assessment, although required, cannot burden the instructor to the point that it interferes with the curriculum. Short quizzes, one liners or verbal questions and in class challenges may be all that is required to assess a concept and confirm that it has been accomplished. The confirmation should be valued by both the instructor and the student. Of greater importance to the student may be the revelation that a concept has NOT been accomplished. It is at this point that *the student* needs to do something extra to catch up. If a significant portion of the class has not yet mastered the subject, the instructor may need to provide additional discussion and/or assignments to clarify or reinforce the topic. More often, individual students need to take control of their own destiny but many just don't know how.

Addressing Student Needs

Determining that a student is behind isn't nearly as difficult as finding ways to help them catch up; however, in the end, it is the student that has to do the work to either stay up or catch up. Programs can smooth the way by providing pathways and support. However, the student that “doesn't have time” to do the work, follow the path or use the provided support, probably should not have taken the class. They need to re-evaluate their commitment to their future. Instructors are a finite resource. They only have so much time and much of that must be dedicated to the preparation of the course and its presentation, plus the service and professional development expectations. Instructors do need to be available to students outside of the class room, but "one on one" may not be very efficient or affective for the overall needs of the class. Providing a Teaching Assistant or tutor can be helpful, but also has limitations and constraints. An often untapped resource is the pool of knowledge accumulated by the students themselves.

As a whole, students in a class and those in the program that have already taken the class, possess significant knowledge of the subject. This is especially true in aspects of the subject deemed to be the "essential minimum knowledge" that is required to pass a course. In any class, there are those students that only need to hear it once, be shown once, or go through the procedure once to have mastered that aspect. These knowledgeable students are a resource that students without a complete understanding can and should tap. These students often have time available and may even enjoy sharing what they know with their peers (teaching). Interestingly, it's not always the same students doing the teaching in every subject. Jill may teach Jack in hydraulics and Jack may reciprocate in structures.

The problem in networking student knowledge lies in establishing and controlling the network. Some degree of observation and supervision is required to prevent the proliferation of bad information. To get the students started, the best situation is a spontaneous sharing of ideas during an unsolicited gathering (open a door, let them use a room). Next best might be the

formation of student cohorts using students that have expressed a desire to study in a group environment. Workable, is the group of struggling students identified in a class and assigned a study hall to catch up. In each of these situations, the groups will in time self identify the leaders and followers. Group leadership roles may change as different topics are pursued. Regardless of who controls the direction and pace of the group, no one in the group should ever be overlooked or prevented from teaching what they know to the others. If the groups are heterogeneous enough, members of the group with greater experience will naturally mentor the less experienced. In the case of a more homogeneous group, a mentor with a higher level of knowledge may have to be provided. An upper division student, graduate student or even the instructor could be strategically introduced. And in the case of a group that has been selected specifically to catch up, a mentor with demonstrated competency in the subject needs to be provided. External to the group, a fall back source of ultimate knowledge needs to be available, usually this will be the instructor or another member of the faculty. The students need to feel comfortable approaching the faculty with any question or situation that they have not been able to work out on their own. However, the best solution is for the instructor to direct the group along a path of investigation until the group eventually solves the problem on their own.

To address student needs, the students must eventually do their own work. Even when done in a group setting, each student needs to be working through every step of a problem, making decisions regarding the next step, doing their own calculations and formatting their own solution presentation. To facilitate this it is helpful to have a room with tables or benches that students can work around individually or in groups. The room doesn't need special furnishings, it does need enough space to not crowd the group, and it should be capable of isolating the group from outside distractions. Any software or reference materials that the course/program uses should also be readily available.

Establishing the Mentored Learning Environment

The first step to establishing the Mentored Learning Environment was taken when the program director recognized that unused lab space could be utilized for a study hall and unlocked the door to the lab. The open room was advertised to students in classes and by word of mouth as being available to study groups and individuals. The room was immediately utilized by program students that were searching for a study area. Within days they requested dry erase markers so they could use the room’s 12' whiteboard in their discussions. The lab has Wi-Fi connectivity to the campus network so the students brought in their own laptops and print using a nearby campus computer lab. During the term several informal groups began to be developed. Some of these requested to use the lab on weekends or later at night. The faculty monitored activity in the lab and professors were able to stop by unannounced and look in on their students. Whenever an instructor showed up, they were asked questions. Eventually, funding for a graduate student was made available to act as a tutor and the program's conference area was opened up to facilitate smaller groups working with fewer distractions.

Results

As students began using the Mentored Learning Environment to study, lower division students began interacting with upper division students. Freshmen were invited to the lab to study calculus, chemistry and physics. They were encouraged to interact with other CE students and use the tutor. Camaraderie within the program increased. Seniors preparing for the Fundamentals of Engineering exam were provided opportunities to explain math and science concepts to freshman and reinforce those concepts in their own mind. There was no change in the utilization of instructor office hours. And groups of students began teaching each other. The academic performance of students using the facility noticeably improved almost immediately; homework assignments were on time, homework was done in a neater manner and solutions were better thought out.

The initial study hall success resulted in some formality and the coining of an identity. The program faculty didn't want students to use the lab space just to meet together and copy homework solutions from a solution manual downloaded from the internet; a process many students currently consider "studying." They hoped the students would openly discuss course topics, readings and assignments among themselves and work problems out while teaching each other. Formally banning the use of published solutions in the lab has been seriously discussed to promote more open discussion, experimentation, and *learning*, but has not yet been enforced. By identifying the lab as a space for mentored learning, the program is encouraging students to do more than just work out problems in a study hall. Students are encouraged to become acquainted with each other, to help their peers and accept help from their peers.

In the second year of the program, additional structure was implemented. In courses that were known to have high failure rates, at risk students were advised early in the semester to commit to meeting in the lab with the tutor at a scheduled time for 3 hours a week. Engineering Mechanics, the course with the highest failure rate (up to 50%) in the program, was singled out as the course where the greatest impact might be made in the program and a focused effort was made to identify the at risk students. Initially students were identified midterm (in part because the process evolved in the first 8 weeks of that term). In subsequent semesters, a pretest is being used to identify at risk students as early as the first day of class. Participation in the program is voluntary and no credit or deficiency for either attending or skipping the lab is included in the course grade.

In the first attempt, the Mechanics course only had an enrollment of 15 students but 9 were advised to seek help and participate in the scheduled 3 hours of study with the tutor. Out of the 9 students advised, 7 agreed to participate. All 15 had the option to participate and several of the better students used the lab without committing to the structured 3 hours; some of the students often used the lab and tutor for more than 3 hours per week.

The 6 students in the Engineering Mechanics course that agreed to participate in the Mentored Learning Environment met regularly with the tutor for approximately 9 weeks. All but one of the students participating in the tutoring passed the course and all of the participants (including the student that failed) experienced improved performance as a result of their effort. One participant asked that the program have mandatory attendance so that family demands to work instead of study could be thwarted (work to support family vs. study to achieve self-improvement is a common conflict that students in this program have to resolve). The distribution of grades for participating students was: A(0), B(3), C(2), F(1). The student that failed showed improvement in understanding concepts and the quality of work during the term, but was unable to pass the final exam. The final grade distribution for all students enrolled in the course was A(3), B(5), C(5), F(2). The other student failing the class did not attend class regularly, had no interest in the tutoring offer and did not take the final.

Conclusions

It was observed that making laboratory space available for students to study in with minimal supervision and having basic tutoring available resulted in improved student performance and significant student interaction. This was a very low-grade and inexpensive study conducted out of a combination of opportunity and necessity. The effort has provided an excellent ROI. Faculty with limited time to interact with students one on one are able to meet with groups of students on a scheduled or unannounced basis and better use their time (they still maintain office hours and meet with students one on one as time permits). The students, in teaching each other, are gaining confidence and expanding their knowledge of course materials. The study area is in close proximity to faculty offices and students ask for guidance when they are really stuck. The students are also building a social network within the program that is beneficial and feel like they are an integral part of the program.

The program plans to continue offering the Mentored Learning Environment to all interested students and encourage students that are identified as at risk to make a special effort to frequent the lab, use the tutor, work with the faculty and get to know their peers.

References

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