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A Quantitative Assessment of the Benefit of a Learning Community Environment

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Abstract - An introductory course in manufacturing processes was taught to a cohort of engineering technology students participating in a learning community (LC) experiment and to a group of non-participating students. The LC students were all freshmen and took all the courses as a group. They were encouraged to work in teams. Non-LC students were also encouraged to work in teams but their class schedules were not coordinated. Data were collected on test scores, homework scores, and homework completion rates. The data show that the standard deviation of the grades distribution is significantly smaller for the LC group and that outliers with failing scores are not present. The non-LC group had a significant number of outliers with failing scores. These results are interpreted to mean that the LC was successful in integrating first year students into study groups. The study groups facilitate learning by increasing attendance, class participation, and homework completion.

Index Terms – Learning communities, Engineering, Engineering technology, Manufacturing, First year.

Introduction

The simplest learning community (LC) is a group of students that take some or all courses together [1]-[6]. The students benefit by developing support relations with their peers and teachers. At the Rochester Institute of Technology (RIT), the LC also includes faculty, who coordinate activities and share observations of student behavior and performance.

One major benefit of a LC is that teaching of different subjects can be coordinated and the student can see complementary and even contradictory information presented in a less confusing manner. It is easier for students to make the connections between subjects when the material in multiple courses is presented in a coordinated fashion.

For first year college students, the LC can be instrumental in easing the transition from high school and the home environment. Further, participating in a LC has been correlated to increased student effort and performance in their courses and to increased overall satisfaction with their college experience [7]-[8].

A benefit of the LC for participating faculty is that they communicate and exchange observations about the behavior and performance of individual students. This results in a more holistic view of the students that cannot be achieved by observing their behavior in only one classroom.

Two pedagogical research schools support the use of LCs, 1)developmental theory and 2)cognitive science. Developmental theory proposes that students learn when exposed to novel situations that induce disequilibrium [9]. Cognitive science stresses the importance of making connections to previously known facts [10]. LCs provide the interdisciplinary and interactive environment that forces students to think about their experiences in deep and complex ways, by providing diverse viewpoints and explanations and by facilitating complex peer to peer and student/teacher interactions that result in richer and more complex ways of thinking about a subject. The end result is deeper and more complete understanding of the material studied.

In engineering education, the work of Professor Richard Felder [11]-[12] and of Roger and David Johnson [13] also indicate that cooperative learning is more effective than individualized or competitive learning and will result in increased self-esteem. According to research, cooperative learning is the most beneficial for students with disabilities, and for the introverted and the extroverted [14].

Experiment

During the 2004-2005 academic year, RIT organized LCs for first year students in the same department. For students in the Mechanical and Manufacturing Engineering Technology (MMET) Department, the primary additional requirement was to be enrolled in pre-calculus, instead of Introductory Calculus which is the normal mathematics course taken by first year students in their first term of study. The other courses included in the LC were English and Literature, Freshman Seminar and Introduction to Manufacturing Processes.

All students in the MMET Department, LC or not, are encouraged to work in teams, in preparation for careers as engineering technologists. This includes projects and assignments specifically assigned to a team as well as encouraging students to study together and consult their peers in and outside the classroom, except during exams.

Most of the students in the Introduction to Manufacturing Processes course are first year students in the MMET Department, but in addition there are students from other Departments and Colleges for whom this course is a 3rd or 4th year elective. There is also a significant number of 2nd year students who transfer into the department from other departments, primarily from engineering and science specialties. There were a total of 21 students in the LC group

and two groups of non-LC students with a total enrollment of 73.

The course Introduction to Manufacturing Processes is a survey of the basic manufacturing processes divided into the broad areas of joining, machining, casting and forming. Team assignments take the form of Case Studies and proper grammar and use of the language is important in the team report. There is also weekly homework, one midterm exam and one final exam. The majority of points that are used to calculate the final grade are in the weekly homework. There is also a lab portion to the course, where students learn to use some of the equipment studied. This is done in teams of two.

Results

Tables I and II contain the statistics describing the performance of the LC and non-LC students in the Introduction to Manufacturing Processes course. The average grade point average (GPA) for the LC group was 81.9% versus 80.8% for the non-LC group. Although the difference in GPA is not statistically significant, the fact that the LC group did as well as the regular students is remarkable because LC students were selected for their weakness in mathematics, and there is a modest amount of mathematics in the course. The same results are observed for the laboratory portion of the class in which the LC average was 187 points out of a possible 200 and the non-LC average was 177. Again, the difference is not statistically significant. However, one interesting observation is that the highest and lowest grades were in the non-LC groups.

Table I GPA Statistics		
GPA	LC	non-LC
N=	20	73
AVE=	81.9%	80.8%
STDV=	0.07	0.15
MIN=	65.4%	4.5%
MAX=	93.6%	96.5%

Table II Lab Grades		
LAB	LC	non-LC
N=	20	73
AVE=	187	177
STDV=	6.19	38.38
MIN=	176	0
MAX=	196	200

Even more significant than the GPA is the large difference in the standard deviation of the grades. For the LC the standard deviation of the GPA was 0.07 and for the regular students it was 0.15. This difference is statistically significant at the 99% confidence level as shown in Figure I. This appears

to indicate that LC students studied together and that all students achieved the same level of understanding of the material. This is confirmed by the fact that there were no stragglers or overachievers in the LC. The difference in the standard deviation is even more dramatic for the laboratory grades at the 99% confidence level as can be seen in Figure II.

Figures III through VI show the histograms of the final GPAs at the end of the course, and the histograms of the laboratory scores. For the LC all grades fall between 65% and 94% whereas for the non-LC they are spread between 5% and 96%. The most interesting scores are the failing outliers seen in the histogram for the non-LC students. There are two students with less than 20% GPA and three additional students between 20% and 60%. The lowest two belong to students that stopped coming to class after the second or third week of class and the other three also dropped out of the class before the end. Such outliers are absent in the LC. These results confirm the previous observation that the LC students are a closer knit group that studies and learns together.

One student in the LC had medical problems all quarter and missed class on and off during the quarter. Early in the quarter his irregular attendance was noticed by the faculty and, only because of the regular communication, it became obvious that something was wrong. Without the sharing of notes it is probable that the student would have disappeared from the classroom and ended as an outlier. Instead, the noticeable absence from multiple classes resulted in special attention and help from the faculty and peers, and intervention by the university's academic counseling group. The student's parents were notified and were involved in the effort to help. In the end, the student's illness was too much to overcome and he requested a leave-of-absence (LOA). His grades are not included in this report but he had a passing grade in the Introduction to Manufacturing Processes course until he was granted the LOA. All the effort focused on this student was a direct result of the LC environment and compares favorably with the non-LC students in which the support system is more impersonal and consists of mailing warnings of potential failure to the student, departments and advisors on the third week.

The LC also had a positive effect on the weekly homework performance. All students were encouraged to work as teams to complete the homework as long as they delivered individual solutions. The accumulated GPA for the homework was 82.37 for the LC and 79.89 for the non-LC (see Table III). Also confirming the results in favor of the LC was the number of homework missed, which was 3% for the LC and 6% for the non-LC.

Table III
Rate of Homework Completion

<u>HW</u>	<u>LC</u>	<u>non-LC</u>
AVE=	82.37	79.89
Missed=	4	29
TotalHW=	132	452
%Missed=	3%	6%

Discussion of Results

The Introduction to Manufacturing Processes course had identical content and requirements for LC and non-LC students. From the data it appears that the LC was effective in helping the students to integrate into study groups and is a support mechanism that prevents students from losing the motivation to attend and participate in the classroom. In a situation where a student is having problems, he/she can be easily identified and will have support from sources internal and external to the community not normally available to students that are not members of a learning community. The payoff is the reduction or elimination of failing outliers and, eventually, higher student retention.

In addition, it appears that this group of LC students, selected for their deficient math skills, performed above their usual level of performance by achieving the same grades that regular students earned. Although the LC students did not get higher grades than the non-LC students, they first were at a disadvantage because they did not have as good preparation as the typical non-LC student.

Conclusion

Learning communities will reduce the number of students that for various reasons stop attending and/or participating in the courses in which they are registered. This is because of the greater visibility of troubled students, and because of the many support mechanisms available to learning community students and faculty. The end result is a higher retention rate.

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