# Enhancing Learning Through Cooperative Learning: UTM Experience

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***Abstract*** - Lecture-based classes are the predominant teaching method in all levels of education. This teaching style, undoubtedly is able to deliver knowledge to students and produce graduates. However, this teaching technique is usually unable to invoke higher level of cognitive skills. With an ever-growing volume of knowledge that must be covered in engineering education, an alternative technique must be used to enhance learning. Co-operative learning is a proven teaching technique that is able to enhance students' learning through active learning. This technique has been widely accepted in engineering education in the United States, Europe, United Kingdom and Australia. In UTM, lecturers from different faculties of engineering implement cooperative learning in their classes. The main aim is to induce better retention, in-depth understanding and mastery of knowledge among students. This paper shows how cooperative learning successfully enhance students' learning by looking at the performance of their grades in different engineering classes.

**Keywords: Cooperative learning, learning enhancement, engineering courses**

## 1. Introduction

Lecture-based classes are the traditional teaching method in all levels of education. This teaching style undoubtedly is able to deliver knowledge to students and produce graduates. However, in recent years, the expectations on our graduates have increased. Graduates are expected not only to acquire technical knowledge but also should be well equipped with soft skills. Soft skills, also known as generic skills are non-technical skills, abilities and traits. These skills are not inherently embedded in each individual. They can only be acquired and developed through regular practices. As for an engineer, it is more critical to adapt and acquire these soft skills because of the nature of works that requires them to be able to pose and demonstrate several crucial skills.

Local universities are currently challenged with critics from industries and employers on the quality of local graduates. Industries and employers become more demanding when they want our graduates to have better oral and written communication skills, teamwork skills, critical and creative thinking skills and problem-solving methods. Besides, graduates are expected to be conversant with engineering ethics and the connections between technology and society.

One of the main issue needs to be addressed is that local graduates are claimed to be unable to apply what they have learned in the university to the workplace. The demands from industries and employers cannot possibly be fulfilled using the current approach to educating engineers. The issue of local graduates quality is not only a concern to the employers but also the Board of Engineers Malaysia (BEM), which listed ten attributes of an engineering graduate.

Considering high expectations and pressure from various parties on our local engineering graduates, it is time to change the teaching styles and learning environment. The reality is that better teaching methods do exist. Engineering education needs teaching methods that are able to invoke higher level of thinking besides develop soft skills among students. One of the best ways to achieve these is by using cooperative learning in the classroom.

## 2. Cooperative Learning

Although developments in education are very impressive in recent years, especially on methods to facilitate learning more effectively, many engineering classes are still taught exactly in the same way as decades ago [1]. In typical engineering classes in universities in Malaysia, students are taught using lectures. Students would seem to understand the material, but most would commonly fail to perform in quizzes and tests. It is normal to observe that students start to lose their attention after fifteen minutes of the

class. By the end of a one-hour class, some students are already falling asleep especially when they cannot appreciate or understand the materials taught. Even a gifted and an experienced lecturer has trouble to sustain class attention for a 50 minutes to one-hour lecture [2].

Due to this scenario, it is not surprising to see studies revealing that students can only recall 70% of the material presented during the first ten minutes and 20% of the material of the last ten minutes [2]. Besides, studies also reveal that students tend to remember 50% at most by hearing and observing. However, the percentage can increase up to 90% if they are actively involved in the learning process by saying out, discussing and doing related activities [3].

In pure lectures, the lecturer dispenses knowledge in the classroom and students passively absorb it. Research shows that this mode of teaching is only effective to present large body of factual information that can be memorized and recalled within a short duration of time. However, if the objective is to help students to retain the information in long term and to stimulate their interest in a subject, learning activities that involved students actively are more efficient [1]. This facts show that students' learning can be enhanced through active learning. Active learning engages students in doing something besides listening to a lecture and taking notes. Students may be involved in discussion, or writing, reading and reflecting individually in the classroom. As long as they are engaged and actively involved, the learning process becomes more effective and help them to understand learning materials better.

One form of active learning that can assist students in learning and understanding the subject is cooperative learning. Cooperative learning is active learning that involves the collaboration and interaction of students in teams under the following conditions [2]:

- Positive interdependence between team members to accomplish a task
- Individual accountability in completing their share of the work and mastering all material
- Face-to face interaction in at least part of the task
- Appropriate use of interpersonal skills, like communication, leadership and conflict management.
- Regular self-assessment of group functioning to identify any improvements that need to be made and maintain those that functioning well.

Cooperative learning is different from the regular group project. Cooperative learning is a formal instructional model in which lecturers carefully design lessons and activities that are suitable for use by teams of students. These teams are small, heterogeneous, stable and adequately prepared and motivated to work together. In cooperative learning, the main idea is to get students actively involved in teaching and learning processes. Involvement of students is critical for effective classroom learning. Therefore, in cooperative learning, well-designed activities are interspersed along a lecture. These activities can take less than a minute, or as long as 15 minutes. Among the activities that can be carried out is by asking the students to discuss several realistic situations in which engineers are required to understand the phenomena and solve the problems. By doing this kind of activities, students will be more excited to learn and think deeper. Students tend to study hardest and learn best what they are interested in and believe they have a need to know [4, 5]. Once students are asked to work on a problem in groups, the class becomes lively. Almost all students talk about the problem, some are arguing and laughter can be heard occasionally. To have all students talking about learning material excitedly is almost impossible in a traditional lecture-based classroom.

University Teknologi Malaysia is a university with the most number of engineering courses and faculties and the largest number of engineering students in Malaysia. There are Faculty of Chemical and Natural Resources Engineering, Faculty of Electrical Engineering, Faculty of Mechanical Engineering, Faculty of Civil Engineering and Faculty of Geoinformation Science Engineering. Each faculty offers various engineering courses for undergraduate and postgraduate levels. Before this, almost all engineering courses in UTM were taught using traditional lectures. Until recently, starting last year, UTM has been introduced to the concept of cooperative learning and problem-based learning. Four series of workshops and courses on critical thinking and problem-based learning were conducted for forty selected lecturers, representing all faculties in UTM. After attending the third series of the workshops, three lecturers from Faculty of Chemical and Natural Engineering Resources (FKKKSA) conducted a one-day workshop on cooperative learning and problem-based learning for other interested lecturers in the faculty. The objectives of the workshop were to introduce these two new teaching techniques besides to explain the steps and methods of implementing them. Since then, there have been several lecturers started using cooperative learning as another mode of teaching. Mostly 90% of the lecturers attended the workshop organized in FKKKSA tried implementing cooperative learning in their classes in the coming semester. A few lecturers who attended the four workshops series organized by the university were also identified to have used cooperative learning in their teaching. Several lecturers were also attracted to

cooperative learning from reading and peers' experiences.

This paper presents the responses of lecturers conducting cooperative learning activities and describes efforts in implementing cooperative learning in engineering courses in UTM. This paper looks on the process of implementation by lecturers from various disciplines as well as the outcomes and their concerns about this teaching technique.

## 3. Survey on Cooperative Learning

In conducting this research, a set of questionnaire was designed. The questionnaire consists of 25 questions. The questions concentrate on the issues of cooperative learning implementation methods, impact of cooperative learning on students' learning and development of soft skills, and problems and concerns of lecturers involved upon the cooperative learning implementation.

The questionnaire was distributed to fourteen respondents. These respondents are lecturers from three different engineering faculties in UTM. Eleven of them are from Faculty of Chemical and Natural Resources Engineering, two from Faculty of Electrical Engineering and one from Faculty of Mechanical Engineering. These lecturers are identified to have used cooperative learning as part of their teaching approaches in their classes.

Some of these lecturers have implemented cooperative learning aggressively. Some of them are really satisfied with the outcomes of this learning process. Consequently, after implementing cooperative learning for two semesters or more, they decided to use cooperative problem-based learning in their teaching. Nevertheless, half of the lecturers are still cooperative learning novices, and implement cooperative learning partially in their classes.

The results of this survey will be discussed in detail in then next section.

## 4. Response to Survey

Fourteen lecturers responded to the questionnaires given where one was from Faculty of Mechanical Engineering, two were from Faculty of Electrical Engineering and the rest were from Faculty of Chemical and Natural Resources Engineering. The number of female lecturers implemented cooperative learning almost double the number of male lecturers. Nine female lecturers and five male lecturers are identified to have tried this teaching method in their classrooms. Some of these lecturers are very experienced while some are inexperienced junior lecturers. Their length of service as academicians ranges from as little as two years to twenty years. Five lecturers are novices with two years of teaching experiences while the others have been teaching for more than ten years. It seems like cooperative learning is more attractive to either very junior lecturers or very experienced ones.

Results from these questionnaires show that majority of the lecturers who implemented cooperative learning admitted that they first found out about this teaching technique from attending workshops or courses. Nevertheless, reading related books, papers and websites and input from peers were also among major factors that attracted them to use cooperative learning. Almost half of these lecturers implemented cooperative learning for the first time last semester. However, there are four lecturers who had used cooperative learning as their teaching method for more than four semesters. Only five lecturers implemented cooperative learning to first and second year students.

Ten of these lecturers had 31 to 60 numbers of students in their class. In FKKKSA, the maximum number of students per section is sixty. Several faculties, such as Faculty of Electrical Engineering and Faculty of Mechanical Engineering have large number of students per class, which ranges from 91 to 120. Basically, number of students does not matter, as cooperative learning is suitable to be implemented in both small and large size classes. All lecturers surveyed conducted their classes in classrooms instead of in lecture halls. Classroom was more preferable since it was more flexible for students to rearrange their seats during cooperative learning activities sessions.

In term of group formation, only three lecturers, including a lecturer who taught Master students, let students to form their own group. They believed students were mature enough to choose their own group members that would be beneficial to them. For the other lecturers, they divided students into group of four or five based on students' academic performance, gender and race. Nine lecturers received good responses from students on cooperative learning implementation whereas the others felt that their students showed excellent responses. Out of fourteen lecturers, ten implemented cooperative learning alone by him/herself. Only one lecturer made an initiative to team up with junior lecturers in implementing this teaching method. Among the main reasons that make them decided to try cooperative learning are to make class becomes livelier and to enhance students' learning besides their own self-initiative to try new teaching methods. In term of time allocation issue, almost all lecturers agreed that cooperative learning required more time for class preparation compared to common class.

However, only half of them claimed that cooperative learning took more time to cover a topic in class compared to pure lectures approach. These are inexperienced lecturers applying cooperative learning for the first time. Therefore, they do not know what to do if they are unable to cover the syllabus within the class time.

Despite several drawbacks on cooperative learning, all lecturers agreed that cooperative learning did bring a lot of advantages. For instance, students' overall results had improved in the semester/s they implemented cooperative learning, where lower failure rate and higher passing marks were demonstrated. Cooperative learning also gave students better and deeper understanding on the materials learned. Students enjoyed coming to class more than attending common class and class became much more lively. Lecturers also admitted that cooperative learning had successfully embedded students with team working, communication, critical thinking and adaptability skills as well as higher self-discipline.

## 5. Recommendations

All lecturers surveyed are determined to incorporate cooperative learning in other courses they will be teaching in the future. One of the reasons is they feel very happy with the students' more positive attitudes shown when cooperative learning was being implemented. Students were more eager to attend classes and participate actively in class discussions. Students also became more independent when preparing for a class and this could stop or at least minimize spoon-feeding culture.

All lectures also think cooperative learning is suitable to be implemented in other subjects in their faculties. Numerous engineering subjects including Thermodynamics, Electrical Technology, Power System, etc. were recommended as suitable or better to be taught using cooperative learning. There are also several lecturers who think that cooperative learning is suitable to be used for all engineering subjects. After implementing cooperative learning, these fourteen lecturers discovered a lot of positive attributes about their students. Class attendance was better, students showed higher self-confidence and responded immediately when class problems were given. Students were also more eager to read their textbooks and other recommended reading materials and they were able to accomplish many things with minimum supervision. One of the lecturers even noticed that her students are becoming more intelligent and they can think cleverly when given the chance.

However, it cannot be denied that these lecturers faced several problems in implementing cooperative learning. Unsuitable class timetable and a large number of students per class were among the most common problems faced. New lecturers found increased preparation time as well as time limitation for in-class activities were major problems for them. Some lecturers faced a problem in facilitating all groups within the one-hour class duration. And one of the biggest problems was the existence of students who refused to cooperate hence their groups became dysfunctional. The problem of dysfunctional groups were faced by several lecturers and they were able to tackle this problem successfully by reminding students of their teamwork responsibility from time to time. Counseling the students individually could also solve this problem. Frequent in-class spontaneous oral quizzes could also address this problem effectively.

Many suggestions were also given by these fourteen lecturers to improve the effectiveness of cooperative learning implementation in UTM especially in the engineering faculties. A major suggestion was to obtain strong support from the university's top management to conduct more courses or workshops in raising awareness on cooperative learning among lecturers and students in UTM. In addition, smaller number of students per class and better facilities were also among the suggestions given to improve the teaching and learning in UTM.

According to these lecturers too, most students were happy to be part of the given group. The following are some positive comments from students shared by several of these lecturers:

- I have more confidence in performing much better in other subjects.
- It is amazing that this subject is actually not difficult as seniors claimed.
- I used to skip classes on purpose but not with your classes.
- Eager to share knowledge with friends outside classroom.
- Start implementing cooperative learning for first year students.
- You are the best lecturer in the faculty!

These written comments were obtained at the end of the semester. From the comments, it is clear how much students realized the advantages of active learning especially cooperative learning and working in groups.

## 6. Enhancing Learning Through Cooperative Learning: A Sample Case Study

Two sets of students' overall marks were given by one of the lecturers surveyed from Faculty of Mechanical Engineering as the example of students' achievement upon cooperative learning implementation

in this paper. Six regular sections of the Introduction to Industrial Engineering subject were offered last semester (2003/04-02) with five lecturers teaching this subject. One of them was the one surveyed for cooperative learning implementation who is a very experienced lecturer in this subject. This lecturer taught two sections, which were section 3 and 4. Section 3 had 70 students consisting mostly excellent students (good grades students). Section 4 had 58 students. Majority of the students in this section were weaker students (moderate grades). In section 3, the lecturer used pure lectures approach while section 2 was taught using cooperative learning. Students in all six sections sat the same tests and final exam individually. Standardized marking was done where questions in tests and final exam were graded by the lecturer who set the respective questions to ensure consistency in marking the exams.

Figure 1 illustrates the distribution of marks (out of a total of 100%) for section 3. The passing mark for UTM is 40%. Out of a total of 70 students, there was approximately 4.3 percent failures. 37% of students, the highest percentage of students in the mark distribution, obtained overall marks in the 55 –64% range (both the 55 – 59% and 60 – 64% ranges were obtained by 18.6% of students in the class). Only 18.6% of students scored above 80% (11.4% in the 80 – 84% range and 7.2% in the 85 – 100% range).

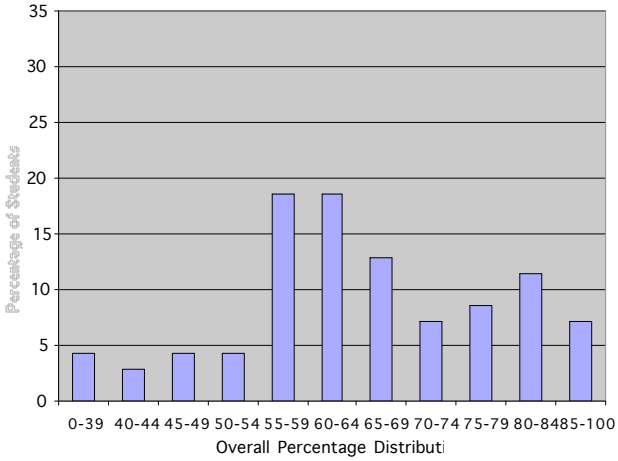


Figure 1: Distribution of overall marks for section 3.

*Figure 2 shows the results distribution of students in section 4. There were 58 students in this cooperative learning implemented section. Students were divided into groups. Students were involved with in-class group discussions and were given group assignments from time to time. From Figure 2, there were no failed students in this section. Only 5.2% students obtained total marks between 40 to 54% (1.7% in the 40 – 44% range and 3.5% in the 50 – 54% range). This percentage is very small compared to section 3 where 16% of the students scored below 54%. Surprisingly, almost 50% (46.6%) of students obtained overall marks above 80% (29.3% in the 80 – 84% range and 17.2% in the 85 – 100% range). This is a significant improvement compared to pure lectures conducted in section 3.*

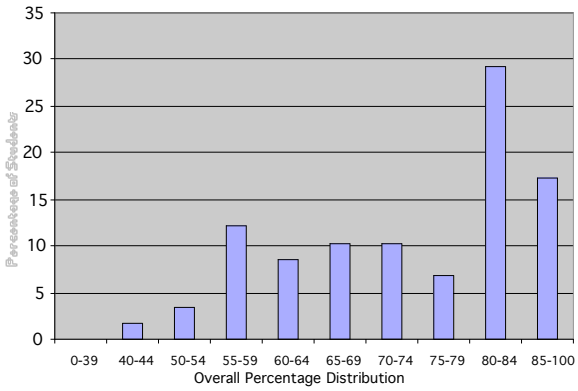


Figure 2: Distribution of overall marks for section 4.

In analyzing the results of the students in these two sections, using cooperative learning helped reduce the number of failures and increase the passing marks. And the fact that section 4 was mostly attended by weaker students proves that cooperative learning obviously helped the "not-so-excellent" students to learn better and they could obtain excellent scores if taught using the right approach.

## 7. Conclusion

On the whole, cooperative learning was well received by lecturers who had implemented this teaching method as well as students who went through the learning process.

All fourteen lecturers surveyed showed high enthusiasm on cooperative learning implementation. Their efforts in making cooperative learning a reality by implementing it in their classes should be praised. However, there are many improvements to be made to attract more lecturers in UTM to try this teaching technique in enhancing the students' learning process in engineering.

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