

OPEN LABORATORY

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This paper is prepared for presentation at AEESEAP'99 Midterm Conference
Bangkok, Thailand, May 12-14, 1999

Abstract: *The education imparted to the student today is based on the lecture being done by the faculty and the laboratory work undertaken by the students with the teacher doing the supervision of the laboratory work. The objective of laboratory work is to bridge the gap between the theory taught in the classroom and the actual practice in the field. At present students are not inclined or motivated to learn from the laboratory work because of lack of space, equipment and competent teacher. The open laboratory concept requires each student to actually perform the laboratory work any time the laboratory is open. In doing this the student will have to learn since they individually have to undertake the laboratory exercise and will be checked by the teacher. The open laboratory may require additional personnel space and equipment but if it will be implemented it will result in students learning more from the laboratory work.*

I. INTRODUCTION

A. EDUCATION

A fundamental question that is always related to education is why do people strive to earn an education? The answer to such a question justifies the need of people to be educated. It goes without saying that people are motivated to learn because they consider the knowledge and know how they may gain to be useful and therefore an asset to possess. The main aim of the teacher, therefore, is to see to it that knowledge is imparted or transferred to the student. It is

likewise important that the student does not merely possess the knowledge but must acquire the know how in using that knowledge. Therefore acquiring knowledge is not the end of education, but a means to an end.

There is, however, a paradigm change taking place in higher education. This change states that education is not based on the process (instruction and learning) but is now geared towards the end product or result (learning). The change now taking place transfers the learning process from what was then commonly practiced teacher centered

teaching to what is now known as student-centered learning.

In the process of implementing the paradigm change two important concepts have been raised. The first is the need to have all students learn. The second is how will it be done? In the same manner the teacher will have to answer two questions student will always raise whenever they attend classes. The first question is why do they have to learn the subject matter? The second is where will they use the acquired knowledge? If this questions are adequately answered, the students would be motivated to learn and eventually acquire an education they desire.

B. ENGINEERING EDUCATION

We will now go to engineering education. We first define what engineering education is supposed to mean and that is the development of the student to a creative and highly skilled problem-solver. The knowledge they have gained, the skills they have acquired from their education will have turned them into engineers who investigate problems and find solutions to the basic needs of man. Engineers will make scientific discoveries and find ways to harness them for humanity to use. The degree in Engineering that a student earns will open doors to creative and technical challenges for the engineer to face.

Engineering education is usually done in two ways. The first is formal education. There also a growing trend to earn a degree through distance

education. The formal Engineering education is usually made up of two parts. The first is the lecture aspect which explains the theories and concepts to the students. Most of the time the teacher does the explaining although the students is the most important component of the process.

The second method of educating engineering students is when they have to take up laboratory subjects. The main purpose of having the students take the laboratory subjects is to bridge the gap between theories taught in the lecture class and the actual practice of engineering in the field.

C. LABORATORY CLASSES

Laboratory classes are usually designed to be three or six-hour classes and are held in either three-hour intervals or, in extraordinary cases, for six straight hours. There are two types of laboratory subjects. The first is the laboratory subject offered as a part or continuation of the lecture subject. In the higher years, however, there are laboratory subjects which are not attached to any lecture classes. It should be mentioned that the methods in the offering of the laboratory subjects are the same and the only difference is the fact that the time placed on the presentation and the course for a lecture with laboratory component has more breadth and depth compared to a pure laboratory subject.

There are several objects in the offering of a laboratory subjects and these are the following:

- a. Familiarization with the

- use of equipment, supplies, procedures and testing in the laboratory
- b. Model identification
- c. Validation of assumptions
- d. Prediction of the performance of more complex systems
- e. Testing and compliance with specifications
- f. An explanation of a new and fundamental information

As much as possible, the laboratory should be provided with adequate equipment to serve its purpose. However, this is hardly true of most institutions (due to high cost of equipment), which can barely provide the minimum requirements. There are several ways to maximize the use of available laboratory equipment. One method is to organize students in groups. In the station method, each group is given a complete set of laboratory equipment to do the laboratory exercise. The rotation method allow maximum use of laboratory equipment, especially when these are inadequate. A group will undertake a laboratory exercises with equipment necessary for doing that particular exercise; when the exercise is finished the group will move on to perform another exercise. The rest of the class groups will take their turns in the rotation in doing the various exercises. Some seldom used equipment may be used together by two or more groups but each group must be individually provided with equipment which are constantly used. In large laboratory classes

students assist in classes and can greatly lessen the burden of the teacher as to enable him to exercise better control, instruction and coverage.

II. UNDERTAKING LABORATORY CLASSES

A. WHAT IS TO BE DONE

So that the student may learn in a laboratory class, he/she needs to develop several skills. The first skill the student must develop is the ability to understand and undertake how a laboratory exercise is done. The ideal way to develop this skill in a laboratory class is to give the title of the laboratory exercise and leave it up to the student to find out what the procedure in undertaking the laboratory exercise is going to be. The teacher may give hints to help the student obtain the needed information from either the library or any other source. When a student who searched for information, finds what he sought, and understands it such that he/she can apply the information to correctly undertake the required laboratory exercise, the student will have to learned an important skill. It is of utmost importance that all students in the laboratory class should learn how to undertake the laboratory exercises. The next skill needed in a laboratory class is the ability to perform the laboratory exercise independently and individually. When a student does this he/she learns and understand of the subject matter and develops confidence and self-reliance.

The next skill that the student has to develop is understanding the

relationship of undertaking the laboratory exercise and how it is related to the practice of the profession of the student after graduation. The fourth skill that needs to be developed by student enriched in a laboratory class is the computational skills. This is done when the student has to actually compute the results independently and individually of each laboratory exercise.

The fifth skill that a student has to develop is communication skills, both written and oral. The results of the student's work in undertaking a laboratory exercise will have to be reported and when the student does this he/she improves his/her writing skills. When the teacher will ask a student to explain how the laboratory exercise was undertaken the oral skills of the student are developed.

The last skill that is needed is discipline in doing the laboratory exercise, preparing the laboratory work and understanding the theory why the laboratory work has to be undertaken. All of these will be attained if the student does his/her work independently. These are the important skills needed to be developed by the student while taking a laboratory subject. In some laboratory subject it can be easily learned while in others it will be a problem but it is important that the teachers should strive to develop these skills in their students.

B. WHAT IS HAPPENNING

A laboratory class will consist of around 30-50 students. In order to perform the laboratory exercises the students are divided into groups. The

groups vary in size from 4-12 students. In most cases the size of the groups formed are dependent on the availability of equipment to be used for the specific laboratory exercise. There are cases when the equipment is available but is out of order and cannot be used by the students to perform the laboratory exercise. In most laboratory classes some equipment which are used are not calibrated so that data that are obtained are erroneous.

The laboratory room may not be large enough to accommodate the students in the class so that students who have to perform the laboratory work are not able to do it comfortably. In some cases the supporting facilities such as electrical outlets, gas outlets, water outlets are not available or if it is available it is not adequate. A typical laboratory room will not be able to comply with the CHED requirement of two square meters for each student using the laboratory room.

Most of the time a laboratory class is classified as a secondary class and the teachers who teach the subject are not qualified or have just been recently hired. In such cases students do not learn. The main and foremost problem is that the laboratory teacher is usually paid two-thirds or three-fourths for every hour for undertaking the laboratory class while a teacher is paid full for every hour of undertaking the lecture class.

The typical teacher therefore who is supervising the laboratory class does not understand the theory and the relationship of the subject matter with the lecture or with its importance in the actual practice of the profession.

The students who use this wrong procedure and will do the same thing in the field unless this is rectified within the nearest future.

In a typical laboratory class therefore the teacher is not competent enough to teach the class, the laboratory equipment is not adequate and calibrated. All of these will result in the students not being inspired to learn and what the student will therefore do is just comply with the specific objective of just passing the laboratory subject and then say that a laboratory subject was just a necessary evil for the student to do.

C. PROBLEMS ENCOUNTERED IN LABORATORY CLASSES

Engineering education in the Philippines is beset by lack of laboratory equipment for students to use in doing their laboratory exercises. While this problem may not be much of a bother for small engineering schools, it can be so much worse in schools with large enrolment. There are two possible ways which can solve the problem. The first is the direct way, which is the purchase of as much laboratory equipment, as the school can. This, however, cost money, which most schools can hardly afford to spend. The other way is the use of the open laboratory.

The second problem is doing laboratory exercises in groups of five to six students. The leader performs the laboratory exercise and another acts as a recorder while the rest of the group will just observe how the

laboratory exercise is performed. In a group of five students at one or two students will understand how the laboratory exercise was undertaken while the rest will just copy the results of the laboratory exercise often without understanding how it was obtained. This problem might be minimized by the purchase of additional equipment. However, the problem will still be there because it is impossible to have the needed equipment used individually because of time constraints, space limitation and supervision of so many groups undertaking the laboratory exercise. Using the open laboratory concept of doing laboratory work can again solve this problem.

The third problem is that the laboratory procedure for each exercise should be understood by all members of the class but most of the time this is not true. Again the solution to this problem is by using the open laboratory method. The fourth problem is in small colleges of engineering where the enrollment is small the use of the equipment is not maximized. By letting each student undertake the laboratory exercise this problem is answered.

The last and biggest possible problem encountered in most engineering schools is students have to be spoonfed in order for them to learn something. There is therefore an urgent need to transfer the process of learning from being teacher-centered to student-centered. This means that the student have to be more independent in doing their work so that they will be able to learn and obtain the needed knowledge needed

by their profession. The description of the use of the open laboratory may encourage schools to adapt this method.

III. OPEN LABORATORY

A. Innovative Method of Using Open Laboratory

An integral part of the open laboratory are the work-stations, which are set up in strategic locations in the laboratory room. A station is equipped with supplies and equipment that an individual student will need when performing a laboratory exercises. So that the number of students using the laboratory may be better controlled, the number of stations in the laboratory room is best limited to fifteen. In cases where a school's funds are low, or equipment is adequate, it is recommended that the school should set up only what it can at first, and added others when it can until the number of work stations are sufficient to serve the need. In due time, the number of work-stations will be adequate.

An open laboratory may be used as soon as the work stations are ready. Unlike ordinary laboratory rooms, the open laboratory is open for the students to use as much as 30-48 hours per week. This means that the student can come in to perform laboratory work any time the laboratory room is open. Where the work stations are not enough, the laboratory room is kept open longer than usual.

While this setup is advantageous to the student because he can come in to work at his convenience, more

personnel will be needed to do the extended time. Work students who are knowledgeable in how the laboratory exercises are done are usually hired. It has been noted that the work students who participate in this program profit from the privilege. They get trained and so develop competence, besides earning extra money they can use to pay tuition. The training that the work students get is so beneficial that some senior students volunteer to consist the work students in the open laboratory for free.

An office, near enough to provide easy accessibility to the open laboratory, is provided for the teacher assigned to supervise it. The salary of the work student usually comes from the savings made in reducing the teacher's salary when they teach the open laboratory. The reason the salary of the teacher is deducted by one credit hour for every three hours of contact is that the teachers will not usually supervise the laboratory class. Instead it will be the work students who will supervise the work of each student in the laboratory. The main duties of the laboratory teacher of an open laboratory class are the following: grade the laboratory report of each student, check with the work student if the student did his laboratory work. To check the work of the student the teacher also gives practical examinations to find out if the student knows how to do the laboratory and if he/she actually performed the laboratory exercise. The teacher may even require a student or group of student to do a project using the equipment of the

laboratory in relation to the subject matter covered in the laboratory class.

The teacher will also be responsible for the giving of the final grade of the student. The student enrolled in the open laboratory is usually oriented in the use and operation of the equipment. The student is also trained in safety precaution when using the laboratory equipment. The student is finally informed that if he/she cannot solve the problem they should seek the assistance of the student assistant and teacher. The student is made to understand that after he/she has done his laboratory work he/she should submit his/her laboratory work to the teacher so that it can be graded.

When the work is completed all the students are be able to learn because he/she individually performed the laboratory exercise.

B. Advantages Of Using The Open Laboratory Method

The main and foremost advantage of using the open laboratory method is that students will have to learn in order to pass the subject. In ordinary laboratory classes a student can always copy a fellow students notes since they belong to the same group. In a typical open laboratory class the student cannot do this since he/she has to independently do the laboratory exercise. The results obtained in the open laboratory class will not be the same as the work of students who merely copy the results of other students. In order to pass the subject the students will have to learn and this can be done by doing the laboratory work individually.

The second advantage is that the

student will learn self-discipline. Although there is no specific time a student must do the laboratory exercise, he is under obligation to perform it a time convenient for him to do so; otherwise, he fails. Such a situation develops self-discipline, a skill which, if thoroughly learned, will greatly help the student in the practice of his profession.

The third advantage is the open laboratory allows the student to perform the laboratory exercise any time he/she is free. This allows the student leeway to undertake the laboratory exercise when he/she feels the time is right to do it. In a typical laboratory class the student is required to do the specific laboratory exercise in a specific time and therefore the student is force to do the laboratory work even if the student is busy or is not prepared to do so.

The next advantage is that the open laboratory allows the college to maximize the use of the laboratory equipment in a one-to-one basis. This is not usually possible in a typical three-hour laboratory class. The maximizing of the laboratory equipment therefore creates a win-win situation in the laboratory class. The students are able to individually use the equipment and therefore learn. On the side of the school the equipment is used to a maximum therefore justifying the reason for its purchase.

The reasons given justify why it is advantageous to use the open laboratory method to maximize the learning process of the student. At the same time it allows the school to deliver quality laboratory education.

As stated the final advantage is that everybody wins in using the open laboratory method when undertaking laboratory exercise.

C. Disadvantages and Problems of Using The Open Laboratory Method

If an analysis of the possibility using the open laboratory method is undertaken, several problems will be encountered. The first is that Administration, Dean, Faculty as well as students must be convinced that the open laboratory method will work and be beneficial to all. Unless this is done open laboratory method will never be used in any school.

The next problem is the need to have an adequate laboratory room to hold the open laboratory classes. What the school may have at present may not be adequate for the needs of the open laboratory. As mechanism to see to it that the laboratory room is adequately secured from nonlaboratory students should also be provided.

Another disadvantage is that students will not be able to work in teams or groups anymore. This will therefore minimize the students learning through team work. The communication skills of the students, especially oral, will also be minimized because of a lack of group work.

The last problem is the operation and staffing of the laboratory room. Since the laboratory room has to be opened eight to ten hours a day, additional personnel will be needed. The technician or work students who will operate the laboratory should also be competent and knowledgeable in supervising the laboratory work being undertaken. In fact they should know

how to undertake all the laboratory exercise themselves. Since they will be the only ones stationed in the laboratory room they should have the command and the respect of the students taking the laboratory class. They should be competent enough to know if the laboratory equipment is not used properly when students are using it.

What has been given are just some of the problems and disadvantages of open laboratory method. The solutions have been given but it is the will of all concerned that is crucial. Without the commitment of the Administration, Dean, Faculty and finally the students the use of the open laboratory method will fail.

IV. CONCLUSION

The decision to adapt or not to adapt open laboratory to teach laboratory subjects will depend on Administration, Dean, Faculty and the students. It is very important that this people will be fully committed to adopt the method of open laboratory if it is going to be successful. A lot of problems may be encountered but a final decision will always show that in adapting the method students will learn more in laboratory classes compared to ordinary form of undertaking laboratory classes. In order to minimize the problems that the college may encounter it is advised that the Dean take a look at the operation of the school adopting the open laboratory method of instruction and evaluate the results if it can also be used by the school.

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