Work based planning for Better Engineering Education

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Abstract
This research paper is explaining one and most important factor in engineering education system which is Work Based Planning (WBP). The proposed planning is considered engineering student education and industry needs are the main competitive parameters in implementing new work based planning for engineering education. It is very important to maintain and develop the work based planning to match university strategies and market demands. The proposed work based plan is to deliver better graduated engineers. The proposed Work based plan (WBP) is spread the benefit to the industry and from the latest university research results.

Keywords: engineering education, engineering student, industry needs, planning, university strategies

1. Introduction

The universities have defined teaching and learning objectives by defining the curriculum of each program, learning objectives, learning outcome and with evaluation based. The assessment is on the basis of the competence strategy of the individual.
Teaching – Learning work based planning is illustrated in (Fig.1). The WBP shows important parts of engineering education work based planning structure. It covers the theoretical and the practical of the education levels. There are strong directed path in the WBP which are necessary to develop and improve the quality of the engineering education program.

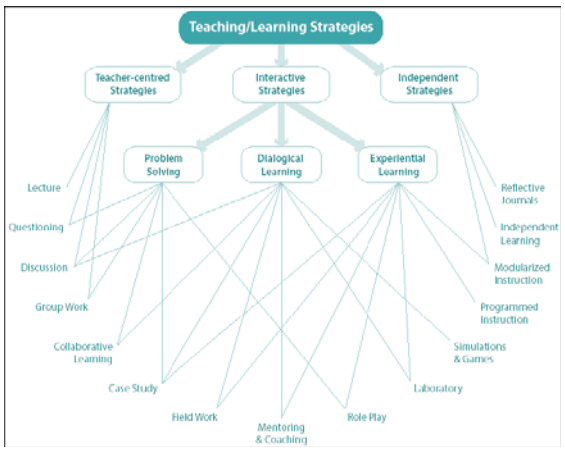

Fig. 1 Teaching – Learning Work Based Planning

In order to approach the topic of teaching/learning Work based planning process this paper takes into account two important issues: the first issue is the engineering faculty planning process takes place which consist of the following points: Reward young faculty for integrating education and research, improve faculty teaching skills, experience in working across disciplines and in partnership with industry to gain knowledge of industrial practice and Increase the diversity of the faculty and the second issue is the learning outcome. This means that needs of work based planning to increases student knowledge, skills and performance as main benefits of implementing the WBP. This paper tries to shed light on those issues, finding on them a conceptual basis for underpinning pedagogical practices and alternative methodologies applied to the teaching/learning work based planning process in engineering education. The paper presents situations where the proposed approach can be applied and it considers for recover knowledge; assess knowledge in the current context. It includes a practical and successful experience, which took into account actual engineering course plan, based on the concept of knowledge as a construction/reconstruction planning process. In the next section, previous work is highlighted. Section 3, the proposed Work Based Planning is described. In section 4, industry level and the Work based Planning is explained. Finally, conclusion and future work is given in section 5.

2. Previous work

There is a simultaneous trend towards improving engineering education at the university level by including more cross-disciplinary [1][2][3][4][5], cooperative learning [6][7][8][9], and project-based learning opportunities in undergraduate engineering coursework [3][10][11]. The shift from traditional lecture courses to project based learning necessitates a shift in assessment practices from individual exams towards alternative means of assessment. The knowledge is as a process which sets up a relation between the cognitive subject and the known object. According to [13], it is possible to introduce the concept of knowledge as a construction process.

3. The proposed Work Based Planning (WBP) process

WBP is in this project defined as an external education for individuals/groups of Graduate students (employees) in a given enterprise, which in cooperation with an university establish a course where employees and their industrial organization continuously go through a well-defined and tailormade competence development course. The WBP course is supervised / facilitated by lecturers from the university and if possible has to base on projects relevant to the industry needs. An important point to stressed in this approach is that the possibility to eventually success is to make WBP flexible to enable student to development motivation depend on learning and knowledge process by given enough time appropriate learning and appropriate learning materials with soft conditions. The WBP is a creative future learning, research should not be analysed only as a scientific principle but must also be considered in its educational aspect base of emancipation not only for students but also for lecturers. The interaction between university and as work based will primary take place in the industry as 'Work Based Planning' is essential in the development of this method. The benefit of the WBP method is as follows:

(1) To planning course program of learning matching the competence development strategy of the faculty
(2) To tailor-make the courses of learning to the individual industry
(3) To planning course of learning time scheduled to match the concrete development projects of the industry
(4) Tools and materials have to be optimized in relation to the individual industry, its organization, competence situation and culture
(5) To develop the skills needed to assess how changes in the environment affect organizations and individuals at work based planning process
(6) To help students identify some of the constraints on individuals at work based training;
(7) To help students identify what contributions organizations make to the community and the economy; and what social and environmental impact they have on them;
(8) To develop skills, knowledge and understanding relevant to students' work as technicians and an appreciation of the need for flexibility and adaptability.
(9) To realize and maintain a historical recall of student knowledge
(10) To assess the context of knowledge in current time of evaluation process
(11) To consider the knowledge dynamics, accessible and fixable
(12) To relate knowledge to the current paradigm in the work based planning
(13) To prevent error integrated to the student learning knowledge process
(14) To planning the course together with students with respect to the original course plan
(15) To start from students previous experience based on teaching learning strategy
(16) To planning for designing teaching and learning strategies
(17) To consider assessment as learning opportunity such that all test and examination are reviewed and explained
(18) WBP to be used as research tool for improvement of the engineering education performance

4. Education and WBP

The Work Based Planning aimed to illuminate by highlighting 'what we know' and 'what we don't know' about work-based learning (WBL), and in doing so identify areas on which to focus attention in the future from an institutional and industry perspective. More specifically, it focused on learning which accredits or extends the workplace skills and abilities of employees. The WBP proposes for planning purposes, the number of stages could be any stages may be considered sequential, parallel and /or depended, but there is also concurrence. None of the roles should be neglected in any of the WBP stages, but there should be a greater emphasis on inculcating technician's skills in the first part, engineering knowledge and discipline in the middle, and professionalism in the final part. The WBP stages do not need to be of equal duration, but defining them as one year each in time period of education time zone may be convenient. Always recognizing that, the WBP stages will be overlap and that they have signified changes of emphasis rather than mutual exclusivity.

5. Conclusion

The key success for new development in engineering education is the Work Based Planning for development, enhance and evaluation proposes based on student knowledge and the university course plan. Planning and development could not only help engineering as a profession respond to a threatened loss of control over new technology, but also enable engineering education to be better prepare for good quality graduate students. The effort to change led to the practical development of an alternative pedagogical approach based on the conception that knowledge is a construction/reconstruction process that, in turn, is study centered, focused on lecturer/students commitment, error logic and continuous assessment.

The WBP is introduced and there are potential demands to adapt new planning in engineering education for better performance of graduate engineers.

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Striving Towards Academic Excellence amongst Engineering Undergraduates – UNIMAS Experience

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Abstract

This paper reports on the efforts by the UNIMAS Engineering Faculty in identifying the fundamental needs of students to excel in their engineering studies. It identifies the four pillars for student's success, that is, fundamental knowledge, motivation, study techniques and attitude. The student's performances are discussed and categorized accordingly and the efforts by the Faculty to assist them are outlined. A review of students results are presented highlighting the important points to take note. By understanding the students' scenario, the correct guidance and efforts can be given to assist them to excel in their studies.

Keywords: academic excellence, fundamental knowledge, motivation; study techniques; attitude

1. Introduction

In the Mission statement of UNIMAS it is clearly stated that UNIMAS aimed to be an institution of choice for both students and staff. In principle, the Faculty of Engineering UNIMAS has embraced this philosophy and worked strategically towards realizing the Mission statement. To reach this end, the Dean's office had recently initiated a strategic planning workshop in Pusat Latihan UNIMAS, Bau on 18th December 2006. A five-year target and action plan was formulated to upgrade the Faculty one notch above the present level. At the same time, efficiency in administrative matters have much improved with greater emphasis on transparencies and better communication amongst academic staff, students and the management. The main thrust determining the success of becoming the Faculty-of-choice will depend on hard work and team work.

The issue of student academic excellence is a fascinating issue to everyone including students, Faculty, stakeholders and others. It hastens to be mentioned that student's academic excellence does not solely depends on their efforts and ability during their studies. That would be the easiest way out of any blame for student failures. It is naturally expected that students who wish to embark on a four year engineering studies in UNIMAS must possess sound command of English and Mathematical subjects. Mathematics is the language for engineering while English is the medium of instruction in UNIMAS. It is vital that potential students sharpen their wits in these two subjects so that they can understand the courses with ease. Having emphasized the above, the present education system at our schools or matriculation colleges cannot guarantee quality applicants all the time. As such, the moment students join our system in UNIMAS, then the responsibility lies on UNIMAS itself to support and guide their education.

The Faculty of Engineering has worked out many avenues to assist students in their studies. No matter student intake are from the best and brightest or weakest and poorest, the Faculty has accepted the challenge of providing excellent engineering education to all undergraduates. The following discussion will attempt to outline as briefly as possible the approaches adopted by the Faculty towards achieving academic excellence amongst our students.

On the onset, four pillars of student academic excellence are introduced. These are fundamental knowledge, motivation, attitude and study techniques.

With respect to engineering studies, fundamental knowledge refers to the student's basic understanding of mathematics and physics. Each student should be at ease in resolving calculus, differentiation, matrices and so on. The minimum level required is "not to fear" the subject.

Motivation involves issues related to the basic reason for studying in university, ambition of the students and parental hopes. Amongst the common level students have are those who are highly motivated (they know what they want), complacent student (they do not strive beyond their abilities), hopeful ones (those who hope to achieve good results in their studies) and a small number of

students who have no sense of motivation (they just study for the sake of continuing schooling).

Attitude of student refers to their willingness to learn, being proactive in class, keeping good relation with lecturers, punctual and discipline and also positive thinking. It also determines whether a student is a hard worker or not or whether he has the perseverance to succeed or not.

Lastly, the issue of study technique is also very important. Their studying in school and university is two different arenas and the mode of studies and everything else differs a lot. Undergraduate students need to take care of their carry over marks, independent study after lectures, sharing study work load in group study and so on. Examinations are set by lecturers themselves and grading are given in terms of CGPA, both of which are neither found in schooling days.

The four pillars can be categorized under two important terms, that is, AWARENESS and EFFORTS (see Fig. 1). Table 1 describes the meaning of these two terms by some related words. The Faculty has simplified the equation of student's success through working out strategies based on the agenda of AWARENESS and EFFORTS. The following sections highlight cases whereby the students' performance was diagnosed either through the dosage of AWARENESS or EFFORTS or both.

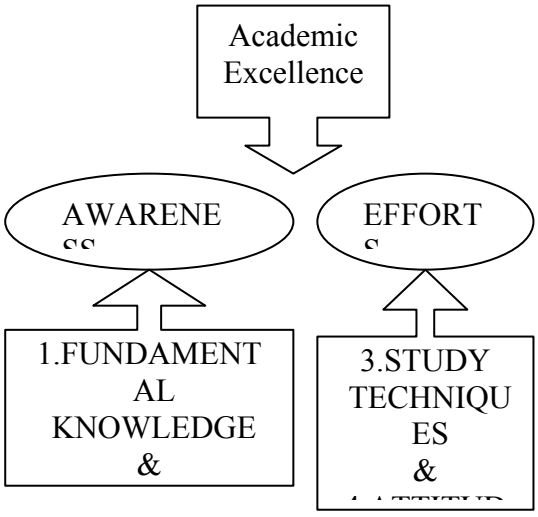

Fig. 1. The four basic pillars of academic excellence.

Table 1. Relevant words to describe the two keywords

AWARENESS	EFFORTS
• Knowledge in maths and physics • Motivation • Self-confidence • Focus in study • Less personal problems	• put up study time • study techniques • credit hours distribution per sem • time management • study groups

2. Students Categories and Efforts to assist them

The Faculty have categorized students' CGPA into five different ranges; that is, <2.0, <2.5, >2.5, >3.0 and >3.5. The categories are shown as Table 2. Study data and analysis on students' performance revealed that a CGPA of 2.5 points differentiate between the group of weak and good students. A psychological threshold limit of CGPA 3.0 determines highly motivated and complacent students.

Table 2. Different categories of CGPA

Category	CGPA RANGE
Failing students	< 2.00
Weak students	2.00 -2.50
Average students	2.50 – 3.00
Good students	3.00 – 3.50
Excellence students	> 3.50

2.1. The Failures in First Year

Those students with CGPA < 2.0 are the LB1 (Lulus Bersyarat 1) and LB2 (Lulus Bersyarat 2) cases and they are dealt with as explained in the following paragraph**.**

By the end of every semester, all students who failed one or two courses (those with LMK grade) are identified and requested to fill in a Mentor-mentee form to explain the reasons for their failure when they come back the following semester. This is done by discussing together with their respective mentor. Most of these students were either from the First or Second years with some rare cases of Third year. It is common that students blame themselves and the common reasons given are either did not study hard enough, failed to understand the course or just got panic during examination. The forms are analyzed by the management and necessary improvements are made to the delivery system. This practice brings AWARENESS on students that they need to

improve and that they have not done well. Having gone through the process few times, students would work hard and despise filling the forms and giving reasons too many times.

For cases of failing two or more courses, special attention is given as to the reasons for failing. More often than not, they are the First year students. It is vital to identify at this stage whether that student possess the necessary basic to pursue engineering students. The issue of EFFORTS become important than AWARENESS. In cases of students not possessing the required ability in mathematics, they would be reminded to work extra hard and improve their abilities. First year students are advised to improve their fundamental knowledge or change to another program that suits their academic capability.

Another strategy involved those students who achieved LB1 and LB2 grade. Luckily, the numbers are not many ranging between ten to twenty students each year and normally involved the First years. LB1 and LB2 grade means the student's CGPA is lower than 2.0 in one and subsequent semester respectively. This group of students lacks both the AWARENESS and EFFORTS. A special session is held with these students to explain their condition and the risk they face if they do not improved. Once identified, these students are strictly allowed to register a limit of 12 credit hours only. The main task for them is to achieve a GPA of above 3.0 the following semester by taking plenty complimentary and generic courses. A lesson well leant involved one female student with LB1 who were limited to 12 credit hours but took all core courses. Unfortunately, she ended up with LB2 the following semester.

2.2. The Dean's List Students

On the other spectrum of students' CGPA are those with CGPA > 3.5 (Dean's list students). It is normal that students achieving this grade since the First year would work hard to maintain the performance until the end of study. These students are self-motivated and normally compete amongst peers in their group. They possessed both the AWARENESS and EFFORTS to be successful. Although majority of them will graduate with CGPA in that range, plus minus 0.4 points, however, some unfortunate cases do crop up at times. The Faculty had a case of student with Dean's list in the First Year but graduated with CGPA 2.40 in the Final year. Historical background revealed that the students encountered health problems, road accidents and lack of motivation.

As far as CGPA is concerned, a CGPA of 3.0 points is the threshold value that boosts the student's confidence tremendously. Generally, those students within this range, their motivation are high and they would put up EFFORTS in their study and maintain their rankings amongst their peers. Again the aspect of AWARENESS is not too demanding because the students realized the importance of doing well and maintain the good results. As part of the Faculty's strategy to increase the number of students getting CGPA >3.0, the recently introduced credit transfer mechanism was enforced. Credit transfer means the said student is allowed to skip one or two courses that are equivalent during their diploma studies. They can register for Complimentary courses from other Faculties or generic soft skill courses offered by UNIMAS. Students who entered the program based on their diploma qualification (comprising about 15% of total student population) were allowed to apply for this credit transfer in the First year study so that they take up less Faculty courses. Results from last semester showed that most of these "diploma" students have CGPA within the range of 2.8 – 3.3 points. This would be a good motivation for these students to do well in the coming semesters.

3. Students Results and discussion

At this point of the discussion, it is timely to present an interesting finding on the student's academic performance. Fig. 2(a-c) shows typical students' CGPA results throughout their four years of study in the Civil Engineering programme at UNIMAS.

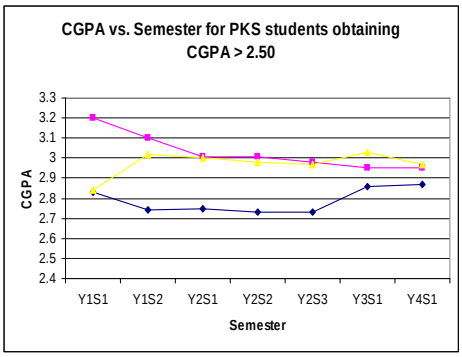

Fig. 2(a) CGPA 2.00 - 2.50.

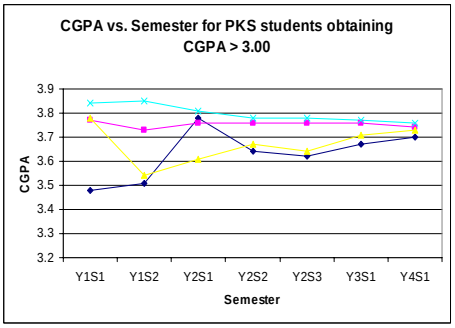

Fig. 2(a) CGPA 2.50 – 3.00.

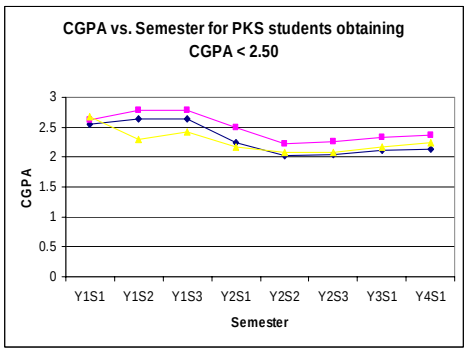

Fig. 2(a) CGPA 3.00 – 3.50.

programmes were also collected together, the distribution of CGPA is as shown in Table 3 below.

Table 3 Distribution of student's performance

CGPA	>3.5	>3.0	>2.5	<2.5	<2.0
% of student	17%	27%	38%	16%	2%

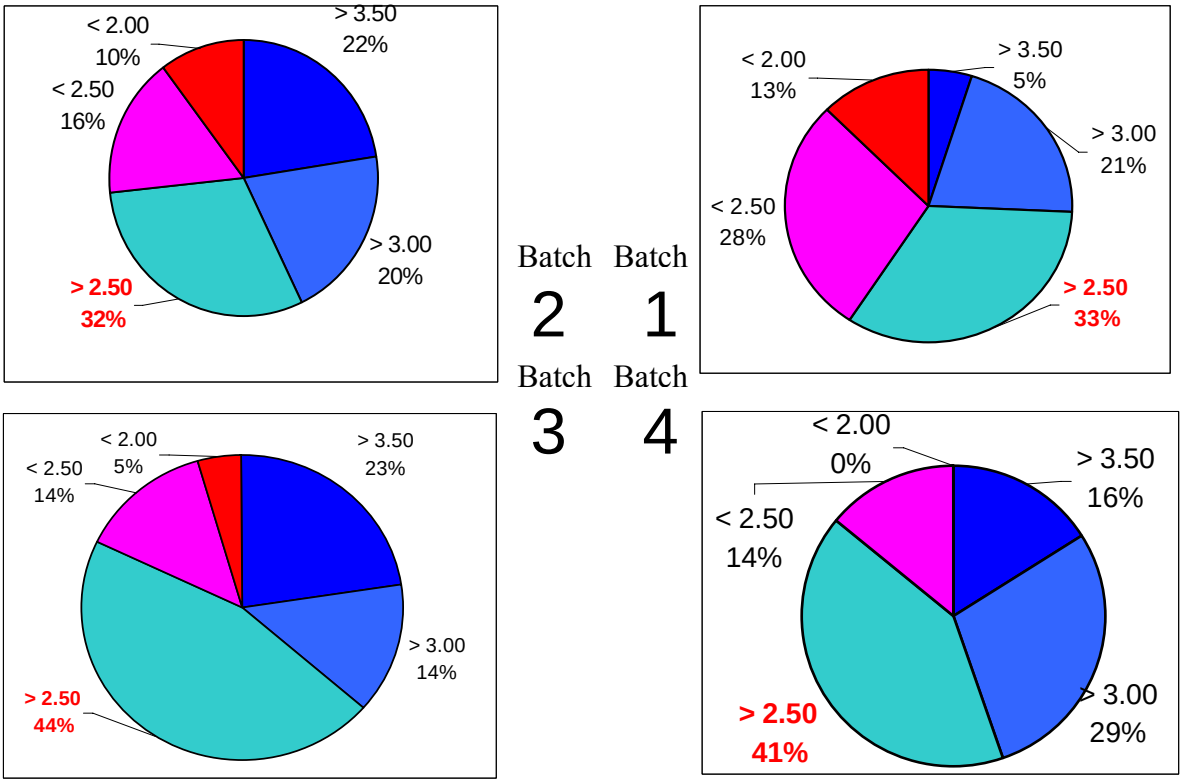

Fig. 3. Percentages of student in respective CGPA for all three engineering

Two important points are noted from the graph. The student's CGPA in the First year are not reflective of their true abilities. Secondly, the trend shows that student's CGPA during the Second year is almost the final value at which the students will graduate. From the Second year onwards, the students' CGPA showed little change until the end. The lines for the other three other programs show similar trends in the case of students taking their courses. It becomes important that the Faculty put more emphasis on the student's performance during the Second year of their studies.

Fig. 3 shows the percentages of students and their CGPA for the Civil Engineering programme at UNIMAS. Although the pattern does change with batches but the most important issue here is the fact that majority of students lied in the CGPA range of 2.5 – 3.0. The results for all the three engineering

Table 4 summarizes the types of students and their results.

Table 4. Different categories of students according to CGPA range

Category	CGPA RANGE
◊ Weak in fundamentals ◊ Wrong study techniques	< 2.00
◊ Also weak in fundamentals ◊ Need to improve study techniques	2.00 -2.50
◊ Complacent group ◊ Need to push beyond present ability ◊ Capable but no pressure to excel	2.50 – 3.00
◊ Right attitude and motivation ◊ Perseverance is important	3.00 – 3.50
◊ Self-driven and right attitude	> 3.50

As a summary, the students academic performance can be rectified by considering the four pillars mentioned earlier. As experience by UNIMAS, the correct dosage needed by the students is dependent of their CGPA ratings. Fig. 4 give a simplification of whether the effort to improve student's performance should depend on improving their basic fundamental knowledge, study techniques, motivation or attitude. In particular, those students with CGPA 2.0 below should be able to assess whether it is the right choice to pursue engineering studies or not if their basic in mathematics and physics are weak. If they were to maintain their studies, then the student must be willing to work hard and improve in those fundamental courses.

4. Conclusion

As a summary, students in the CGPA range >3.5 are already good and motivated from the start and will generally graduate with almost similar CGPA. The number of students achieving CGPA above 3.0 points can be increased by encouraging and targeting the "diploma" students to make up the numbers in this category. These students should take advantage of the credit transfer mechanism introduced for them. Every year, there will always be substantial percentage of students' CGPA that fall under <2.0 points range due to the varying academic abilities of student intake. Those students who fall into this CGPA group need to work hard on strengthening their fundamentals or else better change to another program that suits their academic level. The next CGPA group that warrant attention is the ones with CGPA<2.5. The main strategy is to increase AWARENESS amongst them to do well. They are normally good students but need coaching in study techniques and remain more focus in their studies. With respect to this CGPA range, the main concern for the Faculty will be to reduce the number of Second year students that fall under this range. The final question will be how to deal with the students in the CGPA range of above 2.5 and less than 3.0 points. Present statistics show that majority of the student population (38 percent) lie in this range. No strategy has yet been found to improve their grades because more data is needed to understand the nature of these students. The main question would be to determine which dose of AWARENESS or EFFORTS that could help them reach the level of CGPA 3.0.

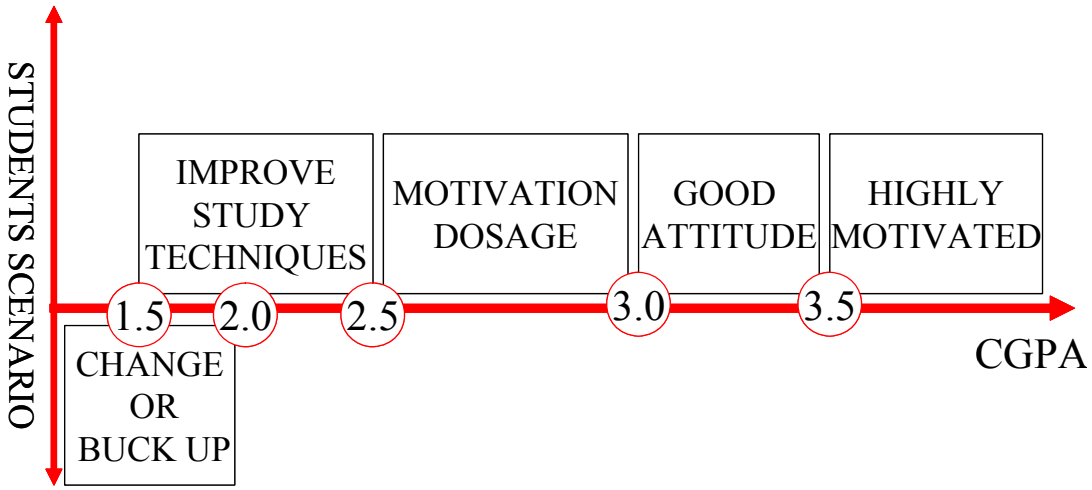

Fig. 4. A summary of the assistance needed by students against their CGPA.

Need-Based Transition Workshop for First-Year Students

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Abstract

To be effective, workshops which assist new students with their transition to first year university study must address the actual needs of the students. Here is an approach we took to identify the transition difficulties of our first-year engineering students and the two-part workshop we developed based on the data collected. Each of the workshops conducted since 2005 has received a rating of either useful or very useful from a very high percentage (>80%) of the students.

Keywords: first year experience; transition workshop; time management; study skill

1. Introduction

The transition from pre-university to first-year university study presents various academic and social challenges. Studies [1, 2] show that the first-year experience affects students' perseverance in university. Running workshops to assist new students with the transition is not new. However, to be effective, any attempt to help students cope with transition issues must [3, 4] be based on the actual needs of the students. Identifying the problems faced by new students is [3] therefore essential for the development of an appropriate transition workshop.

At Monash Malaysia, we designed and conducted a survey in Semester 2 2005 to identify the transition difficulties of the first-year engineering students. The details and results of this survey are presented in Sec. 2. A transition workshop was developed based on the results of the survey and conducted for the students in mid-semester and subsequently for all new students at the beginning of each semester. Details of the workshop and the results of student evaluations of the workshop are presented in Sec. 3. Concluding remarks are made in Sec. 4.

2. Survey

In the survey, students were asked to indicate the area or areas they were having difficulties with:

1. Coping with the new social environment.
2. Organizing my time.
3. Understanding my lecturers.
4. Knowing how to study all the material.
5. Writing laboratory reports.
6. Using the library facilities.
7. Using the computer facilities.
8. Expressing myself in English.
9. Coping with everything.

The 172 first-year engineering students who completed the survey comprised of both 1st semester (75 students) and 2nd semester (97 students) students.

Fig. 1 shows the percentage of all students, of 1st semester students, and of 2nd semester students who have difficulties in each of the nine areas. The results for the 1st semester students and 2nd semester students are remarkably similar. The four areas which a high percentage of students (>40%) have difficulties with are areas 2, 3, 4, 5:

2. Organizing my time.
3. Understanding my lecturers.
4. Knowing how to study all the material.
5. Writing laboratory reports.

Although the percentages of 2nd semester students having difficulties with areas 2, 3, and 4 are lower in comparison with 1st semester students, these percentages are still alarmingly high, about 50%. For area 5, the percentages are essentially the same, about 40%, for the two groups of students. These data show that we cannot leave the new students to somehow learn to cope with these problematic areas on their own. Help is clearly needed, especially in managing time because poor time management is known to lead [5,6] to poor academic performance, high stress and low productivity.

To help address the problem of students not understanding their lecturers (area 3), the School formed a Student-Staff Liason Committee SSLC in Semester 1 2006. The SSLC provides a 'safe' channel for the first-year students to raise problems related to teaching and learning. Members of the SSLC are student-elected student representatives and the Coordinator of First-Year Studies (the author). Cases of ineffective teaching raised in the initial meeting are feedback to the lecturers concerned by the Coordinator. The lecturers are requested to inform the class, and Coordinator, how they will

respond to the feedback. In the follow-up meeting, students provide feedback as to whether there is any teaching improvement.

To address the problem of writing lab reports (area 5), we think that running a one-off time-limited workshop for the new students would not be very helpful. Writing lab report is a skill that is acquired over time through practice. For students to really learn how to write and improve, adequate guide on the structure of the report and feedback on their work must be continually given in each unit which has a lab component.

To address the problem of managing time (area 2) and the problem of how to study (area 4), a two-part workshop was developed, which is described in the next section.

3. Transition Workshop

The transition workshop consists of two parts: time management (time audit, track deadlines, and plan weekly study activities) and learning from textbook (reading, making notes, and learning from example problem). Student evaluations of the workshops conducted to date are also presented and discussed.

3.1. Time Management

In this part of the workshop, students first learn to do a time audit. Each student is given a sheet of paper with 7 columns (representing 7 days in a week) and 24 rows (representing 24 hours in a day). They are asked to cross out the hours (each box is 1 hour) spent on things they *have* to do, for example: going to classes, commuting, eating, sleeping, showering, religious activities, extracurricular activities, part time work. To determine how many hours (out of a maximum of 168) they have left in a week for studying (includes working on homework and projects) and recreation, they simply count the uncrossed boxes. The aim of this exercise is to help students realize that they do not have a lot of time per week for studying (which should be maximized) and recreation (which should be minimized).

Next, each student is given a sheet of paper with 7 columns (representing 7 days in a week) and 13 rows (representing 13 weeks in a semester). Students are asked to
(i) fill in the due days for homework assignments, projects, lab reports, and
(ii) fill in the days scheduled for quizzes and tests
that they currently know of and they are advised to fill in other deadlines as they are announced through the semester.

Finally, the students are asked to use their semester deadline sheets from the previous exercise as a guide to plan their study activities for the week.

Fig. 2 shows the student evaluations of this part of the workshop for each semester from Semester 2 2005 to Semester 2 2007. The results for different semesters are remarkably similar. At least 80% of the students rated it either useful or very useful each semester. The rest found it moderately useful. Written comments show how it was useful:

- Time management - I didn't know anything about this before.
- It made me realized how much time I had wasted per day.
- I realized that I have a lot of time that ought to be utilized in a more productive manner.
- It lets me realize how long I didn't properly manage my time and self-discipline.
- Made me realize some aspects of time management which I did not see before.
- Helps me to figure out my weakness in time management.
- It really tells me how important to have a good time management.
- Gave us a clear understanding on how we should go about managing time.

3.2. Learning from Textbook

In this part of the workshop, each student is given a photocopy of a short section from their physics textbook. (All first-year students take the Physics for Engineering unit which I teach).

First, they are asked to read the text and figure captions carefully and fill in intermediate derivation steps to understand the material. As they read, they are instructed to underline or circle key points and join related key points with lines.

Next, they are asked to summarize their understanding of the material in note form, not in complete sentences, with simple diagrams. Then they compare their notes with mine which serves as a model.

Finally, they are asked to read the question in the example problem at the end of the section and try to solve the problem first before looking at the solution.

Fig. 3 shows the student evaluations of this part of the workshop for each semester from Semester 2 2005 to Semester 2 2007. The results for different semesters are remarkably similar. At least 80% of the students rated it either useful or very useful each semester. The rest found it moderately useful. Written comments show how it was useful:

- Learning from textbook is something new to me.
- Learning from textbook - I didn't know anything about this before.
- I don't know how to use the textbook before.
- I learn a new way to study.
- Making notes – that is a new way for me.
- I didn't really know how to make effective notes.
- Made me realize some aspects of note taking which I did not see before.
- Comparison with lecturer's notes [is useful].
- I realize that making notes is useful for exam.

4. Concluding Remarks

This paper demonstrates an approach in identifying the difficulties experienced by new students in order to develop an appropriate transition workshop. It also shows that a transition workshop which addresses the actual needs of new students is highly effective.

Acknowledgements

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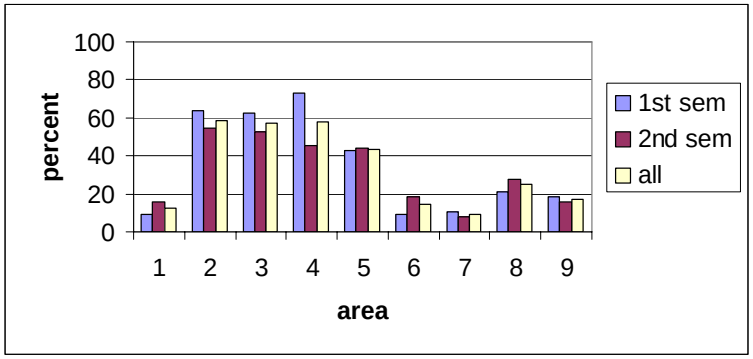

Fig. 1. Survey results: percentage of students who have difficulties in each of the nine areas.

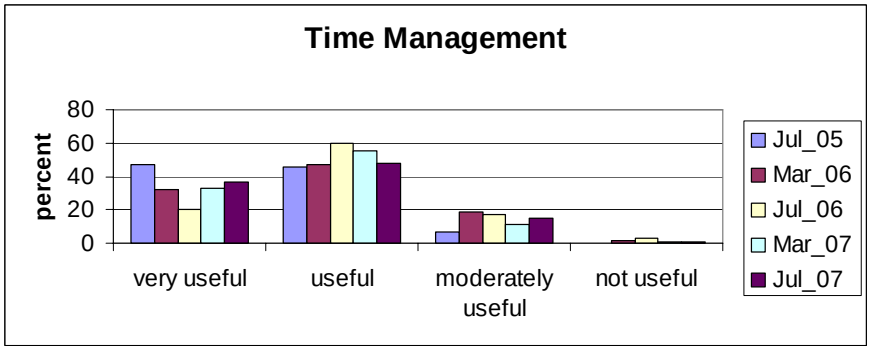

Fig. 2. Student evaluations of the Time Management part of the workshop.

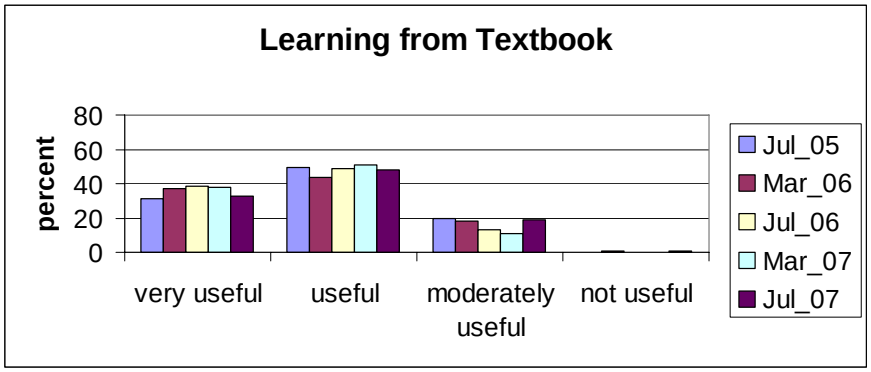

Fig. 3. Student evaluations of the Learning from Textbook part of the workshop.

Problem-Based Learning (PBL) in an Engineering Course from Students' Perspective

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Abstract

Among the earliest engineering course that adopted Problem-Based Learning (PBL) at Universiti Teknologi Malaysia (UTM) was Process Control and Dynamics, a compulsory undergraduate chemical engineering course that is notorious for its difficulty in comprehension and low passing rate. The aim of this paper is to put forth the views of chemical engineering students who had gone through PBL in this particular course from the beginning until the end of their fourteen-week curriculum. Students' impressions, reactions and reflections are taken into account in order to interpret their point of view about the impact and effectiveness of PBL. Even though many were sceptical in the beginning, resistance gradually decreased and disappeared as they progressed through several case studies. The implementation approach is also discussed. Unstructured case studies that emulate real-life problems or realistic ones trained the students to suit with the actual working environment. On the other hand, the role of lecturers as the facilitators is vital to maintain the students' self-motivation, keep the students on track, and elucidated all uncertainties during the closure. In PBL, students learnt of how to learn in a systematic manner. Particular emphasis was placed on learning through questioning, self-directed learning and as well learning with peers. Consequently, students develop communication skills, critical thinking skills and problem solving abilities. In addition, PBL paved the way for students' personal development, increased the level of self-confidence, and empowered the students to be active learners, excel in team working, and accept challenges. Most of all, PBL is very effective in helping students integrate between the facts they have learnt and skills they had with the actual engineering practice from industrial viewpoint.

Keywords: problem-based learning; active learning; team working; critical thinking; skills

1. Introduction

Problem-based learning (PBL) is a learning approach in which the problem comes first whereby the knowledge is sparked and developed along the problem solving process. Unlike the conventional chalk-and-talk teaching method, PBL enables the students to become producers, rather than consumers, of knowledge. The basis of PBL is mainly comprises of "Problem, Solution, Practice, Research, Questioning, Realism, Originality and Integration" [1]. PBL therefore, is a student-centered learning because students actively and continuously engage with the problem with whatever their current knowledge can affords in order to create the next. As a student-centered learning methodology, PBL requires a knowledge-sharing ethics among the students. Despite of students' academic background, they have to work together to strive for the goals, as they are assigned to be in a team working on PBL case studies.

PBL originated and gained wide acceptance in medical education. However, in the last decade, there has been a growing movement through out the world to adopt PBL in other fields, including engineering. Many implementations are reported in North and South America, Europe and Australia [2].

In engineering education indeed, various models of PBL have been overwhelmingly implemented. The implementation approach varies widely, depending on course study, requirement for accreditation, learning environment, and as well, lecturers' creativity in crafting the exciting PBL case studies.

Among the earliest engineering courses that adopted PBL in Universiti Teknologi Malaysia (UTM) was Process Control and Dynamics, a core subject taken by the third year undergraduate chemical engineering students. This course is notoriously known for its difficulty in comprehension and its low passing rate. The course syllabus covers the mathematical modelling of process dynamics, control systems design and analysis of chemical process. The systems deployed in the class vary from simple equipments, for instance, storage tanks, heated tanks, heat exchangers, and furnaces, to more complex ones like reactors, flash columns, and distillation columns. Moreover, several engineering simulators such as MATLAB and HYSYS are also utilised to support the learning process. In this course, it is necessary for students to understand and visualise a process in

operation and relate mathematical theories to the actual process. Students also need a strong background in mathematics and other chemical engineering principles.

A three credit hour course, the reputation for this class preceded the actual lessons by a few years. Students are usually warned about the subject in the second year, on the difficulty to understand the lessons, the tricky exam questions and how it is a norm for the entire class to just scrape through the tests. The first batch of students to have experienced this course with PBL was in the first semester of the 2003/2004 academic year.

Despite of grades at the end of the semester, students who completed this class had a somewhat different opinion about PBL and the course itself. Although the general perception that the course is a tough course did not change, the learning process and the positive outcomes of the class were lauded by many. A short survey was carried out among the previous students who had already taken Process Control and Dynamics of which some of them are working in various industrial areas and the rest being undergraduates. Students' impressions, reactions and reflections were taken into account in order to interpret their point of view about the impact and effectiveness of PBL. In addition, students' opinions, comments, and feedbacks were reported in this study as evidence.

2. First impressions

The emotional cycle that students experience throughout the entire PBL class especially on how they cope with changes oscillates extremely: shock, denial, strong emotion, resistance, acceptance, struggle, better understanding and integration [3]. The new adopted learning method, PBL, and how it works was explained in the first lesson. In the beginning, PBL was not welcomed with much enthusiasm. Discovering that in this method of learning the students would have to do most of the learning by themselves; students were very sceptical about the whole idea. Even more when the students were split into teams in which the members were decided by the lecturer, most of them had already the presumption that this new method would not be effective and hoped that the class would return into the normal lecture in a few weeks.

Students' first impression towards PBL was dreadful although a proper explanation about PBL was stated at the beginning of the semester. In fact, some lecturers who were sceptical about PBL implementation also negatively influenced the students contributing to the negative impression PBL had among students. In general, students were not optimistic about their opportunity to do well in the course.

As observed, students' first impression on PBL was vastly influenced by the bad perspective disseminated by the seniors who had undergone PBL earlier. Normally, the difficulty of the course and the complication of applying the PBL teaching method are linked closely, resulting in a small uproar in the initial classes when the semester began. The myriad of feelings students went through varies exceedingly. From determination down to vacillation, feelings blend together at once. Very few students took it positively initially; having the enthusiasm, eagerness and spirit of this challenging, motivating, and enjoyable learning approach. However, for the rest, they faced a very hard period along first stages of the semester. Lack of enthusiasm and motivation and would ride the students nowhere.

Some students revealed their first impressions towards PBL and describe as follows:

"*Like a disaster, how do I know what to do? I never learnt this and you want me to solve the case study? …that what I thought when I received the first case study*."

"*First, I felt a bit awkward, because the team members are not our close group of friends. Sometimes I feel inferior to them. I often wondered in the beginning how PBL could be important but towards the end of the semester, I felt that PBL was good because the members in the team help one another and I didn't feel shy to ask for help from them. Those made me learn and comprehend more.*"

Some students were undoubtedly angry and unable to accept PBL. One of them expressed the following:

"PBL, self-directed learning and cooperative learning! What am I suppose to do and what my lecturer will do?"

A recent graduate who had gone through PBL described his first impression on PBL as follows*:*

"I still remember at the first moment I heard about a 'couple' named 'PBL and Process Control & Dynamics class' …it was really frightened. Many things flying in my mind before met this coupled. During the first day I met PBL, I felt like crazy. First class with discussion slot and I came with nothing (prepared) at that time. For several weeks, my friends and I complained about the 'couple'. Everything was bad and terrible about PBL and control class as well. However, after going through PBL and control class stage by stage until after the first quarter of the semester, I felt that there was something different and amazing inside PBL. I am sure that it was more than A!"

Although most of the students started to accept PBL after several weeks of the semester, there were a few who remained sceptical until the end of the course study. In this case, lecturer's role is very crucial to help the students develop their self-confidence and positive thinking, but the rest are up

to the student themselves to take initiative and put effort for their development.

3. PBL implementation

The PBL approach promotes theory and practice to be integrated as students are encouraged to think critically, beyond just recalling of previous learnt information or knowledge. Students will have to thoroughly explore on how to interpret and then further deliberate on how to approach the problem at hand. Working in groups enabled the students to argue about a point; promoting them to review their understanding of information through questioning, probing, formulating hypothesis and making references to prior knowledge.

One main concept that was difficult for the students to grasp at the beginning of PBL class is that it is possible for a problem to have more than one correct solution. Having trained for years that each question has only one correct answer, this new method was not easily digested in the early stage of PBL implementation.

In a small team, students collaborate to identify, search, construct and correlate knowledge on new concepts that they need to learn in order to solve the given case studies. However, the students are by no means left on their own without being guided [4]. Even though students took time to suit with each other in their team, they managed to cooperate well. Students were continuously facilitated in order to assist them solve the case studies systematically. Particular emphases were constantly placed on problem identification and problem restatement to ensure that students had the correct starting point before moving forward, which is very crucial to avoid the possibility of misconception and wrong direction. At any time, the students were given a freedom to lead their learning process by themselves with constant facilitation by the lecturer.

3.1. First case study

The first case study came as a shock to the students as it was their first ever PBL assignment. As the case study was downloaded from the e-learning with the due date just a few days after, students' adrenalin rose like a streak of lightning. In order to solve the given case study, students were referred to a few crucial reference books. In addition, lecturer also encouraged the students to look for other sources of information as well. Besides, an interactive e-forum was provided in the e-learning site to support students' learning process.

To come up with solutions for the case studies within a fixed period, teams often have to meet up after class hours. Preliminary team meetings were not very effective. Preparations for the discussions were done half-heartedly or were often incomplete. These resulted in lengthy and frequent team meetings. In fact, students had difficulty focusing on other courses taken in that particular semester in order to finish the case studies on time.

Overall, students were pretty messed up in the first case study. Most of the students were not really satisfied on what they had put forward, and some were depressed. The students were always reminded by the lecturer that it was acceptable to learn from mistakes. Learning from mistakes as part of PBL style, is distinctive compared to the conventional lecture in which knowledge is delivered smoothly without challenges and conflicts. However, lecturers constantly convince and persuade students to keep on trying and put more efforts for the following case studies. Indeed, unremitting motivational phrases and words of encouragement by the lecturer were always there in order to keep students' morale high.

Students were lacking very much in generic and soft skills which are not usually emphasized in normal chalk-and-talk lecture classes. In PBL classes however, the case studies emulate real-life problems or realistic ones that employ the use of these generic skills. The worst is technical reading. Students often have difficulty reading a page of technical texts with constant concentration.

After the pilot case study, some started to accept PBL, though there were still many that remained sceptical. More often than not, these students blamed their lecturer for imposing such powerful learning method on them.

3.2. Continuous development

As the semester progressed, after a couple of case studies, students finally accepted and understood the rhythm of working in PBL class. Interaction between the team members improved considerably and the students understood with each others working style. Meetings to discuss case studies became less frequent as the students have learnt to prepare thoroughly before team meetings. During the discussion, solutions were figured out and discrepancies were debated instead of wasting time trying to read and understand the theories.

In PBL class is that the preparation for quizzes and tests differed very much. Instead of the usual last minute preparation, students mostly prepared by having discussions on some example questions focusing mainly on the theories and smoothing out the finer points in each subtopics.

Towards the second half and nearing the end of the semester, students finally adapted to PBL learning style. Handling case studies became much easier even if the topic was not covered yet. By this time, students learned how to manage time as well. As the group discussions became shorter and less frequent, time were spent on other subjects adequately (although one must agree PBL did take up a chunk of it). In the end of the semester, students realize that PBL enabled them to learn and understand a topic thoroughly and the retention of the learnt material is much longer. By learning how to

learn and by doing it on their own, comprehension towards a topic was better than before.

Meanwhile, students were assigned to reflect on their learning process after each case study was completed and this was done by journalising their learning experiences. The purpose of reflection journals is to assist them to look back and improve on what they had experienced and learnt which includes their feeling and thinking. Moreover, it also helps students to evaluate their actions so that they can look for techniques to improve themselves by eliminating weaknesses and further strengthen their good points. In fact, reflection journals paved the way for students to make their learning process more effective.

Some of the students' comments concerning the PBL implementation are described as follows:

"I found that the implementation of PBL was effective. I don't need to study very hard on the subject because I already understand the philosophy/application from the theory. It's something good that the student need to experience."

"During the first task I was assigned, I really felt too burdened and already had a bad mindset about this method. But surprisingly as the time passes, I really think that it is the best method to learn something that it is technically matters."

"PBL works…. I suggest that this method of learning to be practiced in other subjects (thermodynamics, chemical reaction engineering, etc.) because using PBL, theories are easier to understand. I am willing to do this rather than sit back and relax in a class."

One student wrote the following regarding the technical reading:

"After several case studies, I am not suffering 'reading allergy' anymore. Since this is kind of psychological disease, there is no specific medicine to cure this illness. I strongly believe that the only effective treatment feasible is by influencing ourselves via our emotions and feelings. We are the controllers, not others."

A group of student who are now working as engineers gave the following comment regarding the PBL approach that emulates the real life problems or the realistic ones:

"The most valuable thing I ever gained from my PBL class was how to deal with problems. PBL translates the real working scenarios into the classrooms. You can see that the problems are not properly crafted as in the text books. In fact, there is no specific answer and we are not even known how the answers will look like. PBL was the only learning approach that thought and trained me this lesson – I think it's worth it."

"There are no classes that employ communication and interpersonal skills except for Process Control & Dynamics with PBL implementation. Lack in good communication skills, including verbal and non-verbal, will make our opinions and ideas undeliverable while working. Lack in interpersonal skills, on the other hand, will create sort of troublesome in relationship with our colleagues."

4. Lecturer's roles

The role that the lecturer plays in PBL class varies from those of normal classes. In PBL class, lecturers put their commitment as facilitator and coach rather than the person who just delivers the subject matter. They facilitate classes by clarifying some queries, stimulating groups' thinking and asking the right questions. Questions to the lecturer are often answered by questions that hint at the possible solutions. Students felt frustrated if their questions were not answered directly but acknowledged that this made them explore issues further [5]. In the beginning, this was thought to be inconvenient by most of the students (who are used to getting more direct answers), but these helped the students widen their mind and think out of the box. It took some adjustment, but in the end, the satisfaction of figuring out the solutions by the students was rewarding.

At the beginning of a new lesson, the lecturer gave a brief introduction to what were the expected outcomes of the topic. Then, groups are left to start their discussion by identifying the problem. During the class hours, lecturers would move around, facilitating each group as they progressed along. Eventually, during the presentations at the end of a case study, lecturer encouraged questions from other groups.

At the end of a topic is the closure, where the lecturer reviews the topic learnt and clarifies doubts. This session helps the students tremendously as all loose ends are tied up by means of class discussion. Nothing was left unanswered. Some additional information was also given by the lecturer for better understanding of the topic.

Students found the role of the lecturers was very helpful. Listed below are some comments from the students on the lecturers' role in PBL class:

"Lecturer gives guidance. The role of lecturer as steering students in the right direction is very important in order to solve the case studies. He/She helps the students to accelerate the learning curve."

"Actually, lecturer still has parts to play. They facilitating the teams and help in decision-making. We are also encouraged to see the lecturer should we faced any problem."

"Learning was very effective. Lecturer creates an interactive and dynamic learning environment. There is no time and no way to feel sleepy during class hours."

"Lecturer seems to be the best learning-peer and we learned together. He/She always sparks the learning excitements inside and outside the classrooms. Apart from stimulating students' thinking, we were always encouraged for not to stop thinking at a very shallow point."

Mostly, students admitted that the lecturer made a lot of difference in their learning process. Students found that the lecturer's roles in problem-based classes were more interactive and responsive to their needs [6]. Besides, in the event of stress, confuse and frustration, lecturers were always there to uplift students' motivation. Lecturers also reminded and showed students that they should expect bumps, mistakes and wrong turns. When students encountered wrong turns or wrong answers, they were encouraged to try again and try to understand why they came into the incorrect paths and answers. In fact, lecturers keep convincing students that learning is the purpose of academic works and experiences as well, rather than grades.

5. Impact of PBL

5.1. Active learning

Active learning is a class teaching and learning techniques that involves students in learning activities rather than passively listening to lectures [7]. In active learning process, learning is no longer a standard process, but it transforms into a personalised process. Here the skills of problem solving, critical thinking and learning to learn are developed [1]. PBL also promotes self-directed learning, where students learn to teach themselves by reading and discussing with the peers. Self-directed learning does not necessarily mean all learning will take place in isolation from others rather it can involve various activities and resources, such as self-guided reading, participation in study groups, internships, electronic dialogues, and reflective writing activities [8]. This helps the students to become empowered to take increasingly more responsibility for various decisions associated with the learning endeavour [8]. In short, students were given freedom to select, manage and assess their own learning style.

PBL taught students to first identify the problem at hand and then assess the information available. It was new to the students that in the case studies often too much information was given, but not all were relevant. Students soon learned to isolate the needed data and then identify the missing details. Students also learned at an early stage that answers cannot be obtained by leafing through just the text books.

Students found that PBL encouraged them to take responsibilities of their learning by actively participating, self and peer teaching and the satisfaction of solving a problem on their own.

Some responses from previous students on active learning are described as follows:

"However, using the PBL method, students took initiative to learn the lesson first and lecturer would help in teaching on the parts that students couldn't understand. By solving case studies, sometimes we needed to study three topics in advance."

"I could feel the learning excitement in PBL class. Although some of the case studies were quite difficult and required huge effort to solve it, I had no problem working in a team, finding resources, asking questions for clarification and thinking critically to figure out the solutions."

"PBL enabled us, the students, to engage with our learning process continuously in whatever ways we like which we suit with."

"In PBL class, I am the one who responsible to control my learning; neither the lecturer nor the peers. In fact, my weak academic background did not affect my performances. Actually, we have the right to lead our learning towards success. As long as we put strong efforts and we struggle to reach the goals, we will worth all the sacrifices".

The feedbacks show that students enjoyed cracking their brain although the case studies sometimes were very tough. In fact, students developed creativity and willingness to find resources, learn new things, generate intelligent ideas, argue against ideas and produce brilliant solutions. In addition, students were able to evaluate how effective their learning had been [9]. This was very important for continuous development of students' proficiency in learning.

5.2. Team-working

One of the main features of PBL is team-working. Class comprised of 30 to 60 students was divided into teams consist a maximum of five members each. The team members were decided by the lecturers which ensure each team balanced in terms of genders, races and academic levels.

Throughout the semester, each team undergoes several stages. The first stage, forming, was during the formation of the team. At this time, it mainly involves introductions, getting to know one another and identify each others working style. Since students were new to PBL, attempting to complete case studies together while adapting to each other proved to be quite a challenge to some teams.

Soon after came the second stage, storming, where a few disagreements arose among the group members. Improper meeting hours, handling of the

discussion, the preparation or lack of it was among the issues that were disagreed upon. Not many groups went through this stage however; some groups did have a difficult time.

The third stage was norming. At this stage, once the team members get used to each other, a proper working pattern was established. This was the stage that students adapted to PBL as well. From here, some teams moved on to the performing stage and finally at the end of the semester, the mourning stage was experienced.

In a team, students addressed the problem, collaborated to gather resources, shared and synthesised findings, and posed questions in order to figure out the solutions. Teams that were well mixed opened up opportunities for peer teaching and learning. Besides, there was no such way that opinions or ideas just been accepted without being debated. Argumentation was the secret weapon in mastering about a matter. In each of the team meeting, role playing were carried out. Each student had the chance to be the chairperson of the meeting, the moderator, the reporter and the timekeeper, and the critic person. This responsibility cycle taught students to appreciate and acknowledge each team member and at the same time trained them to be a multiplayer personal.

Team meetings and discussions helped in a good deal too. By debating out the difference in opinion and learning together, the overall understanding of the topic was grasped better by the members. In the event that the teams got 'stuck', a meeting with the lecturer could be arranged in which the lecturer helped them back in the correct direction.

After half of the semester, peer evaluation was carried out. Students were allowed to rate their team members according to a few given criteria such as co-operation and contribution of ideas. By this time, re-shuffling of groups was possible if necessary. This evaluation helped in the sense that it prohibited free-riders. Students, for the fear of getting low peer rates, took initiative in team efforts.

Some of the students' responses on working in a team are describe as below:

"Team working is very important. When we are in a team, firstly, asks the question to ourselves what we can contribute to the team and what our team expect from us. By doing this, we can be a good team player. I believe that we cannot solve the problems alone. If we do solve the problems alone, it takes more time compared by doing it in a team. Everybody has their own ideas, and each idea would help."

"Team-working is what made this course success. Students would not take this for granted as they were all will be having the same grade based on their team."

"Everyone in the team played a part. Everyone contributed ideas and if someone got it wrong they were not penalised. This made weak students to be brave to come up with their opinions and ideas. "

Besides, students who initially refused working in a team finally acknowledged the value of that learning style. A recent graduate who now working in an industry describes his experience working in a team as follow:

"My team missed one of our team-mate because of his/her personal problem in our final case study. At that time we have to do everything by three of us, instead of four. It was really affect my team performance because we had many things to do. Besides, most probably we left some intelligent ideas. By now, I do appreciate my team-mates or colleges because their momentous ideas and supportive participation are unquestionably helpful."

The majority of students felt that PBL enhanced their sense of autonomy and responsibility for their learning. Given the larger numbers of small groups, students had minimal face-to-face time with the tutor and had more independent with their learning. This seemed to develop a sense of empowerment in the learners [10].

Concisely, working in a team bring out numerous advantages that lead to better learning and understanding of the topic being taught.

5.3. Critical thinking

Critical thinking refers to the ability to analyse, synthesise, and evaluate information, as well as to apply that information appropriate to a given context. It is both critical and creative in that synthesis, in particular, requires the learner to take what information is known, reassemble it with information not known, and to derive a new body of knowledge [11].

PBL trained the students to think critically. Students found it to be immensely satisfying as PBL enabled the students to solve problems on their own, come up with proper reasoning and decision making. Critical thinking trained the students to ask specific questions. Students also felt that PBL helped them view a problem in various perspectives, and as well helped them to systematically solve problems.

The following are several comments from students on critical thinking in PBL class:

"It helped me think outside the box. I always ask myself 'if' questions…if I do this what will happen…surprisingly I got to know that for one question there will be different answers…and sometimes the answers will be so simple. I believe that PBL can teach the students how to think critically."

"Critical thinking broke the old perception and the way to solve the problems. By having this way of

thinking, students can easily see the whole picture of the problem and find the key to find out the solution."

"Honestly, the first time when the lecturer told me that a problem could have more than one right answer, it was really difficult to digest. Now that I'm already working, I can really see that that it is definitely true! Thinking critically can give you more than one solution at times."

"I squeezed my brain to solve the case studies. It was pain but worth it. From this class, I did realise that there is no limit of thinking. Critical thinking allows me to gather various learning resources, look for multiplicity of ideas and produce more option of solutions."

From the comments received from students, they admit that learning is more than just memorising. The ability to keep an open mind, link ideas together, justify options and evaluate decisions was developed very well. In fact, students' capability to assimilate this skill from classroom margin into the daily life is the greatest reward.

5.4. Personal development

PBL opened a lot of opportunity for students to develop themselves in both technical and non-technical appearances. Student thought PBL provides an interesting, stimulating, and enjoyable learning environment, and that it offers a more flexible and nurturing way to learn.

Team-working promotes communication and co-operation amongst the team members. Students felt more confident to express their ideas and defend them when challenged and they felt much easier to explain technical concepts.

During the presentation session, public speaking skills were sharpened. Students' self esteem developed as they were confident enough to make decisions. They also realised that they were capable of solving problems that deemed impossible in the first place. They also learned to trust their fellow team-mates as their team working skills were polished.

Students also picked up time management. As PBL case studies eat up a considerable amount of time, students had to manage their time properly to cater for the rest of the subjects taken in the same semester. Generic skills that cannot be taught in normal classes can be easily picked up through PBL classes.

The feed back of students on generic skills acquisition from PBL was mainly positive. Some of the comments are:

"PBL really helped me to develop myself… through presentations and group discussion, I gained self confidence. It also polished my time management skills as juggling group discussions, self learning along with 5 other subjects was really challenging…"

"Before this, I am less confident to voice up my opinions, asking questions and presenting my tasks in front of people. PBL, however, brings to me such a strong energy that helps me to grow my confidence level so that I am able to present myself in front of hundreds people. It's really amazing on how the power of PBL transforms and develops the learners."

PBL method also develops self-control in students. As students were assigned to work in a team, they learned to appreciate themselves and others. After learned and acknowledged the ethics of working in a team, disappointment and anger were controlled and expressed in a pleasant manner. On the other hand, any complaint or critics by the peers were welcomed positively, as evidenced in the following comment:

"I do welcome any opinions and comments from my team-mates and take it wisely. Those help me grown up and keep my eyes open. In contrast, I always give constructive comments."

From the responses obtained, PBL students expressed positive attitudes, increased motivations toward their learning and more passionate to study, than students in conventional learning classes. Besides, they showed maturity in thinking and present themselves nicely. Moreover, the responsibility among the peers was immerged naturally and that is one of the great values of the team-working. Mostly, students changed a lot after gone through PBL class. In fact, self development process is continuously grown even after the PBL class.

6. Conclusion

In conclusion, though a PBL class involves a tremendous amount of work and dedication from the students and lecturers as well, the advantages of PBL outweigh the disadvantages by a huge margin. In the end, students realise that all their sacrifices were paid off, more that the knowledge of the course itself. In fact, it can be seen that the impacts of PBL are very strong and endless even when students jump into the real working environment.

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Developing Undergraduate Project (UGP) Report Writing Assessment Matrices for Mechanical Engineering Program

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Abstract

Undergraduate project or UGP is a research study done by final year undergraduates to fulfill the requirements for the award of Bachelor of Engineering (Mechanical) at Universiti Teknologi Malaysia (UTM). UGP is able to enhance students' knowledge and skills in solving problems through academic research as well as provide communication skills both oral and written. Previously, the allocation of 20% and 40% of report writing assessment from total mark of UGP I and UGP II respectively are solely based on supervisors' evaluation without proper mark distribution. For the past 3 semesters UGP Committee developed detailed mark distribution however, the assessment poses certain challenges namely validity, reliability, comparability, fairness as well as give meanings to students. This paper describes in detail, the development of the assessment matrices or rubrics for report writing of UGP at Faculty of Mechanical Engineering (FME), UTM. A general rubric developed is applicable across the courses offered by the Faculty and it is further detailed to suit the written assessment of the UGP report and at the same time maps the course objective of UGP as well as Mechanical Engineering program.

Keywords: Undergraduate project; report writing; assessment; rubric

1. Introduction

Valid assessment for all courses especially for undergraduate project (UGP) is important as it indicates the strength/quality of graduates produced by the faculty. Issues in assessing undergraduate project have been discussed by many researchers among them are [1-3]. The findings indicated that there were variations in assessment strategies and there were also uncertainties concerning sound assessment practices. Variation found in the assessment practice is consistent with similar studies elsewhere [1]. Jawitz *et al*. [1] also reported that there are many issues in assessing UGP in engineering based on the reported studies by which lead to the variations and uncertainties. Examples are the importance of having defined project, communication with students what to be expected from UGP, having clear guidelines for assessment to academic staff, wide range of topics studied, the variation in abilities and enthusiasm, motivation and powers of assessing by the supervisors. Besides, there are different approaches that have been adopted by supervisors / assessors in assessing the projects.

McKenzie *et al*. [4] provides a study of nature and scope of assessment practices in senior project design or called capstone design. Uncertainties arise concerning sound assessment practices as well as validation of the assessment strategies. A survey was conducted on academic staff and respondent suggested the need for detailed scoring guidelines / rubric for clearer performance criteria. Meyer [2] developed an instrument for systematic and qualitative evaluation to evaluate the senior project course learning outcomes. Dennis [5] gave an example on general rubric of a technical report for a senior project of the mathematical students. Using the rubric, results were analyzed and conclusions were made. Observations gathered provide closed-loop feedback for course outcome remediation. Shaeiwitz [6] provided details on developing rubric. The attributes for the rubric are to address the course outcomes. The assessment result from rubric is used as feedback loop to improve the curriculum. The feedbacks provide qualitative assessment where results to be quantified as well as summative results to improve the program. The study also stressed on the important of having detailed scoring guidelines for clearer performance criteria.

Another study reported by Davis [7] indicated that the quality between projects varies due to the inconsistent level of interaction between students and faculty members. Incremental dateline for report submission that was proposed helped avoid procrastination to students as well as give detailed feedback to the faculty. Realising the importance of clear performance criteria in assessing UGP especially for technical report writing, the Faculty has decided upon the development of matrix assessment. This paper describes briefly the development of rubric and finally proposed the rubric for report writing assessment of both UGP I and UGP II.

2. Undergraduate Project Assessment at Faculty of Mechanical Engineering, UTM

Undergraduate project or UGP is a final year project done in two semesters by final year Mechanical Engineering students. It is a final culmination of the undergraduate learning process and is a requirement for graduation. The final products for both UGP I (2 credits) and UGP II (4 credits) are technical research report and oral presentation. The marks allocation for UGP I and II evaluation is shown in Table 1 [7]:

Table 1. Marks allocation for UGP evaluation

UGP I (Code 4912/5912)			**UGP II (Code 4924/5924)**	
Evaluation Details		**Mark**	**Evaluation Details**	**Mark**
A.	Draft/ initial report	20%	Final report	40%
B.	Seminar I	25%	Seminar II	20%
C.	Overall Execution of UGP	55%	Overall Execution of UGP	40%
Total		**100%**	**Total**	**100%**

Table 2. Marks allocation for UGP technical report evaluation

UGP I (Code 4912/5912)			**UGP II (Code 4924/5924)**	
Evaluation Details		**Mark**	**Evaluation Details**	**Mark**
G.	-	-	Topic Mastery – technical correctness	7%
H.	Problem Identification	2%	Appropriate level of detail	6%
I.	Appropriateness of literature/background study	7%	All requested deliverables included	8%
J.	Proposed Research Methodology and Schedule	5%	Completeness of analysis & data interpretation	8%
K.	Organization – clearly Identified purpose & approach, content organisation, topic transition, appropriate introduction & conclusion	2%	Organization – clearly Identified purpose & approach, content organisation, topic transition, appropriate introduction & conclusion	5%
L.	Presentation - Easy to read, grammatically correct, uniformity of writing style	2%	Presentation - Easy to read, grammatically correct, uniformity of writing style	3%
M.	Layout/ Visuals – graphics quality, uniformity of document design and layout	2%	Layout/ Visuals – graphics quality, uniformity of document design and layout	3%
Total		**20%**	**Total**	**40%**

The initial / final reports and overall execution of UGP are checked and assessed by the UGP supervisor and co-supervisor / second supervisor (if any). For UGP I, the student has to submit a draft or initial report at the end of the semester to his/her supervisor. The contents of this draft should comprise of UGP objectives, description to problem, literature search, solution methods, tools, equipment and findings of initial study that have been carried out. Draft II is the continuation of UGP report to be submitted to the supervisor for evaluation at the end of Semester II. Besides topics discussed in initial report, other aspects to be included are research finding, graphs and charts, illustrations, tables, data, appendices, result analysis, discussions, conclusions and recommendations for future work.

Outcome based approach to engineering education emphasizes on students be assessed on their technical and generics skills as listed in Appendix. In response to ABET accreditation criteria, the Faculty of Mechanical Engineering (FME), Universiti Teknologi Malaysia has decided to propose an assessment matrices or rubrics to assess the skill which among them is report writing. Technical report writing is essential to an engineer

and to ensure that this skill is embedded in the curriculum, a general guideline on technical report assessment is needed.
Previously, the allocation of 20% and 40% of report writing assessment from total mark of UGP I and UGP II respectively are solely based on supervisors' evaluation without proper mark distribution. The decision is made depending on the type and form of project undertaken. For the past 3 semesters UGP Committee developed detailed mark distribution (A to G/F is for overall execution of UGP I/II criteria) as shown in Table 2.

3. Assessment Criteria

In developing a rubric for assessing the UGP, first a standard five-point scale is identified namely below expectation, between below expectation and acceptable, acceptable, between acceptable and outstanding and outstanding. This five-point scale is used for all technical report assessment in FME. Next is to develop the criteria for UGP technical report assessment. The criteria developed are referred to the course learning outcome (CLO) of UGP I/II as listed in Appendix.

Beside technical skills, generic skills are also addressed in program objectives for Bachelor of Engineering (Mechanical) in UTM. While executing UGP, most of these skills are addressed except LG4 which is the ability to work as team. Most of the UGP in FME is an independent research project. Even if it is a shared project, the faculty required the project to be divided among the students in terms of its scope and objectives individually.

UGP I is an initial stage of the research project done by the student. During the implementation of this course, student is expected to identify problem of the project, scope and objective followed by doing related literature study. The weight age is more on literature review and proposal since these two steps are the important initial stage of doing research. Besides, the student is expected to have some preliminary study based on the nature of his/her project. Other important aspects in the assessment criteria are the important of thesis organization as well as proper referencing.

In implementing UGP II, data collection and analysis are two important stages. The use of visual lay outs such as table and graph is considered. Other important criteria in UGP II to be inspected are result and data interpretation, evaluation and discussion as well as conclusion of the project that has been conducted in two semesters. Besides, the organization and proper referencing are also assessed. The proposed rubric for UGP I and UGP II are shown in Tables 3 and 4 respectively.

4. Discussion

As discussed earlier, there is issue regarding the importance of communication between academic staff as the supervisor of the project and student on what to be expected at the end o the course. Among them are information such as what to be included in the report and the supervisor's expectation from the report. To help students on writing technical report, two talks are conducted every semester by academic staff from the faculty. Guidelines are given on what to be expected as well as important issue in technical report writing such as plagiarism. This is done to discourage variations on the final product of the report regardless of variations in research field in the faculty. Besides, students are required to follow rules and UTM standard in writing the technical report as stated in UGP Guidebook and Thesis Manual.

In outcome-based education (OBE) curriculum, a systematic agreement between CLO, assessment and continuous improvement of the course is important. The information regarding the assessment matrix of the UGP is available through e-learning website. The purpose is to give students opportunities to see guidelines for writing good technical reports. It is also hope that based on the guideline the students' communication skills (i.e. written skills) will increase over time. The next phase will be to get feedback from academic staff, graduates, stakeholders as well as evaluators which regarding the rubric which can be done through survey.

5. Conclusion

Based on literature, there are variations in assessing undergraduate project. The main important thing is to ensure valid assessment where in outcome-based education the product from the program (i.e. graduates) is competent and be prepared to the real-world challenge. It is shown that the need for matrix assessment or rubric for UGP is needed. Project variations across the faculty due to different area of specialization from different field require standard performance criteria to ensure fair, reliable and valid assessment. Another important aspect is that information from rubric can be used as a closed-loop feedback to further improve the curriculum / course. This paper provides a rubric for assessing UGP technical reports.

Table 3: Proposed rubric for UGP I

Criteria	Evaluation Scale						
	Weightage	**1 (Below expectation)**	**2 (Between below expectation and acceptable)**	**3 (Acceptable)**	**4 (Between acceptable and outstanding)**	**5 (Outstanding)**	**Remarks**
Introduction - identify problem, objective, scope	2	Unclear problem statement, objective and scope		Define problem to be solved without supporting facts / data		Well defined problem statement supported with facts / data	
Literature / background study	5	Inaccurate / inappropriate theory, lack of evidence of knowledge relevant to topics		Selection of theory is appropriate, literature is presented without review of related previous work		Accurate / appropriate theory, able to critically appraise the literature and theory gained from variety of source and related previous work.	
Proposed methodology	5	Unsupported methodology		State methodology appropriately		Well defined and supported methodology	
Preliminary study based on nature of project:: • **Simulation** • **Case study** • **Experimental** • **Design and development**	4	Little or no attempt in preliminary study.		Provide appropriate materials on preliminary study based on nature of the project		Sufficient and excellent preliminary study i.e. preliminary data for simulation, background study for case study, experimental plans and identified parameters for experimental, conceptual design for design and development	
Organization and writing skills (grammar, uniformity, graphics layout)	2	Disorganized flow, improper use of language, frequent errors in grammar, irrelevant / inappropriate choice of visual layout		Acceptable presentation, proper use of language, few errors in grammar, appropriate visual layout		Coherent and smooth flow of ideas, proper language and interesting to read, grammatically correct, and material is carefully structured with clear visual layout	
Reference	2	Irrelevant reference / referencing is absent / unsystematic		Some related reference		Highly related reference, proper format and consistently accurate	
Total Score	**20%**						

Table 4: Proposed rubric for UGP 2

Criteria	Evaluation Scale						
	Weightage	**1 (Below expectation)**	**2 (Between below expectation and acceptable)**	**3 (Acceptable)**	**4 (Between acceptable and outstanding)**	**5 (Outstanding)**	**Remarks**
Data collection and analysis	7	Irrelevant / appropriate choice of visual layout in presenting data		Use appropriate visual layout e.g. tables, graphs		Data is carefully structured with clear visual layout e.g. tables, graphs	
Results and data interpretation	8	Simply stating data gathered without interpretation and analysis		Interpret data and analyze result adequately		Critically interpret and analyze data and relate it with theories and related work	
Evaluation and discussion	8	Inadequate evaluation of results. Shallow discussion of result		Adequate evaluation of result. Demonstrate integration in selecting and use of theory		Comprehensive and detailed evaluation of results. Demonstrates integration and innovation in selecting and use of theory	
Conclusion	8	Unsubstantiated conclusion based on generalization		Conclusion partially supported by theory / literature		Clear conclusion, well grounded in theory and literature, show development of concept and solution to problem	
Organization and writing skills (language, grammar, uniformity)	6	Disorganized flow, improper use of language, frequent errors in syntax and grammar		Acceptable presentation with logical flow, proper use of language, few errors in syntax and grammar		Coherent and smooth flow of ideas, proper language and interesting to read, grammatically correct, minimal syntax errors	
Reference	3	Irrelevant reference / referencing is absent / unsystematic		Some related reference		Highly related reference, proper format and consistently accurate	
Total Score	**40%**						

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Appendix

Programme Objectives for Bachelor of Engineering (Mechanical), Universiti Teknologi Malaysia

(i) To produce graduates who are able to apply their knowledge and skill to design, analyse and evaluate mechanical engineering systems
(ii) To produce graduates who are able to identify and solve engineering problems systematically, critically, creatively and analytically
(iii) To produce graduates who are competent, posses leadership qualities and able to act professionally in the field of mechanical engineering
(iv) To produce graduates who are able to communicate effectively and address issues related to social, cultural and the environment
(v) To produce graduates who are able to undertake lifelong learning and adapt to the changing environment

Technical Knowledge and Competencies:

LT1 - Ability to acquire knowledge and understanding of science and engineering principles relevant to mechanical engineering.
LT2 - Ability to apply knowledge, techniques and tools in solving problems relevant to mechanical engineering.
LT3 - Ability to design and critically evaluate components, processes or systems related to mechanical engineering using total approach.
LT4 - Ability to apply critical thinking and creatively exploit the current knowledge and technology in line with the development in mechanical engineering.

Generic Skills:

LG1 – Ability to lead and manage engineering projects.
LG2 – Ability to prepare, submit and present quality technical reports within the given time frame.
LG3 – Ability to communicate effectively as an engineer.
LG4 – Ability to work as a team.
LG5 – Ability to acquire entrepreneurship skills.
LG6 – Ability to continue life-long learning and technology management.
LG7 – Ability to practice professional ethics and execute work with sensitivity towards work safety and health, the environment and those with special needs.

Course learning outcome for UGP I

- To define and identify problems related to his/her projects
- To independently search, explore and expand his/her knowledge and experience in depth
- To critically propose and evaluate methods to solve the problems
- To independently plan and manage research work within stipulated period
- To critically present and explain the proposal of their research in written and oral presentation

Course learning outcome for UGP II

- Apply basic principles from fundamental disciplines to identify, formulate and solve the problems of their project
- Able to design and conduct experiments, as well as collect, analyse and interpret experimental data
- Able to use computers and relevant engineering designed tools to develop and implement solutions to their problem
- Able to execute and complete their project within stipulated period (2 semesters)

Making the First Year of the Engineering Program Interesting and Exciting Through an Engineering Orientation Course

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Abstract

Similar to many universities in the world, a typical first year engineering curriculum in the Philippines is loaded with mathematics and natural sciences such that an engineering frosh does not get any inkling of what engineering is and what an engineer does and, more often than not, the student gets bored and gets the misleading impression that engineering is just about number and equations. The authors discuss the importance of having an engineering orientation course in the first year of the engineering program which includes topics such as: the engineering profession; brief history of engineering and its branches; functions of engineering; the engineering curriculum; characteristics of a good engineer; learning styles; developing the engineering hard and soft skills; creativity in engineering design; and, the engineer's ethical and social responsibility. The authors also present activities that make the first year of engineering program interesting and exciting. Such activities include visits to the different laboratories and industrial plants, viewing of engineering exhibits, joining engineering design competition, and film viewing. Based on their experience in handling the course and the students' feedback, the students find the course fun-filled and very helpful in understanding the world of engineers. More importantly, the students stay in their engineering program and look forward to more design courses and hands-on activities.

Keywords: engineering orientation; student – centered learning

1. Introduction

A typical first year engineering curriculum normally is loaded with mathematics and natural science courses such that an engineering freshman never realize of what engineering is all about and what does an engineer do. The students get the impression that engineering is all about numbers and equations and purely technical. Please refer to Table 1 for a typical first year engineering curriculum in the Philippines [1].

Because of this, students tend to lose their interest and get bored in an engineering course such that they shift to another program of study. In his "Visions for Engineering Education", Bordogna suggests that engineering education must focus on the development of human resources and the broader education experience in which the individual curricular parts are connected and integrated, that is, engage students in engineering from the day to day they matriculated and make the study of engineering more attractive, exciting and fulfilling throughout [2]. This suggestion implies that the curriculum of engineering must be so designed that the students will have an interesting and exciting experience during their freshmen year such that they will stay in the program until finish the degree.

To address such a concern and to make the first year of the engineering program interesting and exciting, engineering orientation courses must be introduced. This will make students be aware of what engineering is all about, the characteristics of a good engineer and what are in store for them in the future. Other interesting activities that will harness the creativity of the freshmen will be included in the orientation courses such as design contest, film showing, plant visits, case studies and group discussions.

At De La Salle University – Manila (DLSU), for example, orientation courses are offered to students as follows: (a) A two – day Lassalian Personal Effectiveness Program held during summer prior to the start of their freshmen year, (b) ORIENT1 which meets once a week for fourteen weeks and (c) a one – unit MENGIOR course for mechanical engineering freshmen. Effective SY 2006 - 2007, ORIENT1 was replaced by a new course, PERSEF1 (Personal Effectiveness) wherein some of the important topics in ORIENT1 had been integrated into its course contents.

Starting SY 2007 – 2008 freshies at the Mapua Institute of Technology (MIT) are taking a one – unit orientation course specific to a particular engineering discipline / program.

Table 1. Typical first year engineering curriculum

First Semester

Courses	Lecture hours	Lab. Hours	Units
Algebra	3	0	3
Trigonometry	3	0	3
Chemistry 1	3	3	4
Engineering Drawing 1	0	3	1
English 1	3	0	3
Filipino 1	3	0	3
Philippine History	3	0	3
Physical Education 1	0	2	2
NSTP 1	0	-	(3)
Total	18	8	22 (3)

Second Semester

Courses	Lecture hours	Lab. Hours	Units
Analytic and Solid Geometry	3	0	3
Physics 1	2	3	3
English 2	3	0	3
Eng'g Drawing 2	0	3	1
Philosophy	3	0	3
Filipino 2	3	0	3
Physical Education 2	0	2	2
NSTP	-	-	(3)
Total	14	8	18 (3)

2. Orientation programs

2.1. Frosh orientation program at DLSU

The freshmen orientation at DLSU starts with a two-day Lasallian Personal Effectiveness Program (LPEP) held during summer prior to the start of the first trimester and a one – unit course ORIENT1. The objectives of the LPEP are to welcome the freshmen and inspire them to make the best of their stay in the university, provide them with basic information and skills that would help them through heir stay in the university and introduce to them the Lasallian animo of faith, zeal and communion [3]. The activities included in this program are:

- Welcoming the freshmen by school administrators, faculty and student leaders. An alumni is also invited to give an inspirational message
- Introduction of the Christian Achiever Framework
- Getting to know activity among freshmen
- Testimonials from the student leaders
- Giving the freshmen an overview of the policies related to academics and discipline
- A tour of the campus

The ORIENT1 is a follow-up orientation program to freshmen and offered during the first trimester of their stay at DLSU. Its objectives are to provide the students with the basic information and skills that will help them through their stay in the university, to familiarize them with the history and general direction of the university, and to strengthen the integration of the Lasallian spirit of faith, zeal and communion [3]. The design of ORIENT1 includes two parts. The first part is an orientation about the university in general which includes knowing the student personnel services, a session on academic concern with the vice – dean of the college, a session on discipline, a module on time management and Lasallian modules.

In the second part of ORIENT1 students are made aware about their specific majors and the career options that are in store for them after they graduate from their courses. Students find ORIENT1 to be very helpful in terms of adjusting to college life, being informed about polices related to both academics and discipline, and being able to know the different aspects of a Lasallian education. They also find the second part of the course interesting and informational such that they learned a lot about the specific course they are enrolled in which make them decide to stay in that course.

2.2. Mapua Frosh orientation program

The Frosh orientation at the Mapua Institute of Technology starts during the first week of the opening of new academic year. Since the Institute operates on a quarterm, the frosh week is held during the first week of the first quarter by the Student Affairs Office. The week – long program which comprises of academic, social, cultural and religious activities aims to make the first year students feel special and welcome and to provide opportunities for student organizations to welcome them as well in their unique ways. During the week each school (college) prepares a half – day orientation seminar which includes the following activities:

- Welcome remarks from the Dean of the School
- Introduction of School Administrators, Faculty and Staff
- Brief presentations about the school program, student advising, guidance and counseling, registration, rules and regulations, student activities and other school services.
- Welcoming of Frosh by the school student organizations
- Inspirational talk by outstanding alumnus
- Singing of the Alma Mater Hymn
- Tour of the laboratories

During the week – long activity, the froshies attend classes also. The one – unit orientation course is conducted in a particular quarter depending on the curriculum of the particular program. For the School of Mechanical Engineering, the orientation course is offered in the second quarter.

2.3. Mechanical Engineering Orientation (MENGIOR) [4]

MENGIOR is a course that introduces mechanical engineering as a profession with emphasis on the requirements for professional practice and mechanical engineering as a career focusing on the career opportunities. The course discusses developing engineering skills to succeed in engineering study. Following is the course outline of MENGIOR (Please refer to the MENGIOR course syllabus in the appendix):

- Introduction to mechanical engineering profession – topics discussed include the definition of profession, the models of profession and professional ethics.
- The mechanical engineering curriculum – the different courses offered to mechanical engineering students such as liberal arts courses, mathematics and science courses, engineering science courses and allied & professional courses including its importance in the profession are discussed in this topic.
- Characteristics of a good engineer
- Learning in the university environment which includes learning and teaching styles, collaborative learning and group study as well performing laboratory experiments are discussed so the students will have an idea on how to cope up with the different courses that they will be taking up in the entire program.
- Introduction to engineering practice which reiterates some topics discussed in ORIENT1 such as engineering as a career and career opportunities in engineering giving emphasis on design, the licensure examination and on the job training and the professional engineering societies.
- Developing engineering skills which includes topics in communication skills, teamwork skills, creativity and decision making, and engineering design project.

In this course the teaching methodologies include lectures, plant visits, film showing, case studies, design contest, group discussion and workshops. The common strategies used such as lectures, film viewing, case studies, group discussion and workshops are normally done inside the classroom. The students are motivated to participate actively in these activities, thus their communication, teamwork, and decision – making skills are enhanced.

Engineering design project is the application of the technical and creative skills to a term project [5]. To foster the enthusiasm of the students, a design competition can be held. This orientation course is adopted by the Mapua Institute of Technology and the Commission on Higher Education (CHED) for all schools offering mechanical engineering.

3. Feedback from the students

Two batches of mechanical engineering students at DLSU who took MENGIOR in school years 2005 – 2006 (with 39 students) and 2006 – 2007 (with 53 students) were asked to submit a critique of the course at the end of the term. The students were unanimous in finding the course very helpful and interesting in knowing what mechanical engineering is as a profession and its career opportunities. Other impressions about the course are:

- a lot of fun; an hour of learning and laughing
- a refuge / relaxation from boring math and science courses
- heightens student's interest in mechanical engineering and makes them excited to take major courses
- makes them love and appreciate mechanical engineering
- introduces them to the world of engineering
- an excellent course where fun and enrichment of knowledge can be found
- helps students decide to stay in the program
- gives them an idea of what they will do in the future as mechanical engineer
- eliminates misconceptions and myths about mechanical engineering
- a great addition to the mechanical engineering curriculum
- makes them proud of being mechanical engineering students and feel the concern and care of the mechanical engineering department
- a course to look forward to attending every week.

As regards the topics discussed in MENGIOR, the students found the following most interesting and informational:

- Mechanical Engineering as a career and profession – 50%
- Professional Ethics / code of Ethics – 40%
- Creativity and Engineering Design – 20%
- Characteristics of a Good Engineer – 15%

The students found the following topics least helpful:

- Mechanical engineering curricula of other universities
- Flowchart discussion

The students found the following activities interesting and exciting:

- Catapult design contest

- Laboratory tour
- Video presentation

The following were student's suggestions to improve the delivery of the course:

- Include plant visits and field trips to manufacturing plants and power plants
- Have more interactive and hands – on activities
- Increase the number of units (hours) allotted for the course

Some of the student's comments on the faculty handling the course were:

- Passionate in what he teaches and imparts
- Effective and excellent teaching
- Establishes rapport with students
- Have a good sense of humor
- Makes learning a lot of fun

The following are interesting quotations from the critique papers the students submitted:

- I've always seen orientation courses as a tiresome necessity. I took up Introduction to Aerospace Engineering when I was at ERAU, Daytona Beach, and it was a class that didn't challenge me in any way. Everything was rote, mechanical and overall, boring. Thus, when I found out that we had to do the same for Mechanical Engineering here, I resigned myself to experiencing the same thing all over again. I was pleasantly surprised. I found the classes engaging, and I learned things I knew I wouldn't have learned otherwise, such as information about various good colleges in the US, what the job market is like, what is really involved in Mechanical Engineering; for example, the tours of the laboratories were extremely valuable. It was also a great place to get to know the other Mechanical Engineering students. Most of all, however, I enjoyed the chance to work firsthand on an engineering project when we built a catapult.

  Lavina Parwani

- Adapting to university life is quite like no other. You have people who on one hand, take college to be the joyride of their lives and on the other extreme, treat it like a war zone with one main goal, making it out as the victor. Often, during the battle, you find yourself estranged to your surroundings. The first glimpse of serenity or what most yearn for in such conditions would be silence or an appeasing image, so much so that it is actually a mirage. Amidst the hustle and bustle of the college life, constantly springing from one moment to the next, you come across a subject that seems so surreal but is in fact reality.

  Jon Virgil Angeles

- When I took up the different entrance exams two years ago, I all wrote Mechanical Engineering as my first choice. But honestly, I didn't really understand at all what my program means. I just chose it for the reason that my father himself is a Mechanical Engineer and I wanted to be like him. Another thing is that I want to put a title on my name but I never chose it because I didn't really know what I was studying for and where would I end up. But thanks to MENGIOR where it all became clear into my mind. It made me understand what my program Mechanical Engineering was all about. It help me picture out myself on the kind of job I wanted to work in the future. It made me live and embrace my course. Now, I can finally say: I am Mechanical Engineering student and it's a great program to be with. Thanks MENGIOR!

  Roald Dy

- Last term, I had a difficult time with my subjects, ENGCAL2 (Calculus), PHYENG (Physics for Engineering), CHEMTWO (Chemistry), uggghh! I hate it! And when I got my EAF for the next term, it did not excite me that much too. Almost all of my subjects have to deal with math and computations. Except for one, MENGIOR, this is an orientation for my course, Mechanical Engineering. I really looked forward to it because I still have tons of questions in my mind on what my course has for me for my future.

  Marc Anthony Ordinanza

- MENGIOR's introduction is like dipping your fingertips to a mouthwatering cake.

  Earl Mamawal

- MENGIOR is like an ember in a flame of passion of ME student because it starts the flame of passion for the students.

  Geoffrey Ngo

- MENGIOR was definitely one of my favorites this term as I got a chance to explore what was ahead of me in my chosen path.

  Fredic Eron Tan

- MENGIOR is not just an orientation course; it actually teaches us to think critically and imagine the kind of life we would have upon finishing the course.

  Francis Duguan

- There was an activity where in we were required to join. It was the catapult making challenge. At first, I was nervous because I might not have a group and I do not have any idea on how am I going to create a catapult. Then, group mates came and problem no.1 was solved. Next challenge for me was to create the actual project. My goodness!!! It was hard. I had to admit that there are some things a girl could not do like saw

continuously, nail woods together all day long. It was a man's job. However, I am still proud of myself and my group mates because we did everything to the limits. We saw, drilled, nailed and everything! It was indeed teamwork. As a reward, we got the first place.

Maria Carla S. dela Cruz

- Creating a piece of mechanical devise made us act like engineers working on the field. But I can tell that the part we (especially our team) all took pleasure in is the 'IMBENTO: Catapult Making Contest'. We all wanted to take a breather from all the academic works and the worrying about the grades. And it does make us feel a little more like engineers to be. It was an experience using a saw for the first time, going to the hardware store for screws and hooks, doing our own function to create 'B-Asher', the champion catapult. Winning the contest I guess is a bonus. But it felt so good.

Margarita Antonio

4. Some helpful insights and tips

The orientation programs play an important role in the formation of students especially the freshmen. This will tickle their interest and excite them with regard to the courses that they will take up in the succeeding years of their study in an engineering course. This will also make them do their best so as to stay in the program they are enrolled in.

Based on the experience of the authors as the vice – dean of the college of engineering, managing the orientation program and as facilitators handling the course, the following tips are proven to be important to succeed in this endeavor [7]:

- A pool of volunteer facilitators must be created with the vice – dean of the college serving as the over-all coordinator of the program.
- Facilitators are key to success of the engineering orientation program [6]. Student learning must be emphasized over teacher teaching. The teacher is the facilitator; leader and planner.
- The characteristics of a good facilitator are: show genuine concern for the welfare of the students; identity with the goals and objectives of the program; willingness to undergo training; demonstrate the possession of the skills to be taught to the students such as communication, teamwork, creative, etc.; use a variety of teaching methods and apply new technologies to enhance delivery of the courses and adjust methods to students' learning styles.
- Team teaching is a good alternative if few facilitators possess the characteristics mentioned above.
- The facilitators should be assisted in developing and producing the materials needed for the program.
- Coordination with the other units of the university which deals with student concerns such as: student development, student activities, career services, counseling services, industry-academe linkages, etc. prove to be useful.
- As much as possible, giving of examinations must be avoided as a form of evaluating or assessing student performance. Pass/fail grading system maybe a good option for these courses.
- At the end of each of the courses, the student will be asked to evaluate the course and the facilitator. A university unit for testing and evaluation may be tapped for this purpose.

5. Conclusion

Orientation courses play an important role in the formative years of freshmen in a university facilitating their transition from high school to college life. Through this program, they became aware of the university policies especially those pertaining to academics and discipline. They are also oriented with regard to the program they are enrolled in giving emphasis to curriculum and career opportunities after they get the degree.

The orientation courses makes the stay of engineering freshmen exciting through interesting activities that harness their creativity and enhanced their skills in communication, teamwork and decision making. The success of this program can be attributed, based on the experience of the authors, to the following: a good orientation program and well – trained facilitators.

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Appendix

MECHANICAL ENGINEERING DEPARTMENT COURES SYLLABUS

MENGIOR / Mechanical Engineering Orientation**:** Introduction to Mechanical Engineering as a Profession and as a Career
Prerequisite: First Year Third Trimester M.E. Students
Course Description**:** The course introduces mechanical engineering as a profession with emphasis on the requirements for professional practice and mechanical engineering as a career focusing on the career opportunities. The course discusses developing engineering skills to succeed in engineering study.
Objectives/Values: At the end of the course, the student should be able to: understand engineering profession and the requirement for professional practice; understand mechanical engineering as a career and know the career opportunities of mechanical engineers; and, learn engineering skills to succeed in engineering study.

Topics

1. Introduction to Course
   - Course Syllabus
   - Course Requirements

Introduction to Mechanical Engineering as a Profession

2. The Mechanical Engineering Profession
   - Definition of Profession
   - Models of Profession (Social Contract)
   - Professional Ethics

Introduction to Mechanical Engineering Study

3. The Mechanical Engineering Curriculum
   - Liberal Arts Courses
   - Mathematics and Science Courses
   - Engineering Science Courses
   - Allied and Professional Course
4. Who Should Study Mechanical Engineering
   - Characteristics of Good Engineer
   - MBTI personality Test
5. Learning in the University Environment
   - Learning and Teaching Styles
   - Collaborative Learning and Group Study
   - Laboratory Experiments

Introduction to Engineering Practice

6. Engineering as a Career and Career Opportunities in Engineering
   - Emphasis on Design in Engineering
7. The Licensure Examination / The Engineering On-the-job Training program
8. The Professional Engineering Societies
   - The Student Chapters/Branches
   - Code of Ethics

Developing Engineering Skills

9. Communications Skills: Oral and Written
10. Teamwork Skills
11. Creativity and Decision Making
12. Engineering Design Project
13. Integration/Evaluation

Teaching Methods/Strategies: lectures, plant / laboratory visits, film showing, case studies, design contest, group discussion and workshops.

Requirements: Attendance, assignments, oral and written reports, projects.

Assessment/Evaluation: Attendance, submission of assignments, oral presentation and participation in discussion/workshops.

Text/Materials: The Engineering Student Survival Guide by K. Donaldson; hand-outs, brochures of university/college, professional societies and industries.