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STUDENTS' FEEDBACK FOR CONTINUOUS QUALITY IMPROVEMENT OF MATERIALS TECHNOLOGY COURSE OUTCOMES VIA TEACHING & SUPERVISION EVALUATION SYSTEM

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Abstract

Continuous quality improvement (CQI) of a program design and curriculum is a mandatory process to ensure the accreditation of engineering programmes. The most inner loop in CQI of a programme is the improvement of outcomes for each course offered in the programme. This paper studied the CQI of the course outcomes (CO) of a particular course (Materials Technology) via the students' feedbacks captured in the Teaching & Supervision Evaluation System (TSES). TSES is a system for students to assess the Teaching and Learning (T&L) quality of a specific course offered and at the same time also assess the proficiency and efficiency of the Quality Management System (QMS) MS ISO 9001:2008 for Undergraduate and Graduate (by course work) Study Management. Feedbacks are on General Items (such as course content, infrastructure and apparatus), Faculty and the Lecturers' T&L Method. The quality of T&L can be improved consistently through this system. In this study, data from five recent years for the Materials Technology course is analysed for the general items, faculty and T&L which involved questions employing a Likert Scale from 1 (Very unsatisfactory) to 5 (Very satisfactory) for the answers. Feedbacks from the TSES are utilised to improve the conduct of the course in the succeeding session. Results indicate scores achieved in every area have increased through the usage of this system and the CQI cycle at the course level is completed.

Keywords: Continuous quality improvement (CQI), Accreditation, Course outcomes (CO), Teaching & Supervision Evaluation System (TSES), Satisfaction level; Materials Technology course.

1. Introduction

The Materials and Technology in Civil Engineering (Materials Technology - KKKH2164) course is a course taken by second year students in their first semester at the Department of Civil and Structural Engineering, Faculty of Engineering and Built Environment (FEBE), UKM. The course covers introduction to construction materials, their manufacturing processes, properties and features. It is divided into lectures, projects and lab experiments and the lab work focuses on concrete mixing and testing. The method to design the mix proportion of concrete (a construction material most widely used) is given emphasis in the lab experiments as well as in lecture [1]. Problem-based learning is applied as the method of teaching and learning (T&L) of the course. At the beginning of the course, lectures are given to the students in the classroom. The goal is to ensure that students have sufficient knowledge and information about the course. The students, then, are assigned certain tasks in the form of experiments and projects in the laboratory. In their effort to find a solution, the students acquire necessary information before carrying out their experiments [1- 4]. At the end of the semester, the students are required to answer a survey to evaluate the course conduct. The evaluations are conducted using Teaching & Supervision Evaluation System (TSES). The TSES is a part of the tool to ensure the Continuous Quality Improvement (CQI) of the course.

Continuous Quality Improvement (CQI) is a quality assurance process that ensures academic programmes offered remains relevant, dynamic and competitive. The process is cyclic in nature and involves two key activities, namely monitoring programme execution and revision of programme curriculum, which need to be performed systematically. Figure 1 shows the CQI cycle for improvement involving programme execution monitoring and curriculum revision. Major changes were implemented to the programme for students enrolled in the session of 2010/2011 [5].

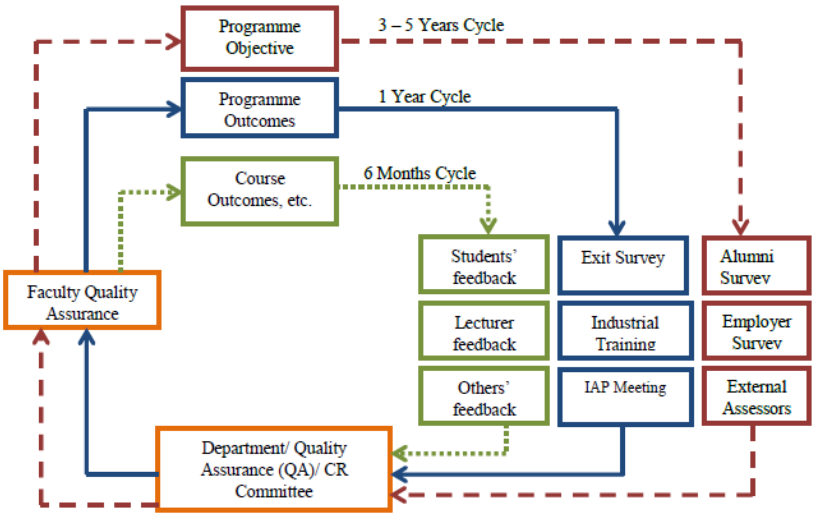


Fig. 1. Quality assurance cycle for the undergraduate programmes' curriculum.

Monitoring at the course level is conducted every semester, whereas at the programme level, it is conducted as an annual activity, which is, after the academic session has ended. For Materials Technology course, the lecturers had made improvements in many aspects including changing different methods of delivery [3], doing assessment on the construct validity of the final examination questions where the validity of the constructed questions is verified by using Rasch Model [6, 7] and introducing new method of handling and assessment of the lab work [1, 2, 4, 8]. There are various methods employed in the process of monitoring the course. One of which is by the usage of the TSES, which is arranged by the institute. TSES is a student feedback system that considers the teaching quality of a course offered, with the purpose of CQI on its programme design and curriculum. It is also to evaluate the proficiency and efficiency of the Quality Management System (QMS) MS ISO 9001:2008 for Undergraduate and Graduate (by course work) Study Management. Feedback includes General items (such as course content, infrastructure and apparatus), Faculty and the Lecturers' T&L Method, as shown in Fig. 2.

Evaluation on the T&L processes which involves activities (course work, co-curriculum activities like lecture series, field work and so on) that is designed to achieve the course outcomes (CO) is important for continuous improvement of the CO [9], hence the curriculum. The CO's for Materials Technology course are as shown in Table 1. Students benefit from the evaluation because their feedbacks help them to understand their strengths and weaknesses. Also, lecturers too gain benefit because evaluation prompts discussion of critical issues regarding teaching methods and expectation of students' acceptance of the T&L of a given course.

Figure 3 shows the improvement of the CO for a 6 month (one semester) CQI cycle. In this study, TSES is used to observe changes in the pattern of students' feedback for 6 semesters for continuous improvement.

Table 1. List of course outcomes for Material Technology course.

No.	CO Statements
CO1	Able to understand/explain/discuss the physical and engineering properties of Civil Engineering Materials
CO2	Able to understand/explain/discuss physical and engineering properties of concrete components (coarse and fine aggregates, cement, admixtures) and fresh and hardened concrete.
CO3	Able to design concrete mix proportion using DoE or ACI method.
CO4	Able to understand/ explain/ discuss testing of fresh and hardened concrete.
CO5	Able to communicate verbally the physical and engineering properties of Civil Engineering materials; physical and engineering properties of concrete components (coarse and fine aggregates, cement, admixtures); physical and engineering properties of fresh and hardened concrete and testing of fresh and hardened concrete to members in class.
CO6	Able to apply testing methods to determine the properties of fresh and hardened concrete under minimum supervision.
CO7	Able to analyse the different types of concrete depending on intended application and requirement to strength and environment.

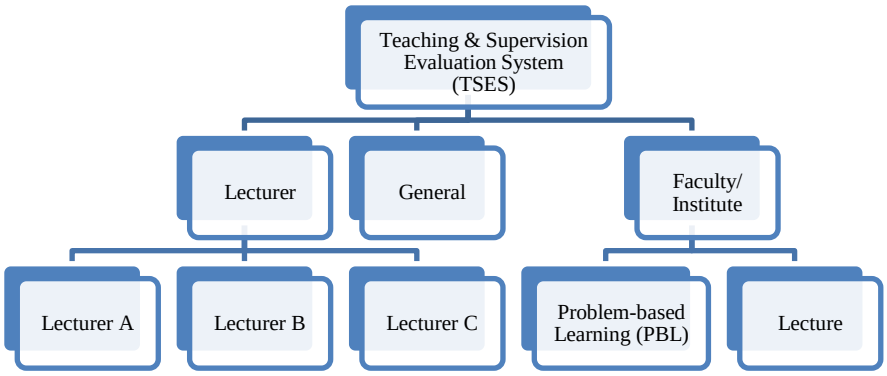


Fig. 2. Details of items evaluated in TSES from students' perspectives.

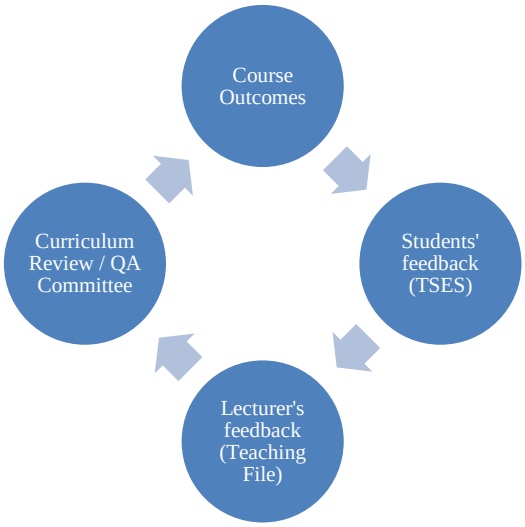


Fig. 3. CQI of CO through TSES for 6 months cycle.

2. Study Methodology

The students' feedbacks on the Materials Technology course were from the last 5 years, namely semester 1-2011/2012, 1-2012/2013, 1-2013/2014, 1-2014/2015, 2-2014/2015 and 1-2015/2016 with 45, 52, 73, 9 and 109 respondents (students enrolled in the class) for the respective semester (as shown in Table 2). Semester 2-2014/2015 is a repeat class. TSES comprises of three main categories, namely general, faculty and lecturer. The faculty category is divided into evaluation of lecture and problem-based learning (PBL) modes. Next, the evaluation of lecturer is for all lecturers involved in the T & L. For KKKH2164, there were three lecturers involved. In this study the findings are focused on the students' evaluation towards general issues and lecturers.

Table 2. Number of students according to semester.

Semester	No. of Students
1-2011/2012	45
1-2012/2013	52
1-2013/2014	38
1-2014/2015	73
2-2014/2015	9
1-2015/2016	109

Students were required to evaluate their satisfaction level for every question provided, as shown in Table 3. Every item was measured using a Likert scale of 1 to 5, where 1 - "Very unsatisfactory", 2 - "Unsatisfactory", 3 - "Moderate", 4 - "Satisfactory" and 5 - "Very satisfactory".

Table 3. Questions for General Items and Lecturers' Conduct.

No.	General Items
1.	Suitability of course content with learning/course outcome
2.	Organization and arrangement of teaching plan
3.	Suitability of course content with current requirements and development
4.	Facilities in the classroom/lecture hall
5.	Safety in the classroom/lecture hall
6.	Condition of teaching aids (complete and functioning)
7.	Environment of the classroom/lecture hall (tidy and clean)

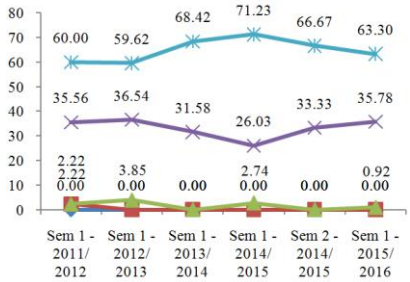
No.	Lecturers' Conduct
1.	Command of course materials and confidence in delivery
2.	Method of teaching delivery (clear and interesting)
3.	Dedication and commitment when conducting course
4.	Punctual and follow lecture timetable
5.	Treat all students equally and friendly

3. Results and Discussion

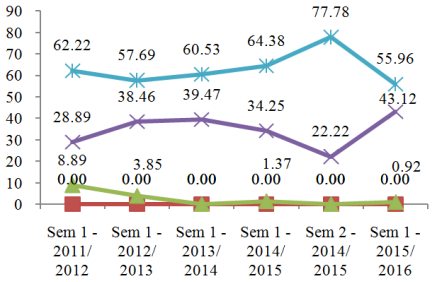
3.1. Feedback and improvement on the General Items

Outcome-Based Education (OBE) states that CO is the main spearhead of course contents and its measuring structure [10]. The suitability of course content with CO is measured to observe the changes in satisfaction level for 6 different semesters. Figure 4(a) shows that the majority of respondents were very satisfied with "the suitability of the course content with the CO". An organized and well-arranged teaching plan helps the process of teaching to go smoothly, increasing the lecturer's confidence prior class, optimizing teaching time, and boosting the teaching materials and approach to the delivery of course content. Figure 4(b) shows that, the majority of students felt that the teaching plan arrangement was 'very satisfactory' in every semester. In the first two earlier semesters though, it was found that there were a group of students that thought organization and arrangement of teaching plan as being 'moderate'. Even so, in the following semester, namely semester 1-2013/2014, the percentage declined because the TSES feedback previously obtained was used to employ continuous improvements on the organization and arrangement

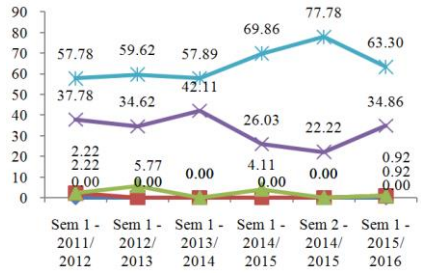
of the teaching plan. The CQI that was applied left the students very satisfied when attending the lecture of the course conducted in the succeeding semesters.



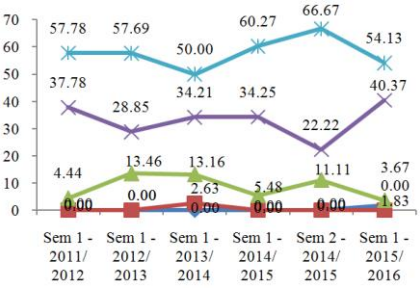
(a) Suitability of Course Content with CO.



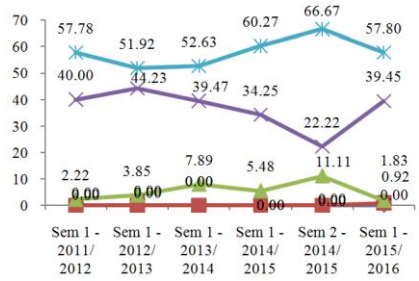
(b) Organization and Arrangement of Teaching Plan.



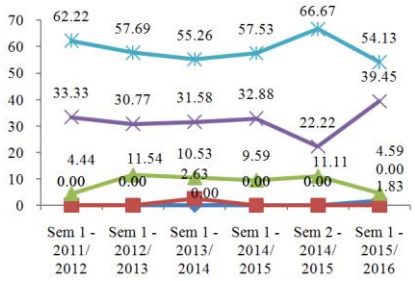
(c) Suitability of Course content with Current Requirements and Development.



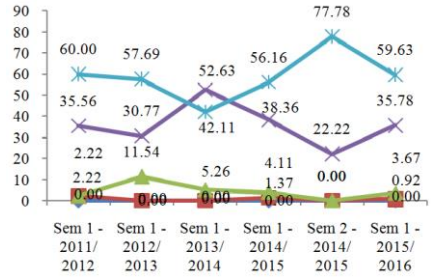
(d) Facilities in the Classroom/ Lecture Hall.



(e) Safety in the Classroom/ Lecture Hall.



(f) State of Teaching Aids.



(g) Environment of the Classroom/ Lecture Hall.

Fig. 4. Students' feedback for General Items during the past 6 semesters.

In an era of rapid technological developments, changes in current environment too occur in a swift manner. In such circumstances, the courses offered are constantly updated to help students to enhance their skills and knowledge consistently with the latest information and technology for the current requirements. Figure 4(c) shows the students' feedback on the suitability of course content with current requirements and development. The graph shows an increase in the percentage of students that chose 'very satisfactory' up until semester 2-2014/2015, with a percentage of 77.88%. In semester 1-2015/2016, a decline was found for the 'very satisfactory' scale and this is parallel to the increase of the 4 scale, whereby 63.3% felt that the course content relationship with current requirements and development was only 'satisfactory'. With that said however, in almost every semester, a small percentage of respondents chose 'moderate' and 'unsatisfactory' for the suitability of course content with current requirements and development. This occurs in line with the rapid technological growth and information abundance in the media and reading materials of students. This is due to, may be, either the student has vast knowledge of the current technological development that are not covered in the course or they basically had lack knowledge on the current technological development. Interaction by sharing information between lecturers and students during the class can help to expose the idea of current technologies.

In order to ensure that students can learn in a comfortable and good environment, as well as the teachers being able to deliver knowledge more efficiently, the faculty should provide suitable infrastructure and facilities in accordance with the course being conducted. Figure 4(d) shows the students' level of satisfaction regarding facilities in the classroom. It shows that only over 50% of them felt that the facilities in the classroom are 'very satisfactory', rather, 22.22% to 40.37% of students that chose 'satisfactory' with their percentage ranging depending on the semester. There were also students (3.67% and 13.46%) that felt the facilities in the classroom to be 'moderate', and in semester 1-2013/2014, 2.63% of the respondents thought that the facilities in the classrooms were 'unsatisfactory'.

In semester 1-2015/2016, as Table 2 shows, the number of students enrolled in this course is 109, and it can be seen that a large number of students in a class is not practical, and their feedbacks as shown in Figure 4(d) reflect their mood of learning. It seems that students need to be comfortable in order for conducive learning to take place. Thus, based on this feedback, the faculty has taken measures to continuously improve the state of classroom facilities, in order to ensure 100% satisfaction from the students and that they are comfortable, and for next coming semester, large classroom is proposed to be divided into small sets of classrooms.

The Ministry of Education has also issued certain safety rules and regulations that need to be followed when building a school or a T & L facility [11]. These rules are also adapted by most centre of learning in Malaysia. Figure 4(e) shows that the numbers of students that are very satisfied with the classroom safety keep increasing each year, showing that the faculty had taken every measure to improve the safety issues. The increased in "very satisfied" percentage and the decreased in "satisfied" percentage shows inverse relation of both scales. Even so, the level of satisfaction as a whole was found to have increased when taking into consideration

both, 'satisfactory' and 'very satisfactory'. In the meantime, the number of students that felt the safety in the classroom is at a moderate level is between 1.83% and 11.11%. Overall, the level of safety in the classroom is constantly undergoing improvement process with the help of feedback from students.

Today's T & L processes have changed in many ways and they have undergone an evolution. In the past, writing and verbal activities are the norm in teaching but now, technology has driven the use of ever more sophisticated tools such as computers, video and the like that combine visual, audio and textual elements [12]. The use of these tools helps the process of teaching and learning to become more innovative and this in turn, directly enhances students' understanding. Thus, the state of teaching aids must be conducive and always in a good condition to ensure that the teaching process is conducted smoothly and completely. Assessment of students' feedback on the state of teaching aids found that most students are very satisfied or satisfied with them (Figure 4(f)). Nonetheless, there are quite a number of them (4.44 up to 11.54%) who think that the states of the teaching aids are in moderate condition. The faculty needs to look into this matter as time will be wasted if the lecturer could not operate the teaching aids properly.

The classroom or lecture hall is the learning environment that includes students, teachers, space and teaching aids. Effective learning is also related to a conducive and comfortable classroom environment. Therefore, physical amenities that cannot function well are among the factors of a classroom environment causing problems in the T &L process. A classroom or lecture hall that is not fully equipped can make students to feel discomfort and lose focus on their learning. And so, the classroom factor can affect students' satisfaction on the facilities provided. As an improvement, lecture hall are cleaned every morning by the cleaning company appointed by the administration and regular maintenance of teaching aids are carried out.

Figure 4(g) shows the level of students' satisfaction on the environment of the classroom/lecture hall. It was found that the percentage of students who felt the environment of the classroom/lecture hall 'very satisfactory' has decreased starting from 1-2011/2012 to semester 1-2013/2014. However, the percentage saw an increase from semester 1-2014/2015 to semester 1-2015/2016. The increase is due to the improvement measures taken, as a result of the feedback given by students of the previous semesters. Whereas the graph pattern for students who chose 'satisfactory' for the environment of the classroom was found to be the opposite of the 'very satisfactory' group. This change indicates that the level of students' satisfaction remained positive because the decrease and increase of the 4 and 5 scales respectively are directly related.

Overall, the satisfaction and wellbeing of the students in the T & L process also depends on the number of students enrolled in a class. It can be seen that for a very small number of students, such as in semester 2-2014/2015, where only nine students were enrolled in the class (Table 1), Fig. 4 shows that they are very satisfied with all the general items. This should also be taken into consideration when conducting a class.

3.2. Feedbacks and improvement on the Lecturers' T & L Ability

An evaluation on the lecturer's T & L capability is critical in order to observe a lecturer's ability to control the T & L processes. For Materials Technology course, three lecturers were assigned to teach it. One lecturer, lecturer A is involved in delivering lectures. Meanwhile, the other two, lecturer B and lecturer C, are both involved in conducting the lab work. Lecturer B only does the marking of the student lab work report. Students still can meet lecturer B at the office for any inquiry of the lab work, even though she is not present during the lab work. At the end of every semester, all three lecturers were evaluated by their students on the following five items:

a) Command of course materials and confidence in delivery;

b) Method of delivery;

c) Dedication and commitment when conducting course;

d) Punctuality and follow the lecture timetable;

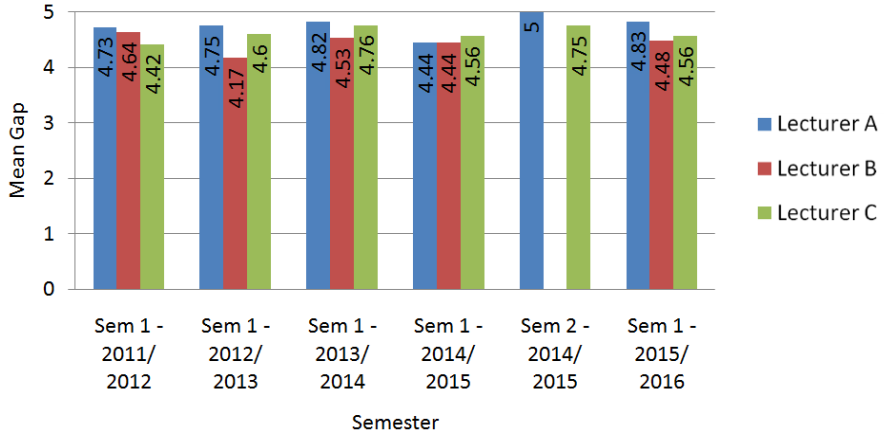
e) Treat all students equally and is friendly.

The results of the students' evaluation for the past 5 years are plotted in graphs as shown in Fig. 5.

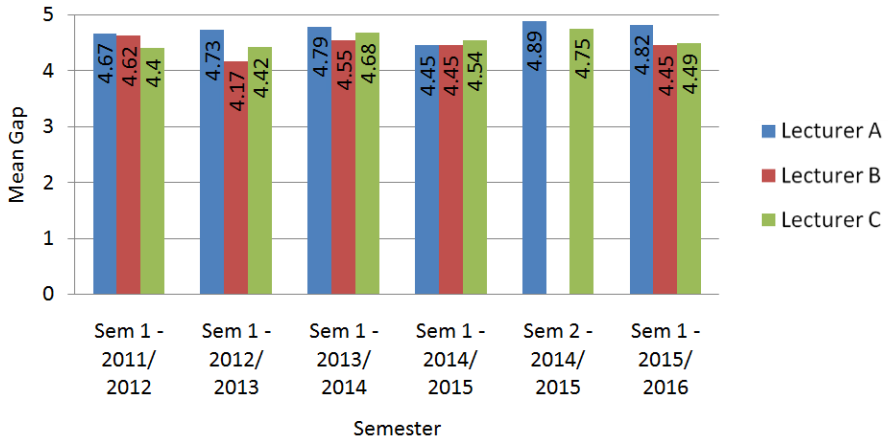
As shown in Fig. 5, it was found that all five items evaluated of the lecturers by the students are satisfactory, whereby all mean values exceed 4.00. This indicates that the students were satisfied with all three lecturers in all five criteria. The lowest mean gap found was 4.15 and it belonged to lecturer B for the criterion (d) punctuality and follows lecture timetable in semester 1 - 2012/2013. Whereas the highest mean gap of 5.00 belongs to lecturer A for the criterion (a) command of course materials and confidence in delivery for semester 2 - 2014/2015. Analysis on all five graphs found that lecturer A obtained the highest level of satisfaction for all five criteria when compared to lecturer B and lecturer C. However, in semester 1 - 2014/2015, lecturer A was found to be at the same level as lecturer B, and lower than lecturer C. Overall, the students' satisfaction level on all five criteria during the past six semesters was 'satisfactory' for all three lecturers.

Through TSES, a remark field was also provided for the students. Here, they are free to state their opinions on the course and lecturers subjectively after having attended the course. As a whole, not all students wrote a remark because it was not made compulsory. Table 4 shows students' comments about the course during the past six semesters. Only one student commented in semester 1 - 2012/2013 and 1 - 2015/2016.

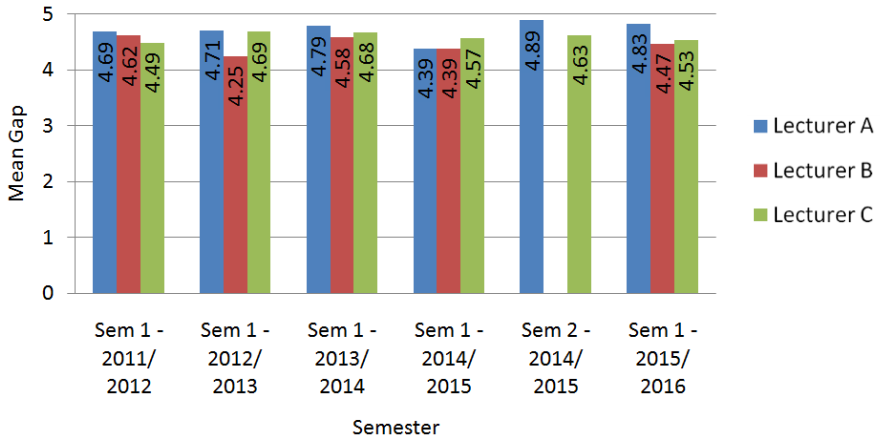
As the Materials Technology course are handled by three lecturers where Lecturer A only conducted lecture on the course subject and lecturer B and lecturer C were involved in handing the lab work, the approach to T & L of all three lecturers were different from each other. Lecturer B and lecturer C focused on practical work executed by the students. Therefore, the comments given by students on lecturer A, B and C describe the obvious relationship between the lecturers and their students, as can be seen in Table 5.



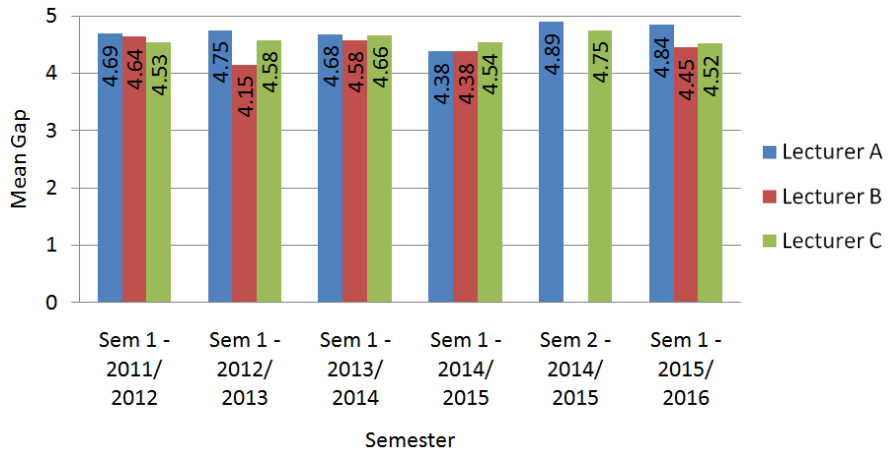
(a) Command of course materials and confidence in delivery.



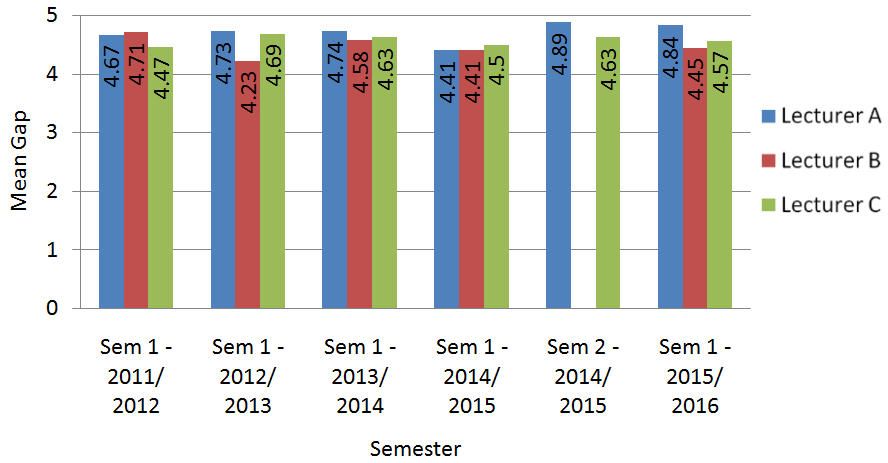
(b) Method of teaching delivery (clear and interesting).



(c) Dedication and commitment when conducting course.



(d) Punctual and follow lecture timetable.



(e) Treat all students equally and is friendly.

Fig. 5. Students' level of satisfaction towards the Lecturer's Conduct.

Table 4. Students' comments on the course.

Semester	Comments
1 - 2011/2012	- No comment -
1 - 2012/2013	Good
1 - 2013/2014	- No comment -
1 - 2014/2015	- No comment -
2 - 2014/2015	- No comment -
1 - 2015/2016	Syllabus unorganized. Books don't help much

Table 5. Students' comments on the lecturers.

Semester	Comments		
	Lecturer A	**Lecturer B**	**Lecturer C**
Sem 1 2011/2012	- look fierce but quite nice and cute, hope to see you in future. - A great lecturer :)	- No comment -	- No comment -
Sem 1 2012/2013	- good - very student friendly	- She never taught us - good - She is on leave - Maternity Leave	- good - easy to understand
Sem 1 2013/2014	- Lessons uninteresting. Will get sleepy - is it she's so good or I like this course so much? Anyway, I feel that I'm gonna miss a lot if I attend her class even 5 minutes late. - A very patient lecturer and nice person.	- do I know her? oh yeah she was my evaluator during professionalism. Oops wrong course and how do I judge that. full marks for her	- He teaches me mechanic. full marks for wrong course
Sem 1 2014/2015	- classes with her are not boring	- Never met the lecturer	- No comment -
Sem 2 2014/2015	- No comment -	- No comment -	- No comment -
Sem 1 2015/2016	- Thank you Dr. A for the fun lessons. Unable to repay you, may Allah grant you Paradise	- No comment -	- No comment -

3.3. Action taken

At each end of the semester, lecturers are required to prepare a report based on the feedback provided by students through the TSES. The issues highlighted by students are made improved by the lecturers are stated in the report. Among the remedial action taken are such as:

i. Lecture materials have been improved to include more pictures and videos on examples of technology, civil engineering and construction materials that were taken by the lecturers themselves - for comment "Lessons uninteresting. Will get sleepy";
ii. Lecturer B was assigned to attend the lab during the lab work - for comment on "Never met the lecturer".

The reports on feedbacks and actions taken are included in the teaching files for each semester to complete the continuous quality improvement in teaching and learning cycle.

4. Conclusion

The TSES is a student feedback system that can help increase the quality of T & L through the CQI process. The quality of teaching and lecture delivery can be continuously improved through feedbacks and evaluation of students' satisfaction level on the course conducted. The number of students' factor can affect their satisfaction level as a whole. Large numbers of students in a class shows low level of comfort and satisfaction and vice versa. Communication between the lecturers and students is crucial in improving the students' satisfaction in the T & L process. The lack of face-to-face time between the lecturer and student in both, lectures and lab work, has a negative impact on the quality of the course. It is through feedbacks of students' satisfaction on the course, the CQI process can be continually employed, with the help of the TSES platform that was developed by the University. Base on the feedback each semester, the faculty and the lecturers improve the learning environment and their method of T & L for each course. The course outcomes are reviewed based on the students' feedback, together with the lecturers' feedback themselves. In this manner, the curriculum CQI inner loop or the 6 months (one semester) cycle is checked.

Acknowledgement

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