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Stimulating Learning Ownership to Engineering Students via Learning Contract

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Abstract

The internet has changed students' learning habits and opened up a vast source of knowledge from all over the world. With strong motivation students are now able to quickly learn on their own and gain a vast amount of knowledge. However, most academic staff still think that they are the main source of knowledge and the student would not be able to gain sufficient knowledge without classroom instruction. This paper describes the notion of a learning contract and how an experiment using learning contracts with a group of undergraduate civil engineering students resulted in improved learning and at the same time developed their soft skills. The experiment was administered on 30 final year students who were enrolled in the Sustainable Urban Planning course. Discussion was held at the beginning of the semester to determine firstly, how the course should be delivered and secondly, how to ensure that students achieve the learning objectives as agreed between lecturer and student. Based on discussions between lecturer and students a decision was made to reduce the hours of lectures and to increase case-based learning and problem-based learning. It was agreed in the final learning contract to have 12 hours of lectures, 3 individual assignments, a case study and one large group project in the form of problem-based learning to encourage immersive-collaborative learning. Students' performances were measured using rubrics and their satisfaction was gauged via a centralised online survey. The results were compared with those of the two previous cohorts and were found to be encouraging. The achievement of the four course learning outcomes improved between 6 to 12% and student satisfaction increased 7%. These results indicate that transferring the ownership of learning to students through a learning contract encouraged the development of self motivation and eventually helped them to focus their learning activities towards the attainment of the learning outcomes of their course.

Keywords: learning ownership, problem-based learning, immersive collaboration, learning contract

1. Introduction

The Board of Engineers Malaysia (BEM) has listed 10 learning outcomes that must be achieved by engineering students in Malaysia (EAC, 2007). The 10 learning outcomes not only place emphasise on the attainment of cognitive domains but also put equal emphasise on the affective as well as psychomotor domains and more importantly, these achievements must be measured and proven. Undoubtedly, during their learning years at universities, it is easier to measure the achievement of cognitive and psychomotor learning outcomes as they are clearly related and linked to the curriculum. However, more effort is required to ensure that each student possess the soft skills of leadership, team work, communication, lifelong learning and environmental awareness. Most engineering learning experience takes place in classes and labs. In the past, learning experience such as this would have met BEM requirements but due to increased competition between countries, and between companies. the BEM (along with other boards' of engineers in developed countries) set more stringent criteria, especially with regard to the attainment of soft skills. Lecture and lab-based learning experience are no longer sufficient to fulfil these criteria; active and action learning are now required to provide more *hands-on* learning experiences to students. The result is a significant improvement in student learning and the cultivation of soft skills.

While these changes were taking place the Internet has revolutionised the academic scene and is now a central

part of university life, both academic (and non-academic) opening the door of knowledge and creating a richer learning experience. Students can now access enormous amount of information with just a click. This has changed students' study habits in so many ways; instead of taking lecture notes, students now prefer to spend time studying on their own and they see their lecturers merely as their advisors (Wegner et.al., 1999). This situation was hampered by the fact that some lecturers still see themselves as the main source of knowledge and all other sources of knowledge are considered as unauthentic, invalid as well as unreliable. In today's educational environment lecturers should take full advantage of such changes in students' learning orientation and develop their role as a facilitator of knowledge. What they need to do is to redesign their course learning experience to ensure that their students have a rich learning experience and become model graduates after completing their programme.

This paper tries to uncover a method which takes advantage of today's learning experience by introducing a learning contract approach; a student centred approach which specifically transfers the ownership and responsibility of learning to the students themselves. This action research experiment was administered on students enrolled in the Sustainable Urban Planning course offered by the Civil and Structural Engineering program.

2. Learning Contract

Learning contracts have long been implemented in the United States with undergraduate and graduate students, in-service training and within the nursing profession. Professional development is used as a vehicle to develop a learning-teaching strategy towards individualized learning, encourage independence, nurture lifelong learning habits and teach nurses to deal with the constantly changing working environment (Richardson, 1987). Schwarzer (et. al. 2000) observed that even though students were confused during the early stage of the implementation of a learning contract, one week later they began to react positively and finally admitted that the learning contract was a sound learning method for them. Most of the students felt that a learning contract began to empower them. The student with a learning contract was able to navigate and reshape the course learning outcomes and throughout the process, it was deemed necessary for the students to reflect, learn, relearn and unlearn in order to make sure that they achieved the desired learning outcomes.

Analysis of literature on the application of the learning contract, particularly in higher education, revealed that the learning contract was used to encourage self-directed learning and individual autonomy in a balanced individual and group learning framework (Brewer, Williams & Sher 2007). To stimulate self-learning students should be given the right to determine what should be learned and how the learning processes will be executed and produced within a particular period of time. Additionally, students also determined how assignments should be evaluated, the percentage of every assessment mode as well as the assessment criteria. This is why the learning contract was also known as "Learning Agreement" because at the initial stage of the learning process both students and lecturer must agree with one another and hence signed a written agreement or contract. However, it should be noted that the lecturer who acts as the supervisor also has responsibility to modify the proposed objectives if they appear unrealistic or inappropriate, too ambitious or perhaps too simplistic (Anderson, Baud & Sampson 1998).

Normally the signed agreement included criteria related to the execution of the assignments. Firstly, the final format of the assignment – how the assignment should be completed. Secondly how would the assignment be carried out – individually or as a group? If the assignment was done as a group assignment, what is the input expected from each student. Thirdly the duration of the assignment and when it should be completed – should the assignment be evaluated as a process, or based on the final result? If the assignment is evaluated as a process, how would each process be evaluated/ Fourthly, what consequences are to be borne by the groups who failed to fulfil/abide by the contract. For instance, a deduction in the points awarded to an individual if he refused to give his cooperation.

The learning contract is usually signed when the two parties have agreed on the terms or criteria listed. There usually is a compromise on the agreed upon criteria. The criteria were set by the lecturer to ensure that the expected achievement is not compromised. Learning contracts were found to be important in the learning of assignments based on self-ability or self-directed study and enabled students to:

1) identify and record

2) set the objectives and aim of self-learning

3) identify the methods to be adopted in achieving the aims

4) Set the time period for execution and result

5) provide proof that the objectives have been achieved

6) determine the level of the assignment/learning achievement and how it would be evaluated

7) determine each student's learning objective based on their own interest and ability

8) plan the work to be produced

9) reflect not only on the final assignment but also throughout the work process, from the beginning to the end

The success of the learning contract and its impact on student achievement has led the Centre for Co-curricular Accreditation (previously known as the Student Development Centre) at the National University of Malaysia, to introduce a new co-curricular system by using the learning contract. With the new orientation of co-curricular activity the lecture based teaching approach has been replaced with an evaluation system based on students' involvement in activities or programs organized by the students themselves. Each program or activity will be evaluated each semester based on eight aspects of program learning outcomes as outlined by the Malaysian Qualification Framework (MQF). Figure 1 depicts eight learning outcomes that need to be achieved at the end of teaching and learning experiences. Figure 1 infers that teaching and learning transactions (within the context of Outcome Based Education set by the Malaysian Qualification Agency) put equal emphasis on the attainment of generic skills as well as mastery of knowledge in the students' subject specialization.

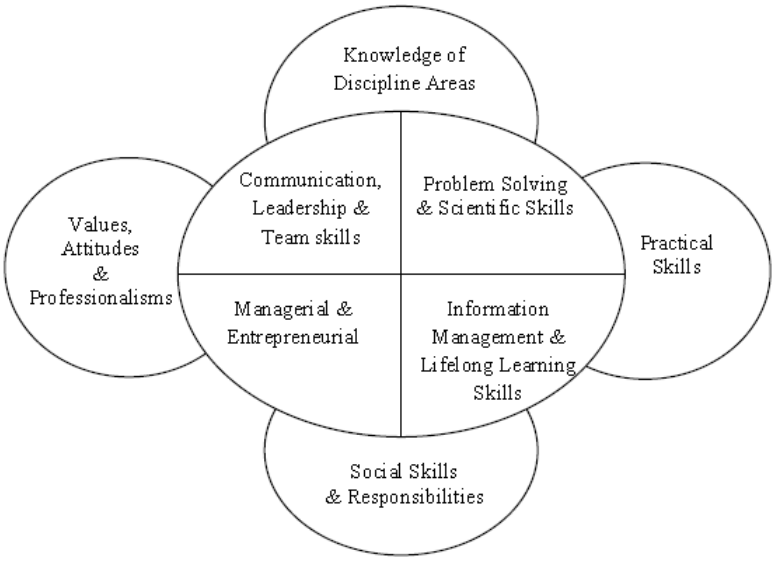

Figure1. Eight learning outcomes domains (Sourse: MQA, 2011)

The implementation of contact based co-curricular activity at the National University of Malaysia led to the development of various learning-assignment/contracts designed in a particular format based on the course and assignment requirements of the parties involved. Some courses, assignments or projects require very formal contracts and the procedure is precisely and clearly stated (with the agreement of all parties involved in producing and evaluating them). On the other hand the learning contract could also be informal, but well-planned and clear. Evaluation of the learning contract is usually student-centred while the grading should be monitored by the lecturer to ensure that its validity as well as reliability is not compromised.

In the field of engineering education Jaén University began using learning contract for the 2010-2011 sessions to increase student involvement, responsibility and independence in their Statistics course. This contract comprised of learning outcomes, learning methods and evaluation. In addition it clearly stated the need for students' commitment. The learning contract succeeded in making the students more active (Roldan & Roldan, 2011) and was used to develop learning autonomy and encourage an improvement of the learning process; this was done by integration with quality management methods to help students monitor their learning process. Student involvement improved markedly because from the beginning they were included in discussion to determine the content of the learning contract (Birtle, 1999).

An analysis of the literature also reveals that learning contracts have been used also in work-based learning to encourage a culture of lifelong learning. The contract clearly drove students to give more commitment to achieve the learning outcomes and this is why the learning contract agreement needs to clearly state the desired learning outcomes, the activities that need to be carried out to ensure meaningful learning, the complete evaluation

criteria, the evaluation method and all the requirements needed for the delivery of the course. To ensure effective implementation a students' activity must be closely monitored and supervised. They were also informed to read several notes which provide basic knowledge (Burn & Chishol, 2003).

In practice, Laycock and Stephenson (1992) suggest that the use of a learning contract can be accommodated within two interlocking continua related to the primary focus and context of its implementation. Figure 2 illustrates the characteristics of contracts within the four quadrants. Based on Figure 2, it could be inferred that learning contracts could be implemented by focusing on outcomes - parts of the programme; process - parts of the programme; process - the whole programme; and outcomes - whole programme. However, in discussing the concerns related to the learning contract Laycock and Stephenson (1992) remind us that the university as a whole must transform itself from an institution whose role is that of "director of learning" towards a "resource for learning". Such a paradigm shift necessitates the provision of a total learning experience throughout the university compound and neighbouring cities or towns so that students are able to fully utilise their surrounding to maximise the development of their innate potentials.

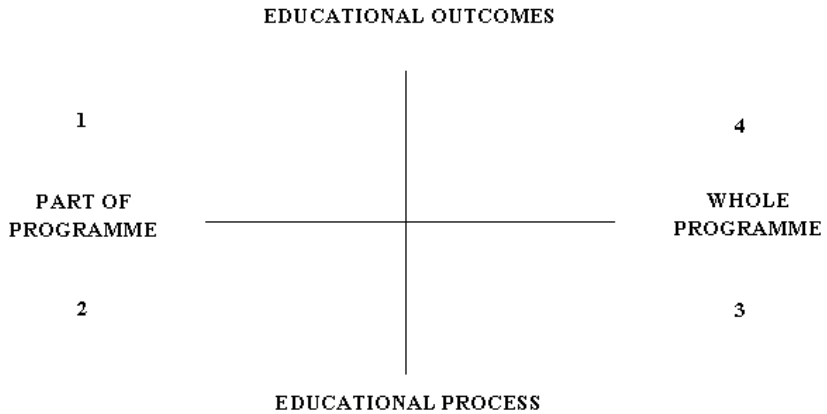

Figure 2. Four quadrants of learning contract implementation (Sourse: Laycock and Stephenson, 1992)

3. Research Description

This action research experiment was administered on some 30 final year students enrolled in the Sustainable Urban Planning course at the Faculty of Engineering and Built Environment at the National University of Malaysia. The Sustainable Urban planning (KH 4283) course was chosen because it was an elective course and accreditation evaluators were usually free to make decisions regarding its method of delivery. Prior to the experiment a discussion was held at the beginning of the semester between the lecturer and the students regarding how this course should be delivered to ensure that all students would be able to achieve all learning outcomes.

The learning contract for the Sustainable Urban Planning (KH4283) course includes 12 hours of lectures, 3 individual assignments in the form of case studies, and one big project in the form of problem-based learning. This project is a group assignment to encourage immersive-collaborative learning. The objective of all these learning forms is to achieve learning outcomes in the cognitive as well as affective domains. Along with many other courses offered, students' achievement of learning outcomes were measured using a 5 scale assessment rubric and student satisfaction was measured using a 5 scale rubric conducted through an online survey.

The students' attainment of course learning outcomes and their satisfaction level are then compared with two previous cohorts in order to see whether the introduction of the learning contract has yielded significant improvement in terms of learning outcomes, attainment and students' satisfaction level.

4. Research Findings and Discussions

At the initial stage of implementing the learning contract many students were confused because their opinions have never been sought in any courses that they had attended before, it was a new and challenging experience. By the second week, all students started to participate in the discussion and a decision was made to reduce the hours of lectures and increase case-based and problem-based learning. To make up for the reduction in the hours of lectures, basic materials for the course were uploaded in the e-learning system to help students understand basic concepts and hence shape their understanding, which later was followed by the application of knowledge . Nevertheless, students would also have to surf the Internet to gather further information they may need to

complete their assignments and projects. As the course is a three-credit hour course a 120 hours of students' learning must be completed and this includes the time students spent using the e-learning system and making the effort to seek further knowledge and completing assignments and projects.

At the end of the semester, having completed the group project to encourage immersive-collaboration learning, students gave a presentation before sitting their final exams. This is to ensure the attainment of all the learning outcomes as agreed upon at the initial stage of the course implementation. In ensuring effective implementation of the learning contract lectures need to ensure that the main content of the learning contract were course learning outcome activities held to achieve those learning outcome, methods and evidences which showed that learning outcomes have been achieved, and the method of evaluation. The contract also stated the time required for each activity.

Table 1 shows the attainment of course learning outcomes in terms of mean value and Graph 1 illustrates the fulfilment of the four stated course learning outcomes.

Table 1. Achievement of course learning outcome

	Course Learning Outcome	2009 cohort	2010 cohort	2011 cohort
1	Able to evaluate a town's sustainability based on Local Agenda 21.	3.97	3.98	4.24
2	Able to evaluate the best practice in sustainable urban planning.	3.95	3.94	4.3
3	Able to evaluate the sustainability of the components of urban development.	3.95	3.93	4.25
4	Able to produce and present a proposal report for the development of an existing traditional town for the next 30 years based on the sustainable town concept.	3.89	3.87	4.34

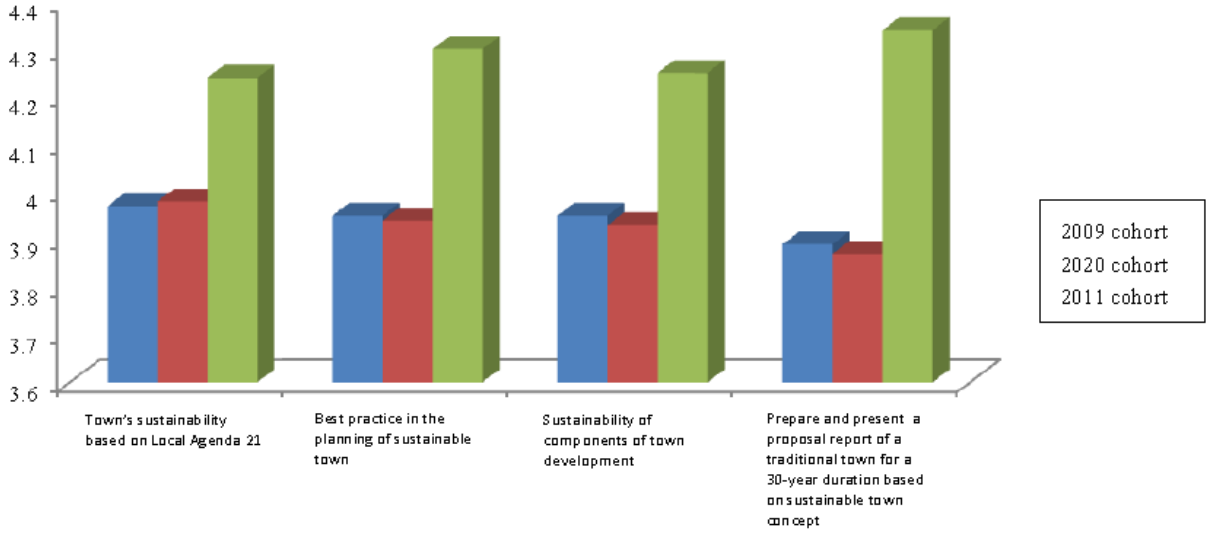

Figure 3. Graph for the achievement of course learning outcomes

In Table 1 and Figure 3 the high mean values shows that overall students demonstrate quite satisfactory attainment of all the desired course learning outcomes. Interestingly, even though the attainment of fourth learning outcomes require students to perform more higher order thinking such as evaluation and creation, students demonstrate the highest attainment in the fourth learning outcome. Such a pattern in learning outcomes attainment displays the effect of the learning contract in stimulating higher order and innovative thinking among the students; freedom given to them to navigate their own learning has inspired them to be more creative in completing their assignment.

Comparison across cohorts also shows that merely immersing the students with student centred activities improves students' thinking at the evaluation level only. As summarised in Table 1, 2009 and 2010 cohorts demonstrate the highest learning outcomes attainment in the first course learning outcomes which only require them to evaluate. As expected they demonstrate the lowest learning outcomes attainment on the fourth learning outcomes which require them to do more than just evaluate but to synthesise and innovate. It could, therefore, be argued that merely immersing them in student centred approach without empowering them to be responsible in

their learning experience is not adequate in stimulating creativity and innovation in them. They need to be given ample opportunity to solve problems and make decisions on how to control and direct their own learning.

Findings generated in this study are consistent with Caffarella and Caffarella (1986) who assert that learning contract develops in students some of the competencies required to undertake fully self-directed learning. Brookfield (1986) also describes learning contract activity as an enhancement towards self direction in learning. This is because the contract between students and lecturer brings the students to the centre of learning activities. As argued by Lane (1988), the contract engenders a sense of ownership of the learning process and by specifying the learning outcomes in advance both parties have an agreed understanding of the expected outcomes. This, in turn, stimulates student enjoyment throughout the fourteen weeks of learning experience.

Table 2. Comparison of student satisfaction

	Student's Evaluation of Lecturer	2009 cohort	2010 cohort	2011 cohort
1	Lecturer delivered sound knowledge	4.14	4.29	4.94
2	stimulating teaching method	4.26	4.32	4.88
3	Lecturer was enthusiastic	4.43	4.45	5.00
4	Our time was well-spent in this course	4.14	4.35	4.82
5	We were given fair and equal treatment	4.29	4.32	5.00

As was expected student satisfaction in their course increased with the learning contract in place and its principal activities completed. They not only perceived their supervisors as being enthusiastic (mean: 5.00) and delivering sound content knowledge (mean: 4.94), they also regarded the learning contract as one of the most stimulating teaching methods (mean: 4.88). For most of the students their involvement in learning contract based learning was very meaningful and their time was well spent (mean: 4.82). And more importantly, for most of the students, they were very satisfied with their lecturer's performance throughout the course and echoed that they were given fair and equal treatment (mean: 5.00). This finding is very important as Buzzell and Roman (1981) cautiously suggest that the use of a learning contract might produce anxiety or frustration within the learners themselves. It could therefore be argued that students in this study finally came to the realisation that the contract was merely a tool, a means to an end and not an end in itself. This explains why their overall satisfaction was very high even though most of the students were initially passive and did not really participate in the learning activity (see Table 2).

Nevertheless, as summarised in Table 2 and graphically illustrated in Figure 4, students in the previous two cohorts demonstrate quite different satisfaction level as compared with 2011 students. Students in the previous two cohorts perceived their supervisors as just possessing sound content knowledge at the satisfactory level. They also feel that their learning time was not spent well during the course and they were not really engaging themselves in the learning activities. Students in the previous cohort also express less satisfaction with the performance of the lecturer even though the lecturer was quite enthusiastic in sharing his knowledge and expertise. It could therefore be argued that without an opportunity to plan, negotiate, implement, execute and hence reflect on their own learning, as well as to be accountable for it, students still feel that any kind of student centred activities (e.g. problem based learning, service learning, case based learning) are still lecturer centred activities.

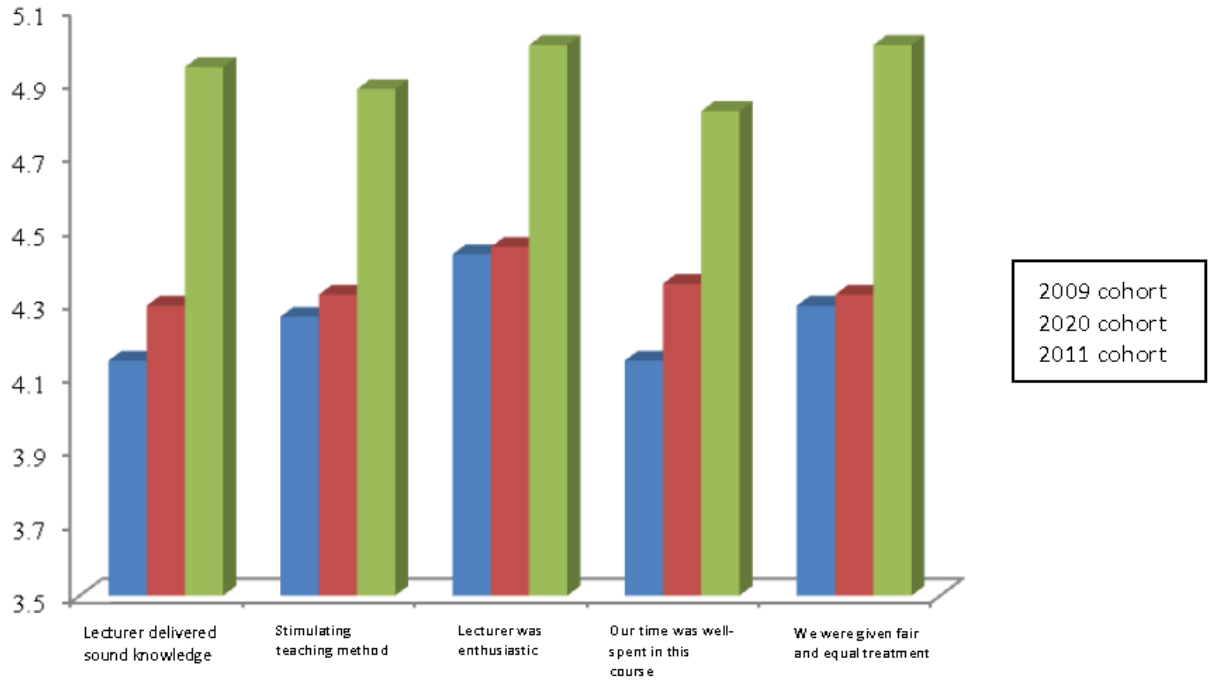

Figure 4. Comparison of student satisfaction

5. Conclusion

This action research study has proven that transferring ownership of learning to students through a learning contract has strongly motivated them to engage in meaningful learning activities and hence achieve the desired learning outcomes. When students signed the learning contract their minds were focused on achieving the learning outcomes. The learning freedom that came with the learning contract had given them a sense of satisfaction as well as ownership of their own learning. By engaging students in the learning contract experience, cognitive skills were developed and also their affective psyche. Not only that, the executive decision making opportunity given to them eventually helped to develop the necessary work-related skills, such as objective setting, negotiation, review and evaluation of one's own, and acceptance of, responsibility for outcomes. As for the university the establishment of a learning contract geared towards the achievement of its educational objectives, vision and mission was another positive educational tool but its real impact is that it produces high quality and hence marketable graduates.

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