Emphasizing learning of the affective domain for the realization of the engineering learning outcomes

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Abstract

Engineering lecturers are now facing greater challenge in their profession to deliver the continuously increasing programme content and higher stakeholders' expectations. Stakeholders are no longer satisfied with graduates who are only competent in technical knowledge and skills but sought graduates who have equally excellent soft skills which require lecturers to place greater emphasis on teaching for learning of the affective domain. The lecture method which used to be the “default method” of engineering lecturers is no longer adequate to achieve the current desired learning outcomes. This article shares some tried out teaching and learning approaches that can be used to enhance the effectiveness of teaching for affective learning of an engineering course.

Keywords: engineering education; affective domain; learning outcomes.

1. Introduction

Present engineering lecturers are facing increasing challenges in their work due to the change of the engineering education curriculum from content based to outcome based education [1]. The changes has brought with it new compulsory courses (creativity course, soft skills courses, entrepreneurship, community involvements etc.) in addition to the naturally increasing engineering subject matter content to be covered. This is compounded by the fact that engineering lecturers -due to their lack of teaching training - have inadequate understanding of how people learn and limited repertoire of effective teaching skills.

According to Kolb [2], the learning cycle begins when the learner interacts with the environment (concrete experience). David Kolb's Experiential Learning: Experience as the source of learning and development (1984) theorized that four combinations of perceiving and processing determine four learning styles that make up a learning cycle. According to Kolb, the learning cycle involves four processes that must be present for learning to occur:-

(i).Activist - Active Experimentation (simulations, case study, homework). What's new? I'm game for anything. Training approach - Problem solving, small group discussions, peer feedback, and homework all helpful; trainer should be a model of a professional, leaving the learner to determine her own criteria for relevance of materials.

(ii).Reflector - Reflective Observation (logs, journals, brainstorming). I'd like time to think about this. Training approach - Lectures are helpful; trainer should provide expert interpretation (taskmaster/guide); judge performance by external criteria.

(iii).Theorist - Abstract Conceptualization (lecture, papers, analogies). How does this relate to that? Training approach - Case studies, theory readings and thinking alone helps; almost everything else, including talking with experts, is not helpful.

(iv).Pragmatist - Concrete Experience (laboratories, field work, observations). How can I apply this in practice? Training approach - Peer feedback is helpful; activities should apply skills; trainer is coach/helper for a self-directed autonomous learner.

Sensory information from this experience is integrated and compared with existing knowledge (reflective observation). Learning involves not only
cognition but more importantly feeling and emotion—affects [3]. For students to learn, they need to at least engage in the learning materials. The ability to engage with the learning materials is a learned skill that is classified under learning of the affective domain.

Classification of intended learning outcomes was undertaken by Bloom [4] to help make teachers more aware of what is meant for someone to learn something. According to Bloom as in figure 2: this classification system was to delineate the "intended behavior" of students—the ways in which individuals are to act, think or feel as a result of participating in a unit of instruction expressed in measurable observable formats (learning objectives).

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Thus the affective domain relates to the emotional component of learning [5]. It emphasizes a feeling, tone, an emotion, or a degree of acceptance or rejection. Affect encompasses a range from simple attention to organization and characterization of complex, but internally consistent, qualities of character and conscience. In brief, the affective domain relates to the emotional component of learning. It emphasizes a feeling, tone, an emotion, or a degree of acceptance or rejection. Affect encompasses a range from simple attention to organization and characterization of complex, but internally consistent, qualities of character and conscience [4].

In higher education however, too much learning activities and efforts are targeted at and designed to develop the potential of learning in the cognitive domain ignoring the instrumental role of the affective domain in learning development [6]. This has resulted in lack of students’ achievements of the intended learning outcomes leading to feeling of frustrations among engineering lecturers. Research has also supported the importance of affective learning in long-term learning whereby the absence of affective internalization of a concept is shown to impair long-term learning [7].

Lower priority that is given to teaching of the affective learning domain may be attributed to two main reasons, the first one being the lack of appreciation for the contribution of affects towards learning [8], [6] and the second one being the lack of pedagogical knowledge and skills on how to promote affective learning [9].

The teaching and learning methods that are presented in this paper are designed to promote learning of the affective domain to support learning in the cognitive domain. The materials were designed based on the assumptions that students learn better if they have trust in the teacher, believe in their capability, are provided with a positive and non-threatening learning environment and possess the necessary learning skills. The ideas on how to create the non-threatening classroom is based on adaptations of suggestions made by Watson [10]. Students also are assumed to learn better when they do learning activities in groups.

2. Institutional context

Examples that are presented in this paper is based on the experience of the first author in teaching a course on MKA 1103 Sustainable Construction Engineering to three cohorts of students in the Master in Civil and Environmental Engineering programme in the Universiti Tun Hussein Onn Malaysia (UTHM). The first cohort consisted of five international students from Libya and no local student; the second cohort consisted of 12 international students from Libya, Yemen, Nigeria and six local students and the current cohort consists of six international students from Libya and six local students.

All international students have work experience in their respective home country while the local students were fresh from University. A mixed class of local and international is now typical not only in graduate programmes but also in undergraduate programmes, i.e., students come from diverse educational and cultural background as well as work experience. These differences would result in different expectations towards a course that needs to be met by the lecturer in charge [11].

Making students aware of their own learning preferences is important to help them learn effectively. A discussion on learning preferences is thus made part of the teaching and learning activities of the author. Knowing students’ learning preference is also beneficial to lecturers because such knowledge can assist lecturers in adjusting their teaching styles to the students’ learning styles [12], [13].
3. What research says about how people learn

Research by Weiner [14] on college students shows that attribution for success or failure and their beliefs about their own abilities, or self-efficacy [15], influence students’ motivation and goals for academic work. Research also indicates that a non-threatening environment is necessary for learning to occur (reference). An environment is said to be non-threatening “…when students feel comfortable sharing their thoughts, ideas, and dreams with the teacher and also with other students. …no one is judged by anyone else” [16]. Having the necessary skills is also important for success in learning (reference).

Based on these assumptions, the elements of teaching and learning activities can be divided into three broad teaching goals,

- Create the need for them to learn the course - make the learning materials meaningful, relate to students past and present experiences and future aspirations (knowing the students)
- provide a non-threatening situation with many opportunities for receiving positive feedback from lecturer and peers and opportunities for self reflections
- Promote self-efficacy by providing opportunity to practice life long learning skills namely information seeking skills from paper-based and internet based sources and information synthesizing skills, persistence etc.

Besides the broad goals, lecturers need to have the specific learning outcomes that they expected from students. For this, they need to choose the appropriate teaching and learning methods. To help teachers choose appropriate teaching and learning methods Majumdar [17] has developed a framework for realizing active participatory learning (Figure 2) which the author has benefitted from.

Figure 2 shows the role of teacher/lecturer with various teaching/learning methods, their objectives and explains and how they may be matched to obtain the required objective. As one moves from the left to the right, less teacher control is achieved. Less teacher control means more focus is placed on learning than on teaching, therefore it emphasizes active, participatory techniques rather than passive one-way instruction from the teacher or lecturer [17].

4. Teaching and learning activities

The following generic teaching and learning activities were used in teaching the course mentioned above. These same activities can also be used in other courses.

4.1. Needs Analysis: Knowing your students

The first impression is the most important for the students. According to adult learning theory, adults learn when they feel there is a need for them to learn [18]. Knowing each other and clarifying expectations, creating trust and promoting non-threatening learning environments needs to be established very first thing in a course.

On the first day, need analyses is performed through “focus group discussions” where information on family background, cultural background, past qualifications, etc are gathered to help me form a general idea of who are weak and may face difficulty in the programme.

The information gathered was used to prepare intervention and remediation activities for those in need. From the analysis, I often came to conclusion that sponsored students are in a better position academically than self-sponsored students which is not surprising considering that sponsored students are selected students.

On the first day I also took the opportunity to convey my expectations towards students and on how they should perform if they wish to succeed in my class. It is also a good idea to get their feedback on their past learning experience at this stage. From this discussion I gather that the learning culture is more open in Malaysia compared to the Middle Eastern Countries. So, at this point I kept notes to ensure that I could keep a balance between disciplined students and flexible content and approach.

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I also explain on how to survive their master’s programme, i.e., students are expected to work hard in order to pass with good grades.
4.2. Video-Discussion-Test: Moving towards Attitudinal Change

To cater to the need to have high self-efficacy and to increase the development of the success attribution among students, video presentations is part of the initial teaching and learning activities. Video presentation has been shown to be one of the best ways to create attitudinal change among learners [19]. The first video presentation / or slides presentations would be related to subject matter and their future career. A class discussion is then conducted to be followed by a short quiz.

The purpose of the video presentation and discussion is two-folds; to promote learning in the affective domain thus boosting motivation by creating awareness of the importance of the subject not only their existing programme but most importantly to their future career and to gauge their ability to understand presented information by relating the new information to their existing knowledge in the area.

The quiz is usually very simple that require students to relate what they have discussed to their previous experience and to gauge their general knowledge on the area. Grading on the quiz is very lenient since the purpose of the quiz is to enhance students’ self-efficacy - to make them believe that they have the ability to succeed on the course. The marked answer scripts are returned to students but marks are not taken into consideration to their final grades. Since the purpose of the test is to boost their self confidence, the worst grade given is B- and the best is A+. Grade A is not given because that will create a sense that the course is too easy. The most important thing here is that there are no failures in the initial stage of learning. So they start with the belief that they can succeed.

4.3. Discussions for self-reflections

One-way lecture is very limited in this course and students are given the course plan with a list of journal papers and reference books, government reports for compulsory reading. Students are expected to do extra readings on journals and books of their own choice.

Discussions take up a major proportion of face to face meetings. For example, discussion on government policy matters/manuals/standards regarding sustainability takes up two weeks of face to face meetings. Discussion revolves on why there is a need for policies and assessment tools related to sustainability. Students were given policy papers on Malaysia and two assessment tools on sustainability.

They were then required to search for other examples such as LEEDS, GREEN MARKS, CSBEE. The purpose of this activity is to make the students aware that there should be government policies that guide sustainability practices or if there are no policies then they should develop the policies to guide sustainability programmes in their respective countries.

4.4. Field Visit: Experiential Learning

Field visit is one of the components of this course which students benefitted a lot from and enjoyed very much. Field visit provide experiential learning experience for students which promotes affective learning that facilitates cognitive learning on the course.

Visits were organized largely by students after my initial introduction to the agency that we planned to visit. In one of the visits, students design and purchased their own corporate uniform indicating their deep identification with the course, which boost their self-esteem tremendously when they were commented on their good corporate identity by the host who is part of the professional engineering organization. The visit activities enhanced students’ self–concept (affective learning).

Figure 3 captures the spirit of one such field visit, a visit to KLCC twin tower which clearly illustrates students’ positive feeling and emotion, i.e., “affective learning”.

4.5. Group work versus individual work

A balance between group and individual work is important. Group task provide students with opportunity to practice on their team–working skills – a much desired skills in the engineering profession. Peer learning can improve the overall quality of student learning.

Unfortunately it is harder to design a good group task and harder still to gauge an individual’s efforts in group effort thus leading to unfair grading sometimes. Group work provides an opportunity for students to clarify and refine their understanding of concepts through discussion and rehearsal with peers. Working with a group also motivates some students to learn. Group work helps some students develop a sense of responsibility. It can also help develop
specific generic skills sought by employers when they have graduated.

Giving individual task is also necessary because lack of individual training on tasks has been one of the major weaknesses cited for problem-based learning. In my course tasks are completed in group initially and progressed to individual work nearing the end of the semester. First assignment was done in groups of four members. The second assignment was done in group of two and the last two assignments were completed individually. The initial assignment was designed to promote affective learning – good feeling, high sense and confidence of achieving target, accountability towards group members etc. in addition to the cognitive learning targets. Once, students develop a sense of potential success, later individual assignment could be done successfully.

4.6. Flexibility in Content

Although we have the syllabus, we can introduce some flexibility into it. For example, while looking into policy on sustainability in Malaysia, students were encouraged to look into policies of their own countries. Thus, the content becomes more meaningful for the international students. This raises the relevance of the materials, promote affective learning and promote cognitive learning.

5. Assessments

A variety of assessment tools were used throughout the semester, some of which were intended for learning rather than grading. Examples of assessment tools used were open book test, take home test, closed book test and critiques by peers and lecturer. Each open book test lasts from 30 to 2 hour per test using open ended items. The earlier test in the semester is allotted longer time than the later tests. Longer time is required for the earlier test because students are not used to open ended questions where information seeking and identifying relevancy are critical. Some students become overwhelmed by information. Furthermore, some students were still under the “one correct answer syndrome” and they keep trying to guess at the one correct answer that they perceive the lecturer wants.

As they mature in the programme, they begin to understand that there are multiple accepted correct answers provided they give reasoned justifications for their answers. The purpose of the first open book test is to gauge students’ understanding of sustainable construction engineering.

The first and second test is open book timed test and questions are open ended. The third test is often take home test to encourage extra reading on the topic tested. The fourth and fifth tests are closed book tests to give students the opportunity to practice for their examinations.

Assessment guide (example used is given in Figure 4) were consulted regularly including that from the Malaysian Quality Assurance (MQA) to ensure compliance with MQA and best practices in assessment and evaluation.

5.1. Assessment of group work

Group work may reduce the workload involved in assessing, grading and providing feedback to students. However, it involves some challenges of its own. Guidelines on how to do it wisely is available widely. In my course a brief in term of 3 objectives were given to the students’ to be assessed (based on University Teaching Development Centre (UTDC).Victoria University of Wellington) [21]. These learning objectives can assess and:

- provide an opportunity for students to discuss/reflect before preparing an individual assignment;
- assist students to learn the skills associated with effective group work (communication, planning, negotiation); and
- enable students to produce a high quality product.

5.2. What grades to give?

Fair grading is very important. Inflated grading is practiced to gain favour by some lecturers. Unfortunately giving grades that they do not deserve can backfire in the long-term. The faculty and University may be known for the wrong reason such as, producing students who are good on paper only.

In my course, students obtain the minimum grade of B- if their correct answers are solely based on the given list of references which includes articles from established peer reviewed journals in the discipline. They fail if the answers are incorrect of course. They can get an A if their answers include additional information from unlisted sources. Insisting that they add new information to get an A grade, provides the
motivation for students to do extra readings. To reduce cheating (giving false information), they need to cite the sources of their references for verifications.

Only two tests were graded for summative evaluation out of 5 tests that were given. The rest of the tests served formative and diagnostic purposes for promoting learning rather than grading.

5.3. Steps in the Assessment Cycle

For each area of this subject we are required to:

i). Define our expected student learning outcomes (what we would like students to learn from the course/program/etc.).
ii) Develop means of assessment and decide on criteria for success.
iii) Check for alignment between the curriculum and the outcomes.
iv) Give students opportunities to learn.
v) Assess whether or not that learning has occurred.
vi) Compile assessment results.
vii) Analyze and reflect on the information.
viii) Plan and implement changes as a result of what we learned from the assessment. (This is often called “closing the loop”.)
ix) Repeat. (This must be an ongoing process throughout the years - not only when we’re preparing for accreditation!)

6. Indicators of teaching success in the course

Three indicators of success of the teaching methods are observed; request to be in the class that I teach, positive feedback from students, good grades obtained by students.

6.1. Request to be in the class that I teach

There have been overwhelming responses from students who wish to be in my course. In fact students have also requested that I teach more courses that I currently do. Students have written and proposed my name as their lecturer to the Dean of Civil and Environmental Engineering Faculty when they wish to register other construction elective subjects.

6.2. Positive feedback from students

One of the positive things students say about my lecture can be seen in their informal comments in class, “I can now see the difference between undergraduate and graduate studies, ...we do not have to answer exactly as your power point. I can use my own ideas”. My teaching methods provide students with more opportunity to be creative and innovative, developing higher self-confidence and self-reliance. Clearly my teaching methods have resulted in affective learning of a higher level which becomes the foundation for cognitive learning.

6.3. High scores given by students on lecturer’s appraisal form

Perhaps one of the strongest evidence of the positive effect of the approaches that I used has been in the form of students’ ratings on my teaching - part of the lecturers’ appraisal system - which is conducted every semester by the University. I have consistently been given high excellence ratings every semester since the first time I taught in the University, a rare achievement among engineering lecturers.

6.4. Students obtain good grades

All students obtained a pass and more than 50% obtain A grade in the course. The good results seem to spill over to other courses where students seem to be putting good efforts (indicator of affective learning) to achieve the good grades that they now feel is achievable.

7. Conclusion

Promoting learning of the affective domain is important as it affects learning in both the cognitive domain. Some techniques that can be used and tried include. Know the students, setting rules and regulations

• Let the students know you believe in them
• Let them know of your teaching styles - if students do not know lecturers teaching style they have no hope of passing and therefore no efforts made.
• Provide unthreatening environment so that students are willing to open up.
• Inculcate feeling of self-efficacy which should lead to greater efforts and leading to success I learning of the cognitive domain
• Emphasize life-long learning skills for increased learning transfer
• Provide some flexibility in content
• Use varied assessment tools for more valid measure of learning gain and target learning through assessment as well

Attending to learning of the affective domain is challenging but the reward would be great in the form of more satisfied students, more job-satisfaction for lecturers and most importantly enhanced learning of the cognitive domain. Although the examples were based largely on teaching of international students, local students should benefit equally well from such teaching and learning initiatives.
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