THE EFFECT OF AN INTEGRATED AFFECTIVE-COGNITIVE TEACHING AND LEARNING APPROACH ON ACADEMIC ACHIEVEMENT, SELF-EFFICACY, LOCUS OF CONTROL AND ATTITUDE TOWARDS ENGINEERING

Tahira Anwar Lashari, Maizam Alias
Faculty of Technical and Vocational Education,
Universiti Tun Hussein Onn Malaysia
86400 Batu Pahat, Malaysia
hb100017@siswa.uthm.edu.my

Mohd Jahaya Kesot
Centre for Diploma Studies
Universiti Tun Hussein Onn Malaysia
86400 Batu Pahat , Malaysia

Zainal Abidin Akasah
Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia (UTHM).
86400 Batu Pahat , Malaysia

ABSTRACT

Engineers are responsible for the sustainable development of society and to be effective in their role they must possess holistic skills that encompass the skills of the affective and the cognitive domain. Therefore, engineering education must place equal emphasis on the needs of the affective domain in addition to the needs of the cognitive domain. However, existing engineering education practices do not pay adequate attention to the needs of the affective domain. Therefore, the study seeks to determine the effect of a teaching and learning approach that integrates the affective and the cognitive learning needs on academic achievement, locus of control, self-efficacy, and attitude towards engineering. A quasi-experimental design study with pre and post-test was conducted on 70 engineering students who were enrolled in the Diploma of engineering programme in the Universiti Tun Hussein Onn Malaysia with n=36 and n=34 for the experimental and control group respectively. The results indicate that the experimental group was better on the achievement test and attitude measure compared to the control group and the academic improvement was most noticeable among the low achievers. In conclusion these results indicate that an integrated affective-cognitive learning approach can be used to induce simultaneous improvements in learning of the cognitive and affective domain.

Keywords: *Locus of control, self-efficacy, attitude towards engineering, academic achievement*

1 INTRODUCTION

Engineering education is receiving much emphasis in technical and vocational education (TVET) sector for its potential role in supporting socio-economic development. Ensuring effective engineering education is essential as it is the key factor to producing engineers who have a huge potential to contribute to the prosperity of a nation. Engineers' involvements in nation building can be observed in many areas such as in the development of innovative products; creation and management of communication systems; prevention of new and mitigation of old environmental problems; creation of health care devices and above all, making the technology work. In all these pursuits they have to ensure that current endeavors do not negatively affect the future well-being of a nation. To do those engineers must have holistic attributes that include affective skills in addition to the necessary technical know-how.

Consequently, there has been an increasing demand for engineering education providers to produce graduates who are more holistic in their attributes to be well prepared to ensure well-being of society and sustainability of the world economy. Thus, in addition to meeting the demand for high engineering content knowledge and practical skills development (cognitive and psychomotor domain), engineering education must also be geared towards the development of the "people skills" domain (affective domain) which is predominately associated with emotional components of learning outcomes as defined by Anderson & Krathwohl (2001).

The affective domain can be the target of education (learning goals) as well as the mediator for learning occurrence. The affective dimension of learning encompasses emotional attachments to objects such as feeling uneasy among peers, fear of rejection by others, keen interest towards a course, and perception of self-worth as discussed in Akasah and Alias (2010). The affective attributes of a person is associated with their personality and these attributes can cast a big influence on academic achievement (Alias & Abu Bakar, 2010). The affective and cognitive connections have been shown to be an important component in educating professionals in other fields. For instance; in the medical field, doctors and nurses are specifically trained to develop their affective skills. Thus along with their training on the technicalities; they are also trained to demonstrate caring attitude (affective traits) towards patients to boost positive mental state and promote healing in patients (Shephard, 2008). Increasingly today, engineers also need to deal with people and definitely their decisions affect people. Therefore, they must have the necessary people skills (affective skills) to be effective engineers.

Affective skills developments are related to personality traits that have received substantial amount of attention in psychological functioning (Bandura, 2005). Although personality traits such as self-confidence, locus of control and attitude are relatively stable in nature (Bandura, 2005) they can be changed and there are ample opportunities for engineering students to develop and strengthen their personality traits in the classroom (Lashari *et al.* 2012). Catering to the affective learning needs can support the internalization of cognitive learning contents (Akasah, & Alias, 2010). Furthermore, these traits are important in initiating and sustaining learning efforts. Thus, developing these traits further is important in promoting achievement of cognitive and affective learning goals. However, there are relatively limited discussions on the role of affects in learning particularly in engineering education compared to the cognitive learning domain (Strobel, 2011). Ignorance of the role of affect (such as attitudes) leads to failure in providing an adequate model for effective and sustainable engineering education. Moreover, ignorance also stimulates frustration among engineering lecturers which leads to undervaluing of students' potential (Alias, Akasah & Kesot, 2012). The lack of empirical evidence to support the successful integration of affect into teaching and learning for cognitive domain is also hindering its application in engineering education (Strobel, 2011).

Therefore, this study attempts to investigate the effect of an integrated affective-cognitive teaching and learning approach that caters to the affective learning needs in the teaching and learning process, on the targeted learning outcomes.

2 AFFECTIVE-COGNITIVE PSYCHOLOGICAL ATTRIBUTES IN LEARNING

Three psychological attributes (composed of affective and cognitive attributes) namely self-efficacy, locus of control, and attitude towards engineering were identified from the literature to be important attributes that will support affective learning needs.

2.1 Self-efficacy

Self-efficacy is a belief on self capacities to accomplish a particular task or to bring positive outcomes in any circumstances (Bandura, 1977). Research indicate that self-efficacy plays a critical role in balancing the psychosocial development by ascertaining one's identities and creating meaning in what they are doing leading to a sense of worth and belief in self potentials (Bong & Skaalvik, 2003). Thus, from an educational perspective, high self-efficacy encourages greater efforts towards task accomplishment (Krista, 2008) and consequently in maintaining consistently good academic performance.

2.2 Locus of control

Locus of control refers to the belief that a person has regarding the factors (internal or external factors) that influence the outcome of an event (Krista, 2008). A person is said to have an internal locus of control if he/she attributes his/her success to personal hard-work and ability. Vice versa, a person is said to have an external locus of control if he/she attributes success or failure to other factors beyond personal control such as fate or luck (Rockstraw, 2006). Learning is influenced by locus of control as what people attribute their experience to will affect their choices of learning behavior. If a person believes that he/she will succeed if he/she works hard then, he/she will work hard. Consequently, the hard work will result in success and the same person is more likely to demonstrate similar responses in future as the need arises (Ponton *et al,* 2001). Thus, it has been shown that having an internal locus of control is associated with higher academic achievement (Grantz, 2006).

2.3 Attitude towards engineering

Attitude is a psychological construct that is defined as a predisposed reaction to objects, events and situations. The quality of a person's attitude (negative or positive) can influence their tendency to behave in certain way towards the attitude object or related objects. A positive attitude towards engineering for example, can motivate a person to be more receptive toward pursuing engineering knowledge and to make efforts to learn which will lead to success.

The attitude construct is made up of three components namely cognitive, behavioral and affective (Mayer, 2008). The cognitive component refers to one's belief system; behavioral component relates to the behavioral tendency with observable characteristics such as facial expressions and body gestures while the affective component is related to emotional features of attitude.

3 METHODOLOGY

This section explains the research methodology used for the study which includes a discussion on the research design, discussion on potential threats to internal validity, population and sample, instruments, instruments reliability, the intervention material and ethical consideration.

3.1 Research Design

The study utilized the pre and post test quasi-experimental research design (non-equivalent group design) in an effort to establish cause and effect relationship between the intervention and learning outcomes (Figure 1); which shows the sequence of pre-test, intervention and post test administrations.

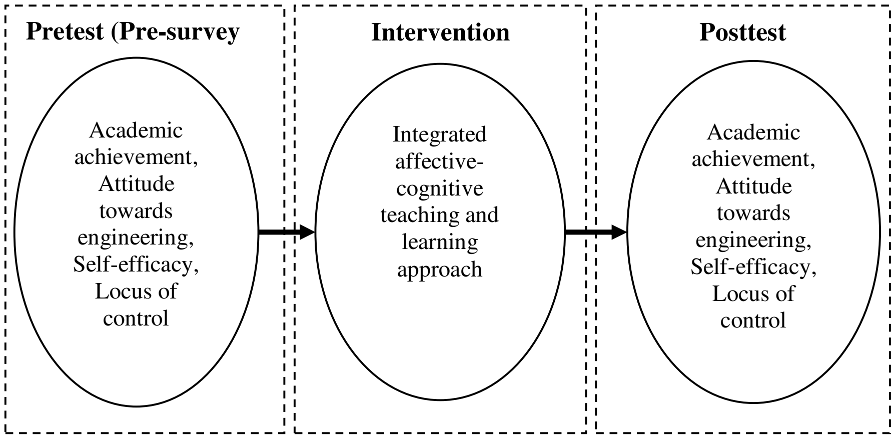

Figure 1: Procedure of Quasi Experimental Design

Quasi-experimental design is similar to the experimental design method but lacks random assignment (Black, 1999). Exposure to treatment depends primarily on self-selection or administrative decisions. The researcher can control the nature of treatment but subjects tend not to be randomly assigned or randomly selected (Black, 1999). Although true experimental design is often favored in studies that attempt to establish causal relationship but randomization was not desirable in this study because placing the students with unfamiliar faces or conditions might affect the outcome of the study (Alias & Hafir, 2009). A review by Schroeder *et al.* (2007) indicate that teaching strategy interventions range from 0.28 to 1.48 in their effectiveness based on effect size.

3.2 Controlling for Threats to Internal Validity

Prior to the exposure to intervention, certain remedial steps were taken to avoid external invalidity by ensuring similarity between sample and population and between comparison groups as much as possible and to strengthen causality claim (internal validity). Trochim & Donnelly (2007) has identified eight threats to internal validity that need to be considered in conducing quasi-experimental design namely, maturation, statistical regression, selection bias, history, experimental mortality, testing, instrumentation, and deign contamination. The following sections will discuss each potential threat and how it is dealt with or controlled/not controlled for in the study.

- Maturation threat refers to physiological changes that occur during life span that can pose a threat in long-term studies. However, maturation was not expected to be a threat in this study. This is because, the time span for the current study is relatively short (eight weeks) and could not result in significant maturation of participants. Furthermore, both groups were studying simultaneously and therefore would have undergone similar developmental process.

- Statistical regression refers to tendency of the previously extreme scores (low/high) that tend to move closer to the overall means in subsequent measures. Statistical regression becomes a threat when the extreme scores is a result of indifferent true score instead of a result of the effect of the treatment. True scores can be achieved via valid and reliable instruments. A standard tool decreases the probability of the errors. In this study standard tools had been utilized for measuring the psychological attributes and therefore statistical regression is not expected to confound the result.

- Selection bias threat occurs when participants of certain important attributes dominate a certain group and is indicated by statistically significant groups' performance prior to intervention. In this study, the group equivalence was tested on baseline using the independent equal variance *t*-test method to determine the difference in all measures of the study. The initial inspection indicated that both groups were equal prior to the intervention. Thus, selection bias is not expected to be a threat in this study.

- History becomes a threat when prior external events affect the outcome of a study and from an academic perspective; history refers to the academic background of a student. Since, the academic backgrounds for both groups were similar; history is not expected to be a threat.

- Experimental mortality threat refers to loss of subjects, participants leaving or dropping out from the experiment. Experimental mortality is not a threat in this study as subjects remains the same throughout the experiment.

- Testing threat refers to the confounding in the finding as a consequence of students learning from using the same tests in repeated measures. Learning from tests was indeed a possibility that cannot be avoided as the study used same pre and post test instruments. Efforts were undertaken to reduce this effect by providing eight weeks interval between the pre and post test as suggested by experts. Furthermore, even if learning takes place, both groups would have learned in similar way and the internal validity would still be maintained.

- Instrumentation threat refers to the tools which are used to measure variables of the study. For example, using instruments that have different scoring format for pre and post test might cause confusion in scoring and scores. However, since same instruments were employed during the pre and post test, instruments were not expected to be a source of threat to validity.

- Design contamination threat refers to the confounding that results from interactions between members of different groups under study. If it happens, the influence of the intervention could also be experienced by the control group and this will reduce groups' difference in the outcomes and may make it harder to get statistical significance in the difference. This source of invalidity is possible as students were from the same university but not likely as students are from different classes and are not provided with opportunities to associate closely with each other through on assignments.

3.3 Population and Sample

The samples were two intact classes of diploma students from civil engineering department of the Universiti Tun Hussein Onn Malaysia (UTHM). The first class consisted of 36 students which were taught with the proposed approach. The second class consisted of 34 students and they were taught with the conventional method of teaching. The two groups came from similar educational background thus; prior experience is not expected to be a source of confounding. Furthermore, the two groups were taught by the same lecturer to avoid confounding arising from teacher's attributes. In the study, the two groups are exposed to similar experiences in terms of teaching and learning culture, educational resources, and teaching staff. However, the difference was only with respect to the intervention.

3.4 Instruments

Data were gathered using three standard available instruments to measure self-efficacy, academic locus of control, and attitude towards engineering. Using existing instruments are beneficial as their validity and reliability is already established which provide standards for comparing the findings later on. Creating new instruments was avoided as it is time consuming and the newly developed instruments might not have the desired level of validity and reliability (Malik *et al*. 2009).

3.4.1 Self-Efficacy and Study Skills Questionnaire

The Self Efficacy and the Study Skills Questionnaire (SESS) developed by Gredler and Garavalia (2000) was used to measure self-efficacy of the participants. The instrument consists of 32-items with three negative items, item 14, 25 and 31. The negative items were scored in reversed scoring manner. Participants were asked to state their level of agreement to given statements on a scale of 1 (strongly disagree) to 5 (strongly agree). The maximum score that can be obtained on the self-efficacy measure is 160 and the minimum score is 32 which is equivalent to 5 and 1 on the Likert scale whereas a score of 96 (equivalent to 3 on Likert scale) is considered as an average score. Higher self-efficacy is indicated with higher scores.

3.4.2 Rotter's locus of control scale

Although there are many diverse instruments for locus of control as suggested by Halpert & Hill (2011) the Rotter's locus of control scale developed by Rotter (1966) was used to measure locus of control as it is the most widely used measure. It measures generalized expectancies for internal versus external locus of control of engineering students using 29 items. Higher scores on the scale indicate a higher external locus of control and vice versa. A score of 14 is the cut-off score and if a person's score is 14 or less then he/she is considered to have internal locus of control (Hadsell, 2009). Subsequently, those who score higher is said to have an external locus of control. The scale uses the binary response format as predetermined by the original author.

3.4.3 Pittsburgh freshman engineering attitude scale

The Pittsburgh Freshman Engineering Attitudes Scale (PFEAS) developed by Besterfield-Sacre *et al.* (Besterfield-Sacre *et al.* 1998) was used to measure attitude towards engineering. Participants were asked to state their level of agreement to given statements on a scale of 1 (strongly disagree) to 5 (strongly agree). Scores varies between the minimum of 35 and maximum of 175 which is equivalent to 1 and 5 on the Likert scale. Item 4, 6, 8, 9, 16, and 24 were revered coded because they were negative items.

The scale consisted of 50 items clustered into thirteen sub-scales. The sub-scales measure freshman attitude towards engineering based on the following constructs: general impressions of engineering (GI); financial influences of studying engineering (FI); perception of how engineers contributions to society (PECS); perceptions of work engineers do and the engineering profession (PEP); enjoyment of math and science courses (MSC); engineering perceived as being and "exact" science (ES); and family influences to studying engineering (FISE), confidence in basic engineering knowledge and skills (CBEKS); confidence in communication and computer skills (CCCS); adequate study habits (ASH); working in groups (WIG); problem solving abilities (PSA); and engineering capability (EC) respectively.

Out of 13 subscales, five subscales namely MSC, ES, CCCS, ASH, and WIG were excluded as they are not directly attributed to attitude towards engineering. These sub-scales measure the general perception regarding enjoyment of math and science courses, perception of engineering as an "exact" science, confidence in communication and computer skills, study habits and students' and perceptions on team working. Three items from CBEKS (item 44, 45, and 46) were also eliminated as not all students have the experience in the areas depicted by the items.

3.4.4 Achievement test

An achievement test was specifically designed for the specific course to measure academic achievement in the post intervention while the pre-intervention academic achievement was based on secondary data obtained on a pre-requisite course.

3.5 Instruments reliability

The Cronbach's alpha internal consistency method (Trochim & Donnelly, 2007) was used to estimate the reliabilities of all instruments except for the Rotter's locus of control scale that was estimated using the test-re-test reliability method. Table 1 shows the reliability coefficients obtained on the pre-intervention and post-intervention measures.

Table 1: Baseline and post-test reliability estimates on the research instruments

No.	Items	Instruments	Reliability estimates on pre-intervention data	Reliability estimates on post-intervention data	Average reliability
1	29	RLOC	.534	.534	.534
2	32	SESS	.782	.820	.801
3	35	PFEAS	.718	.853	.786
4	12	AA	-	.692	.692

Reliability estimates of all measures are in the medium to high range with the lowest obtained for the Rotter's locus of control scale. Although relatively low, the reliability of the Rotter's locus of control (RLOC) obtained in this study is acceptable as it is similar to those found in previous studies which has been reported to be ranging from 0.43 to 0.75 using the test-retest reliability method (Liu, Lavelle & Andris, 2002; Krista, 2008; Hadsell, 2009; Alias, Akasah & Kesot, 2012). The Cronbach alpha reliability estimate obtained for the self efficacy and the study skills questionnaire (SESS), in the current study is high and comparable to the previous study which ranges between $\alpha = .75$ to $\alpha = .87$ (Gredler and Garavalia, 1997, Alias, Akasah, & Kesot, 2012). Reliability estimate for the Pittsburgh Freshman Engineering Attitudes Scale (PFEAS) was also high based on the Cronbach's alpha coefficient indicating that the instrument is reliable. This is comparable to previous findings that reported reliability coefficients ranging from 0.54 to 0.87 (Malik *et al*. 2010; Alias, Akasah, & Kesot, 2012). The reliability estimate for the academic achievement (AA) was also high based on the Cronbach's alpha coefficient indicating an adequate reliability as suggested by Trochim & Donnelly (2007).

3.6 Intervention materials

The intervention materials were based on the integrated affective-cognitive framework reported in Alias *et al*. (2013). The framework was specifically designed to promote learning of the cognitive domain by catering to the affective learning needs of engineering students. The suggested types and sequence of activities in the framework are based on knowledge gained from best practices in teaching and learning for the affective and cognitive domain. Thus, considerations of the affective personality traits namely self-efficacy, locus of control, and attitude are integrated in the teaching and learning activities. In short, the framework is designed to enhance cognitive development via deliberations of personality traits with three affective objectives namely:

(i) To develop/enhance the level of self-efficacy
(ii) To evoke a positive attitude towards the subjects of engineering
(iii) To develop the sense of responsibility among students (internal locus of control).

The three personality traits were taken into account in each lesson plan and they were dealt according to the needs of the objectives of the study.

A lesson template based on this framework is shown in Figure 2. Based on this template, a typical lesson in this study started with efforts to enhance self-efficacy by showing them a motivational video to provide vicarious experience which is one of the means of enhancing self-efficacy (Bandura, 2005). Vicarious experience refers to the experience of observing others succeed which will promote the perception that one (the observer) can also succeed on the same task. Suitable motivational videos that provide vicarious experience can strengthen students' self-beliefs in their capabilities and boost self-efficacy of the observer (Akasah & Alias, 2010). Academic wise, motivational video provides a non-threatening learning environment and help students develop coping strategies to manage anxiety that in-turn create conducive affective traits that can facilitate learning achievement (Pervin, 2007). The beginning teaching strategy was also designed to develop and invoke positive attitude towards learning of the materials at hand. Activities include those activities suggested by Ormond (2000) to inculcate thoughts and feelings connections.

Later stage of teaching focused on dealing with locus of control. Teaching and learning activities were designed to promote internal locus of control as having internal locus of control is related to better persistence in learning efforts. Lecturer continuously made students aware of their responsibility towards learning during classroom discussion. In short, activities were systematically designed and implemented into the lesson to invoke the positive affective traits according to situational demand.

3.7 Ethical Consideration

Written permission to use the three instruments was obtained from the relevant people associated with the instruments. Official permission and informed consent was also sought to draw the sample for the study from the Universiti Tun Hussein Onn Malaysia (UTHM). Students were given a brief description of the study at the beginning as suggested by Krista (2008). All records and participants identities were treated as confidential as required by ethics based on suggestion by Jolivette (2007).

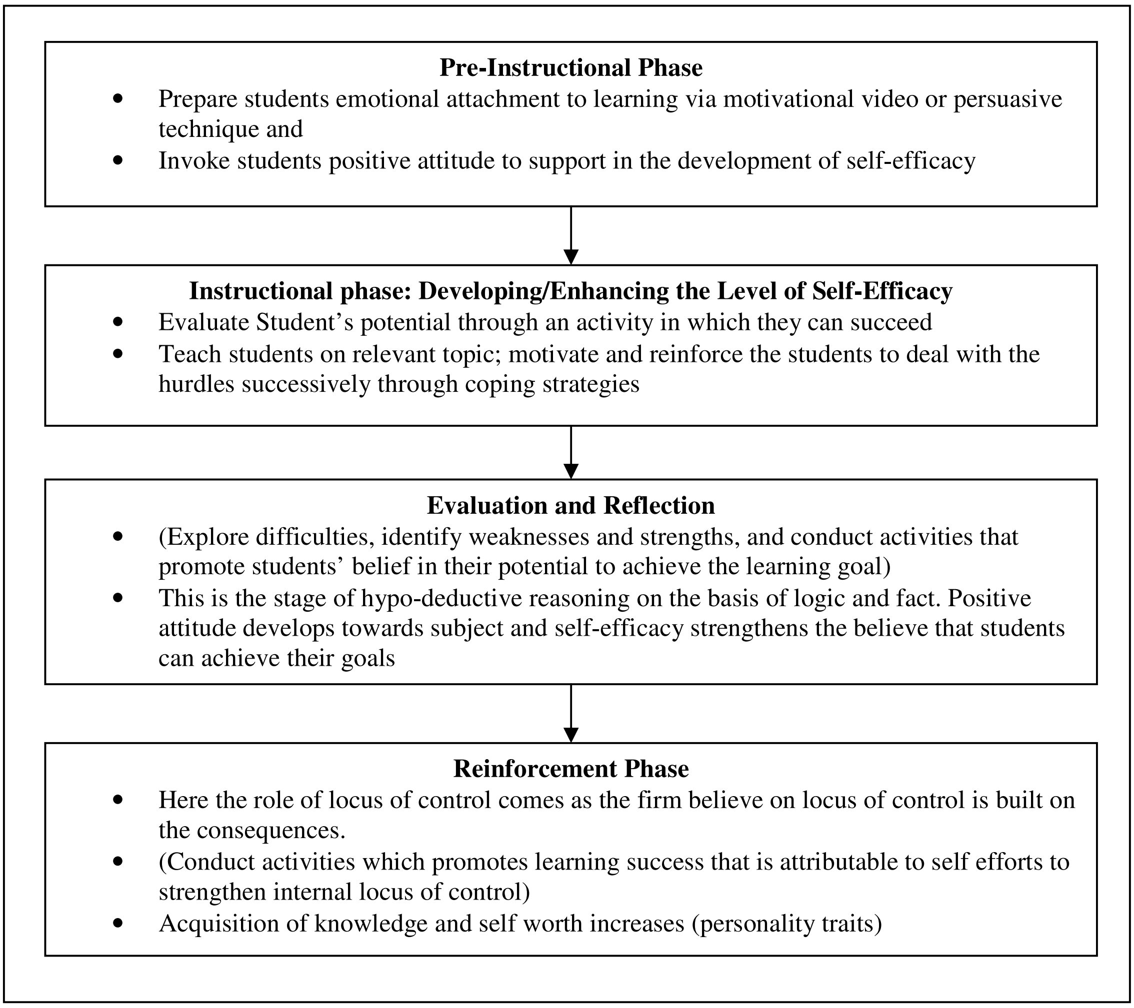

Figure 2: A typical Teaching and learning activity

4 RESULTS

This study was carried out to ascertain the effect of an intervention (i.e. integrated affective-cognitive teaching and learning approach; an instructional approach incorporating personality traits development namely; locus of control, self-efficacy, and attitude towards engineering) that promotes students academic achievements.

4.1 Group equivalence based on pre-intervention data

The pre-intervention data were analysed using the independent *t*-test after ascertaining that all assumptions were met. The Shapiro-Wilks statistics for normality test were computed as it is suitable when the sample size is less than 100 (Razali & Wah, 2011) to determine the suitability of a parametric test. The results indicate that the data were all normally distributed as shown in Table 1.

Table 1: Normality test on pre-survey data

Sr. No.	Variables	Shapiro-Wilk		Summary
		Statistic	p-value	
1	Academic Achievement	.983	.464	Distribution is normal
2	Locus of control	.973	.128	Distribution is normal
3	Self-efficacy	.976	.203	Distribution is normal
4	Attitude	.968	.073	Distribution is normal

The independent equal variance *t*-test was then used to determine the difference in academic achievement, locus of control, self efficacy, and attitude towards engineering between the two groups after ascertaining that data have equal variance based on the Levene's test (Table 2).

The equal variance independent *t* test is a parametric test which is applied to compare between two means when data are normally distributed and homogeneous (Trochim & Donnely, 2007). The 5% significance level was set for all tests as recommended by Trochim & Donnely (2007). The *t*-test results indicate that the two groups were similar at prior to intervention with respect to academic ability and self-efficacy but dissimilar with respect to locus of control and attitude towards engineering (Table 2a – 2d).

Table 2a: Descriptive statistics and *t*-test results on pre-intervention data for group equivalence on academic achievement

Academic achievement							
	Descriptive statistics		Levine's test		Independent *t*-test		
Group	M	*SD*	*F*	*p*	*t*	*df*	*p*
Experiment	74.73	10.65	.005	.946	-2.48	68	.806
Control	75.37	11.16					

Table 2b: Descriptive statistics and *t*-test results on pre-intervention data for group equivalence on locus of control

Locus of control							
	Descriptive statistics		Levine's test		Independent *t*-test		
Group	M	*SD*	*F*	*p*	*t*	*df*	*p*
Experiment	6.75	1.90	1.39	.241	-2.68	68	.009
Control	8.12	2.34					

Table 2c: Descriptive statistics and *t*-test results on pre-intervention data for group equivalence on self-efficacy

Self-efficacy							
	Descriptive statistics		Levine's test		Independent *t*-test		
Group	M	*SD*	*F*	*p*	*t*	*df*	*p*
Experiment	114.69	9.23	.203	.654	1.456	68	.150
Control	111.44	9.46					

Table 2d: Descriptive statistics and *t*-test results on pre-intervention data for group equivalence on attitude towards engineering

Attitude towards engineering							
	Descriptive statistics		Levine's test		Independent *t*-test		
Group	M	*SD*	*F*	*p*	*t*	*df*	*P*
Experiment	124.31	24.67	1.73	.192	2.008	68	.049
Control	114.79	12.76					

4.2 Effects of intervention on academic achievement, locus of control, self-efficacy, and attitude towards engineering

To assess the effect of the intervention, difference between groups on the locus of control, self-efficacy, attitude towards engineering and academic achievement were determined using the MANCOVA method. This statistical method was chosen as it allows the researcher to assess the effect of an independent variable on several dependent variables (Trochim & Donnelly, 2007). Since the study has four dependent variables therefore, MANOVA is suitable for the data analysis. Furthermore, it takes into consideration the effects of covariates on multiple dependent variables.

Thus the MANCOVA method allows the researcher to control for prior differences (i.e. covariate) thus avoiding confounding from covariates. The use of *t*-test on gain scores which is often used when comparing improvements between groups (Oakes & Feldman, 2001) is not suitable does not takes into account the influence of covariates (pre-intervention scores) on the dependent variable which is critical to consider as groups were unequal at the start of study. While the analysis of covariance (ANCOVA) does take into accounts the influence of covariates, it does this with respect to one dependent variable only.

Certain assumptions should be met for the MANCOVA to be used namely sample size, normality, homogeneity of variance, and outliers (Trochim & Donnelly, 2007). The sample in each cell must be greater that the number of the dependent variables. Nevertheless, if the sample size is greater than thirty (sample size > 30) meeting this assumption becomes less important. Normality and homogeneity of variance must hold for each of the dependent variable. Homogeneity of variance can be tested via using Levene's test. MANCOVA also is very sensitive to outliers as outliers inflates type I error (Oakes & Feldman, 2001). In the current study, the assumptions for MANCOVA are considered.

Four hypotheses were tested to examine the effect of the intervention on academic achievement, locus of control, self-efficacy and attitude towards engineering.

H_{01}: There is no statistically significant difference between groups on academic achievement.
H_{02}: There is no statistically significant difference between groups on locus of control.
H_{03}: There is no statistically significant difference between groups on self-efficacy.
H_{04}: There is no statistically significant difference between groups on attitude towards engineering.

The result of MANCOVA (Table 3) between-subject factors indicate that there is a statistically significant difference between groups on academic achievement (F (1, 64) = 10.204, p = 0.002, Observed Power = .882) and attitude towards engineering ((F (1, 64) = 6.309, p = 0.015, Observed Power = .696). The effect size is large for academic achievement using Cohen d method (d= 1.38). However, a non-statistically significant difference between groups is found on locus of control (*F* (1, 64) = 2.439, p = 0.123, Observed Power = .337) and self-efficacy (*F* (1, 64) = 1.922, p = 0.170, Observed Power = .277).

Table 3: MANCOVA results for difference on academic achievement, locus of control, self-efficacy and attitude towards engineering

Psychological variables	Groups	M (post-test)	*SD*	F	*p*	Observed Power
Academic achievement	Experimental Control	79.33 67.55	14.17 19.04	10.20	.002	.882
Locus of control	Experimental Control	6.94 8.65	1.95 2.95	2.43	.123	.337
Self-efficacy	Experimental Control	117.61 112.85	10.80 8.69	1.922	.170	.277
Attitude towards engineering	Experimental Control	139.22 128.26	19.41 10.16	6.30	.015	.696

To determine if the intervention has differential effect on high and low achievers, a deep analysis was done on academic achievement data. The students were systematically arranges on the basis of their score. The first ten cases were taken for analysis and were named as upper cases hence; the last ten cases were termed as lower cases. The upper cases refer to high achievers and the lower cases refer to low achievers.

Table 5 demonstrates the obtained results on post-test which indicated that upper cases students performed equally however; there is a big difference between the lower cases of the two groups. The mean of students from control group was much lower (M=47) as compared to the experimental group (M=56) with the control group being 9 points lower.

Table 5: Mean scores on posttest of students in upper cases from both groups

Sr. no.	Students	Posttest results	
1.	Average scores	Experiment group	Control group
2.	Upper cases	92	92
3.	Lower cases	56	47

5 DISCUSSIONS

The affective-cognitive approach was found to be effective in achieving the course learning goal in the cognitive domain as observed in the greater performance of the experimental group compared to the control group. This finding is similar to previous studies that attempt to improve academic achievement through interventions based on meta analysis by Schroeder *et al.* (2007). The effect size of d=1.38 for academic achievement indicates that this approach is better than some teaching strategies used in previous studies such as the manipulation strategy, Manipulation Strategies (0.57); Enhanced Material Strategies (0.29); Assessment Strategies (0.51); Instructional Technology (IT) Strategies (0.48) as reported by Schroeder *et al.* (2007).

The findings that the students in the low achievement category for the experimental group did much better than the control group while high achiever categories perform similarly indicate that the teaching method may have provided greater benefits to low achievers. This is indeed a desirable outcome for the study as helping low achievers is often the main issue in any teaching and learning efforts. High achievers are not a source of much problem as they often learn irrespective of methods used.

The more positive attitude towards engineering of the experimental group is consistent with expectations. This indicates that the approach used is effective at improving attitude of students. The increase in attitude that is in line with the increase in academic achievement is also expected. The results reaffirmed earlier studies that positive attitude towards a discipline influences students' success in the course as positive attitude, positive thinking and optimism are known to be a core element of academic achievement (Papanastasiou & Zembylas, 2004; Kirchner, 2012). Possibly, students having a positive attitude towards engineering tend to have a low level of anxiety, have greater persistence in facing learning difficulties, and have coping skills during the time of hardships in learning.

Literature has constantly associated internal locus of control with academic success and positive outcome (Liu, Lavelle, & Andris, 2002). So it was expected that the intervention that improves academic achievement would also affect locus of control similarly. However, the finding from the current study seems to contradict existing peer researchers' finding. One of the possible reasons could be the instrument used to measure locus of control. The Rotter's locus of control tool used measures the generalised expectancy for internal vs. external locus of control which is not specially designed for academia. People may have different locus of control for different situations as suggested by Halpert & Hill (2011) i.e., general locus of control may not be affected here but academic locus of control may be.

Similar self-efficacy level between the two groups was taught using integrated affective-cognitive and the conventional teaching and learning approach was also unexpected. The results also indicate that students the two approaches produce similar results. Looking from other point of view, the reason self-efficacy level for integrated affective-cognitive teaching and learning approach did not increase as expected. It is possible that the feedback given in class for improving self-efficacy were not specific enough to generate increase in perception towards self capability.

6 CONCLUSION

Existing knowledge on learning indicates that effective teaching and learning for the cognitive domain can only be realized through the integration of the personal and affective needs of a learner. Prevalent practices in engineering education however do not often consider these needs due to lack of guidance on how to integrate affects. An integrated affective-cognitive teaching and learning approach incorporating efforts to develop positive personality traits such as self-efficacy, locus of control and attitude towards engineering was developed and its efficacy for promoting learning was tested. The findings indicate that this approach is effective at achieving cognitive learning (academic achievement) and selected affective learning outcome (attitude). The simultaneous achievement of cognitive and affective learning goals makes this approach an attractive choice for preparing engineering graduates with holistic attributes. Furthermore, the approach is also expected to be suitable in TVET in general especially in the preparations of engineering assistants and technicians.

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