Relationships between Locus of Control, Self-Efficacy, Efforts and Academic Achievement among Engineering Students

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Abstract. The aim of this study is to investigate the relationships between the affective learning needs namely, self-efficacy and locus of control, learning efforts and academic achievement among engineering students. For this purpose, a survey was conducted on first year engineering students from two technical universities in Malaysia. Self-efficacy and locus of control were assessed using existing instruments while learning efforts were assessed using a specifically designed instrument based on Carbonaro's model of learning effort. Academic achievement data were based on cumulative grade point average (CGPA) obtained from self-report by participants. The findings indicate that females engineering students tend to have higher self-efficacy compared to males while both groups have similar locus of control and invest in similar learning efforts. Only locus of control is found to be related to academic achievement while self-efficacy is found to be related to efforts. In conclusion, locus of control seems to be an important factor in predicting academic achievement among engineering students.

1 Introduction

The need to produce engineers who have high technical skills has resulted in engineering educators giving high emphasis on cognitive learning needs in their teaching and learning practices. However, achievement of cognitive learning goals is not solely dependent on meeting learners' cognitive learning needs but also meeting their affective learning needs as learning involves affects such as feeling and emotion [1]. Furthermore, with additional demand on engineers to have more people skills, affective learning outcomes are recently identified as necessary learning outcomes of engineering education. Thus, understanding the affective domain within engineering education teaching and learning is beginning to be emphasized in engineering education research.

Affective learning needs include having the self-perception of being able to succeed on task (self-efficacy) and feeling of being in control of event outcomes (locus of control). Self-efficacy and locus of control are two concepts that were introduced within the Social learning theory framework by Bandura [2] and Rotter [3] respectively. Self-efficacy is the self-confidence of a person that is related to a specific task, challenge or endeavor which means that self-efficacy may differ according to situations. Locus of control on the other hand is a person feeling of attribution towards a factor on the outcome of an event. A person can thus have an intrinsic or extrinsic locus of control. A person with an extrinsic locus of control believe that luck, chance or fate plays an important role in their life while a person with an intrinsic locus of control believe they have control over their life. Since the introduction of Rotter's idea on the general locus of control, specific locus of control has been suggested. One of it is the academic locus of control by Trice [4] and [5]. Thus some studies use the general locus of control while others focus on the specific locus of control in studying academic achievement.

Locus of control has been shown to be an important factor in predicting academic achievement [6]. Thus, it is expected that with greater belief in one's ability to influence success (high self-efficacy and having an internal locus of control), greater efforts will be invested that will lead to academic success. This hypothesis is supported by previous studies such as [7], [8], [9], [10] and [11]. Higher self-efficacy was found to be associated with higher mathematic achievement score as well as higher Grade point Average (GPA) among electronic engineering students [7] and Grade point Average (GPA) [9]. Self-efficacy is also found to be positively associated with efforts [11] and locus of control [10].

Findings on associations between learning efforts and academic achievement are inconsistent; while [10] found positive association between efforts and academic achievement, none was found in [12]. However, consistency in effort is found to be related to academic achievement instead [12] which support previous suggestion that management and control of learning

efforts on classroom academic tasks is an important element in explaining academic success [13].

Based on the literature reviewed, it can be safely concluded that the findings on relationships between self-efficacy, efforts and academic achievement among engineering students is inconclusive and more studies are necessary to have a better understanding of how these parameters influence academic achievement. The purpose of this study was to investigate the relationships between self-efficacy and locus of control (two affective learning needs), efforts and academic achievement among engineering students. Specifically, the objectives were:

i. To assess the self-efficacy, locus of control and efforts among engineering students.
ii. To determine the relationships between self-efficacy, locus of control, efforts and academic achievement.

2 Methods

The participants were 410 first year engineering students from two public technical universities in Malaysia. Similar entry requirements were required for all engineering programmes. Thus, participants were expected to be similar in academic ability across programmes. However, each programme differs in terms of its general course content. For example, the electrical engineering programme in these two universities has greater mathematics content compared to the civil and mechanical electrical engineering programme which may create varying learning efforts from students.

Three instruments were used for data collection on self-efficacy, locus of control and learning efforts. Self-efficacy was assessed using an instrument developed by Klobas, Renzi, and Nigrelli [14]; locus of control was assessed using the Trice Academic Locus of Control (ALoC) Scale [4] and learning efforts were assessed using a specifically designed instrument based on the efforts model from Carbonaro [15].

The Self-efficacy scale has 30 items. Participants were asked to rate a statement on a scale of 1 to 10 on their agreements to given statements. The maximum score is 270 and the minimum score is 0. The average score is set at 135. The Self-efficacy scale has a reliability of á=.70 indicating moderate and adequate reliability for the purpose of this study.

The Trice ALoC scale which consists of 28 items is similar to the Rotter's Locus of Control Scale but with a difference in focus. While Rotter's measure general locus of control, Trice ALoC measures locus of control that is specific to academic setting. The maximum probable score is 28 while the minimum score is zero and the average score is 13. In this study, a person who scores above 13 is considered to have an extrinsic locus of control. The Cronbach Alpha reliability of Trice ALoC Scale is á =.71, indicating moderate reliability and acceptable quality for the purpose of the study. A high stake assessment would demand a higher reliability than currently achieved.

The Learning efforts instrument was developed based on Carbonaro's model on learning efforts [15]. According to Carbonaro, efforts can be divided into three components, rule oriented efforts, procedural effort and intellectual effort. The quantity of each type of effort can be measured according to their frequency and duration. A maximum efforts score possible is 150; a minimum score is 30, and the middle score is 90. Thus, the learning efforts instrument assesses three categories of effort, rule oriented efforts, procedural efforts and intellectual efforts; measured according to their frequency and duration. The reliability of the learning effort instrument is á=.88 indicating a high reliability.

The instruments were distributed to participants with the help of lecturers of the respective classes of participants. Permissions were sought through the various university authorities prior to the data collection activity. At the onset of the data collection activity, the aim of the study was explained to the participants and confidentiality was assured to ensure that participants give honest responses. Each participant was given a small token for his/her assistance in the study. Completed instruments were gathered on the same day that they were distributed.

3 Results and Discussions

Instruments were distributed to 410 participants, and 360 (87%) completed questionnaires were returned. Distributions of respondents are shown in Table 1.

Table 1. Response rate according to programme and gender.

	Female	**Male**	**Total**
Civil engineering (CE)	86	51	137
Electrical engineering (EE)	44	35	79
Mechanical engineering (ME)	45	99	144
Total	**175**	**185**	**360**

The civil engineering participants have the highest mean on CGPA (M = 3.11, SD=0.50) followed by the electrical engineering (M=3.05, SD=0.45) and mechanical engineering participants (M=2.62, SD=0.69).

3.1 Self-Efficacy, Locus of Control and Learning Efforts among Engineering Students

Overall mean for locus of control is slightly above 14 (Mean=14.56, Standard Deviation=4.22) indicating slightly extrinsic locus of control. Mean (M) and Standard Deviation (SD) for locus of control, learning efforts and self efficacy according to gender are given in Table 2. Similar means are observed among male and female participants (Table 2). Overall mean on learning efforts is above average (M=111.73 which is greater than 90) with females scoring approximately 5 points higher than males. Above average self-efficacy is reported with higher self-efficacy among females.

The independent t-test results on means between genders indicate that only the difference on learning efforts is statistically significant (t=3.108, df=358, p=.002). This result in combination with Table 2 indicates that females are making greater learning efforts compared to males.

Table 2. Locus of control, Learning efforts and self-efficacy of engineering students according to gender.

	Female (n=175)		Male (n=185)	
	M	SD	M	SD
Locus of control	14.37	4.22	14.75	4.21
Learning efforts	114.04	13.28	109.55	14.11
Self-173.57 efficacy		33.95	175.67	33.92

The current finding indicate that engineering students were slightly more extrinsic in their locus of control which means that they perceive external factors as more influential in determining the outcomes of their efforts. The findings contradict previous finding [17]. However, in [17] the Rotter's locus of control scale which measures the general locus of control was used instead. Students may feel more in control on general matter but may feel less in control where academic matter is concerned. So the current finding is not necessarily indicative of contradiction to [17].

Similar locus of control trends are also observed among male and female participants indicating that both males and females similarly perceive the external factors as being influential in determining the outcomes of events. Similarity in locus of control between males and females engineering students support the findings from a previous study by [19] and [20]. The current finding is however, in contrast to that of [21] where Jordanian males engineering were found to be more intrinsic in their locus of control compared to females meaning that males feel that they are more in control of the outcome of events compared to females. The difference could be due culture where males are generally expected to take up the leadership roles. Females engineering students in the current study seem to be making more efforts than male engineering students are. This could be due to the biased nature of engineering programmes that necessitates females to try harder to succeed.

Statistics according to programmes which are shown in Table 3 indicate that differences exist between group means on all three variables under study.

Table 3. Locus of control, learning efforts and self-efficacy according to programmes of study.

	CE	EE	ME
	M (SD)	M (SD)	M (SD)
Locus of control	13.2 (3.9)	14.5 (3.3)	15.9 (4.6)
Learning Effort	112.3 (12.4)	114.9 (12.9)	109.5 (15.4)
Self-Efficacy	179.1 (34.6)	170.8 (31.8)	172.6 (34.1)

When differences in means were tested using Analysis of Variance (ANOVA) method, only differences between groups on locus of control (F=15.471, df=2, p=.000)) and learning efforts (F=4.143, df=2 and p=.017) were statistically significant. The statistically significant difference indicates that there is a statistically significant difference between at least two groups. A pos-hoc analysis indicates that civil engineering students are more intrinsic in their locus of control compared to the mechanical engineering group.

The difference observed between electrical and mechanical engineering participants on learning efforts indicates that electrical engineering participants make greater learning efforts compared to mechanical engineering participants. Difference in self-efficacy was not statistically significant between programmes (p>.05) indicating that all groups have similar self-efficacy level.

Self-efficacy of engineering participants were found to be above average, similar to previous findings by [17] and [18] who found that engineering students have average or high self-efficacy. Perception of self-efficacy is also found to be similar between males and females which support findings from a previous study on Indian engineering students [19]. Current finding is different from [18] where American female engineering students were found to be more self-efficacious compare to males. Cultural influence could be a factor here as the studies in [19] and [20] are within the Eastern culture while the study in [18] is on American students (Western culture). Further study is needed to verify this hypothesis.

When the three parameters were compared among the different engineering disciplines, interesting findings emerged. Participants from different discipline differ in their locus of control and learning efforts. Civil engineering participants were the most intrinsic in their locus of control and has the highest on the self-efficacy measure. This finding is in accordance with earlier expectation where high belief in ability to succeed and ability to control an outcome is associated with better academic success. In this case, the civil engineering participants who have the highest perception on the ability to succeed and the ability to control outcome have actually gotten the highest mean on CGPA as previously stated.

Electrical engineering participants on the other hand reported making the most efforts but have the lowest self-efficacy. This could mean that having weak belief in their natural ability to succeed, the electrical engineering participants thus invest in more learning efforts to ensure that they can actually succeed in their programme. Another possibility is that the greater efforts required is due to the high mathematical content of electrical engineering programmes that may demand greater learning efforts from the electrical engineering students. Mechanical engineering is the most extrinsic with the lowest effort mean score. This could mean that believing the external factors such as luck and teachers to be in control of outcomes, mechanical engineering students may then decide not to invest in much effort which reflects their lowest mean score. This interpretation is in line with earlier expectations and supported by previous studies.

However, the greater investment in learning efforts observed within the electrical engineering group could simply be due to a manifestation of the gender effect as the electrical engineering group has more females than males and females in the study have been shown to invest in more learning efforts irrespective of

programme of study.

Variations in efforts for different programmes of study have been observed in previous study. In [21] software engineering students work harder compared to Bachelor in Information Technology and Bachelor in Computer Science students who seem to invest less effort to achieve higher grades. This indicates that different programmes may demand less or more efforts from students depending on the nature of programmes.

3.2 Relationship between Locus of Control, Learning Efforts, Self-Efficacy and Academic Achievement

Statistically significant correlations are only found between CGPA and locus of control r=-.223, p<.01) and between self-efficacy and learning efforts (r=.294, p<.01). Statistically significant correlation is not found between locus of control and learning efforts (p>.05). Furthermore, no statistically significant correlations are found between learning efforts or self-efficacy and academic achievement (p>.05).

The results indicate that those who score low on locus of control tend to score high on CGPA meaning intrinsic locus of control is associated with higher CGPA. The current finding supports findings from previous studies in [23] and [21]. Data from the current study also indicate positive association between self-efficacy and learning efforts which is similar to [10] but contradicts [20]. Similar to [10] and [12] the current study fails to establish correlation between effort and CGPA. Consistency in effort instead of total effort was associated with academic achievement [12]. In contrast to [9], [10] and [23] the current study fails to establish associational relationship between self-efficacy and CGPA. No correlation between self-efficacy and locus of control was found in this study which is similar to [20] and [23].

However, when the data were analyzed separately for extrinsic and intrinsic locus of control group, the results were different (Table 4); there is a statistically significant correlation between locus of control and learning efforts while the other relationships remain similar in directions and strengths.

Table 4. Correlations between locus of control, learning efforts, self-efficacy and CGPA for group with extrinsic locus of control (N=206).

	CGPA	Locus of Control	Self-efficacy	Learning efforts
CGPA	1	-.219**	-.007	.057
Locus		1	-.047	.195**
Self-efficacy			1	.383**
Efforts				1

The schematic representation of the relationships based on statistics in Table 4 is given in Figure 1. The arrows indicate direction of influence. Thus it can be seen that locus of control influences CGPA and learning efforts, while self-efficacy only influences learning efforts.

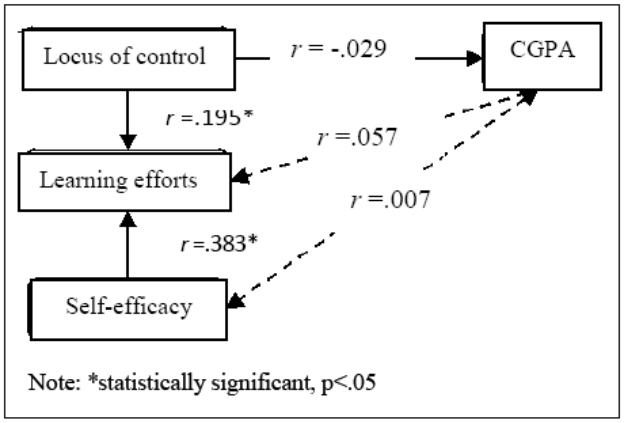

Figure 1. Relationships between locus of control, learning efforts, self-efficacy and CGPA.

4 Conclusions

The study was set out to determine the level of locus of control, self-efficacy and learning efforts among engineering students in Malaysia and ultimately to identify the connections between these parameters and academic achievement. The data support the conclusion that Malaysian engineering students tend to have high self-efficacy with females having higher self-efficacy compared to males engineering students.

In general, engineering students tend to have extrinsic locus of control with the exception the engineering students in the civil engineering students who tend to be intrinsic in their locus of control. This finding can arise out of two possibilities i.e., a specific programme of study can predispose a learner to be intrinsic or extrinsic in locus of control or having a specific type of locus of control can predispose a person to choose a certain engineering programme. More research is needed to have a definitive answer.

The data also support the conclusion that self-efficacy and effort are indirectly related to academic achievement for students with extrinsic locus of control but not for those with intrinsic locus of control. This is an interesting finding that demands further research. The inconclusive findings on some hypotheses tested indicate that the relationship between affective learning needs namely self-efficacy and locus of control, effort and academic achievement among engineering students are still in need of further research to be fully understood.

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