The relationship between academic self-confidence and cognitive performance among engineering students

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Abstract*: The purpose of this study was to determine the relationship between type of confidence inducing stimulus, academic self-confidence and cognitive performance among engineering students. The study samples consisted of two groups of engineering students from a Malaysian polytechnic. The type of confidence inducing stimulus (positive or negative) was the independent variable, cognitive performance was the dependent variable and ASC was the hypothesised mediating variable. An ACS questionnaire and a cognitive test were used to gather data on ASC and cognitive performance respectively. The results indicate that the positive group has statistically significantly higher ASC level (3.08) compared to the negative group (2.67) and the positive group also demonstrates a statistically significantly higher cognitive performance compared to the negative group; 71% and 54% respectively. It is concluded that boosting the ASC of engineering students can enhance their cognitive performance.*

Introduction

Self-confidence is an individual's characteristic (a self-construct) which enables a person to have a positive or realistic view of themselves or situations that they are in (Sieler, 1998). It refers to a person's expectation of his or her ability to achieve a goal in a given situation and is a very influential factor in ensuring a person's potential is realised (Stevens, 2005). In other words, a person with a high self-confidence has a realistic view of themselves and their capability which makes them persistence in their endeavours. According to Neill (2005), self-esteem and self-efficacy in combination is what constitute self-confidence. Neill (2005) defines self-esteem as a general feeling of self-worth or self-value. A person with low self-esteem believes that he or she is worthless or inadequate while a person who has high self-esteem believes other wise. Self-efficacy on the other hand is the belief in one's capacity to succeed at tasks. Self-efficacy according to Neill (2005) can be general or specific where general self-efficacy is belief in one's general capacity to handle tasks and specific self-efficacy refers to beliefs about one's ability to perform specific tasks in certain things. Self-efficacy is also sometimes used to refer to situation specific self-confidence. Thus, academic self-confidence can be viewed as self-efficacy.

Bandura's self-efficacy theory

Self-efficacy is a situation specific self-confidence (Bandura, 1986), a belief that one is competent to handle the task at hand. People with high self-efficacy - that is, those who believe they can perform well - are more likely to view difficult tasks as something to be mastered rather than something to be avoided. According to the theory, self-efficacy is enhanced by four factors: enactive attainment (successful performances), vicarious experiences, verbal persuasion, and psychological state (emotional arousal).

This means that:

i. Successful past experiences lead to higher mastery expectations, while failures lower them

ii. observing other people perform activities successfully can lead to the observers into believing that they also can improve their performance as they learn from watching others

iii. people can be persuaded through suggestion into believing that they can cope successfully with specific tasks

iv. the individual's emotional states influence self-efficacy judgments with respect to specific tasks. Emotional state such as anxiety can lead to negative judgments of one's ability to complete a task

In education, Vrugt, Lanereis and Hoogstraten (1997) introduce the concept of academic self-confidence which refers to a person's self-confidence in the context of academic achievement which is different from the general self-confidence. Academic self-confidence is easily influenced by situational elements differentiating it from the general self-confidence which is not easily influenced by situational elements Zokina and Nalbone (2003).

Problem statement

Although much research has been conducted on the effect of self-efficacy on achievements (Zokina and Nalbone, 2003; Stolz, 1999; Weinberg, 1985) but no studies were found focussing on the self-efficacy of engineering students. Engineering students have been shown to be different on several psychological attributes from the general population. For example spatial visualisation ability among the general population consistently indicates that females perform poorly compared to males. However, among engineering students, no difference was found between males and females in their performance on spatial tasks (Alias, Black and Gray, 2003). The purpose of this study is to determine the relationship between the type of confidence inducing stimulus (positive or negative), level of academic self-confidence (ASC), and cognitive performance among engineering students.

Objectives of study

The objectives of the study were:

(i) To determine if there is any difference in the academic self-confidence of students given positive stimulus and negative stimulus

(ii) To determine if there is any difference in the cognitive performance of students given positive stimulus and negative stimulus

The hypotheses were

(i) There is no statistically significant difference between the academic self-confidence of students given positive and negative stimulus

(ii) There is no statistically significant difference between the cognitive performance of students given positive and negative stimulus

Methodology

Population and sample

The target population are students from diploma in engineering programmes in Malaysian polytechnics. The diploma programme is a three year programme leading to the award of a diploma. Admission into the programme requires a minimum of 5 good passes at 'O' level that includes mathematics and science. Polytechnic graduates are usually accepted into the second year of a degree programme in Malaysian and British Universities. There are currently twenty polytechnics that offer the Diploma in Mechanical Engineering course, scattered through out Malaysia under the Ministry of Higher Education (MoHE). Being managed under one agency means that there is very little difference between one polytechnic and another in terms of its teaching and learning culture, educational resources and teaching staff. In contrast to university lecturers, polytechnic lecturers have professional teaching qualifications. Admissions into these polytechnics are managed by a central agency under the MoHE. Qualified students are normally placed into the polytechnics of their choice. However, if a place is not available at the chosen polytechnic, the qualified candidate is placed in other polytechnics that offer the same course. In short there is more similarities than differences between students of one polytechnic and another.

The samples for the study were selected using the stratified random sampling method where one polytechnic was chosen randomly from 20 polytechnics and 122 subjects were selected from this polytechnic. The samples consisted of two groups of engineering students - 61 students in each group – selected from the Mechanical Engineering programmes in the Port Dickson Polytechnic in Negeri Sembilan, a south western state of West Malaysia. Although selected from one polytechnic only, it is highly likely that the samples do represent the general population due to the conditions explained above.

In this study, students were selected and assigned to each group based on their score on the general self-confidence (GSC) instrument given prior to the study (three and above) and cumulative point average (CPA) (3 and above). Efforts were made to ensure that the groups were approximately similar with respect to their general self-confidence, academic ability, age and gender proportion as these factors were associated with academic self-confidence (Carver and Scheier, 1991; Stevens, 1999). Initial attribute of samples are given in Table 1.

Table 1 Initial attributes of samples

	Positive group	Negative group
CPA	Ranges from 3.0 to 4.0	Ranges from 3.0 to 4.0
GSC	3.76 out of 5	3.78 out of 5
Females	9 (15%)	9 (15%)
Males	52 (85%)	52 (85%)
Age	19 - 21 year	19 - 21 year

Research variables

The independent variable was the type of confidence inducing stimulus (positive or negative); the dependent variable was cognitive performance measured on a cognitive test and the mediating variable was academic self-confidence level measured on an academic self-confidence instrument. Controlled variables were age, gender, academic ability, general self-confidence and age.

Research tools

The data gathering tools were a GSC questionnaire, an ACS instrument and a cognitive test instrument. The GSC instrument consists of eight items; uses the five point scale response format with 1 indicating low level of agreement with the statement given and 5 indicating strong agreement. An example of the items in the GSC instrument is given in Table 2.

Table 2

Self-confidence Statements	1	2	3	4	5
Saya mempunyai kemahiran, pengetahuan dan kekuatan dalaman untuk mencapai apa yang saya ingini dalam kehidupan. (I have the skills, knowledge and internal strengths to achieve what I want in life).	☐	☐	☐	☐	☐

The ACS instrument was based on the instrument used in a similar study by Zorkina dan Nalbone (2003). It uses the multiple choice item format with four alternatives which were coded into 1, indicating lower confidence and 4 indicating high confidence. For this study, the original items which were in English were translated into the Malay language and English names were replaced by Malay names. An example of the items from the ASC instrument is given in Figure 1.

Bagaimana pendapat anda mengenai diri anda dibandingkan dengan rakan-rakan dalam kelas? (How do you rate yourself against your peers in the class?)
a) *Atas dari purata* (Definitely above average)
b) *Atas sedikit dari purata* (Slightly above average)
c) *Purata* (Average)
d) *Bawah dari purata* (Below average)

Figure 1

The cognitive test instrument was also based on the instrument used by Zorkina dan Nalbone (2003). Participants were asked to respond to a set of 15 multiple choice items (with two alternatives, four and five alternatives). The instrument measures mathematical-logical skills as well as the ability to manipulate data and the ability to comprehend analogies and logical reasoning skills. An example of the items from the cognitive test instrument is given in Figure 2.

Aminah berlari lebih pantas daripada Dayang dan Maimun berlari lebih perlahan daripada Aminah. Ianya mustahil untuk menyatakan samada Maimun berlari lebih pantas daripada Dayang. (Aminah is running faster than Dayang and Maimun is running slower than Aminah. Based on the information given it is not possible to say whether Maimun is actually running faster than Dayang.)

a) *Betul* (True)
b) *Salah* (False)

Figure 2

The reliability estimates of the instruments which were based on Cronbach Alpha method are above 0.6 (Table 3) and are deemed adequate for the current study.

Table 3

	No of items	Cronbach Alpha reliability coefficient (α)
General Self-Confidence Instrument	29	0.90
Academic Self-Confidence instrument	8	0.63
Cognitive Test Instrument	15	0.77

Research Design and Procedure

The study uses the quasi-experimental design method with a control group. The method is not considered an experimental design method (only quasi) because the subjects were not randomly selected and assigned in this study. Randomization is not desirable in this case because putting the students among unfamiliar faces may introduce a factor that may confound the outcome of the study.

The research procedure is now here described. Before they sat for the cognitive test, one group was told that the test they were about to take was designed to measure intelligence of university students (negative input) while the other group was told that the test was designed to measure of secondary school students (positive input). Students believing that they were sitting for a test designed for university students were expected to feel inadequate and as a result may not attempt to their best ability; thus the negative stimulus. Students gave their response to the ASC questionnaire before they sat on the cognitive test. Participants were given 10 minutes to complete the cognitive test. Figure 3 illustrates the variable map for the study.

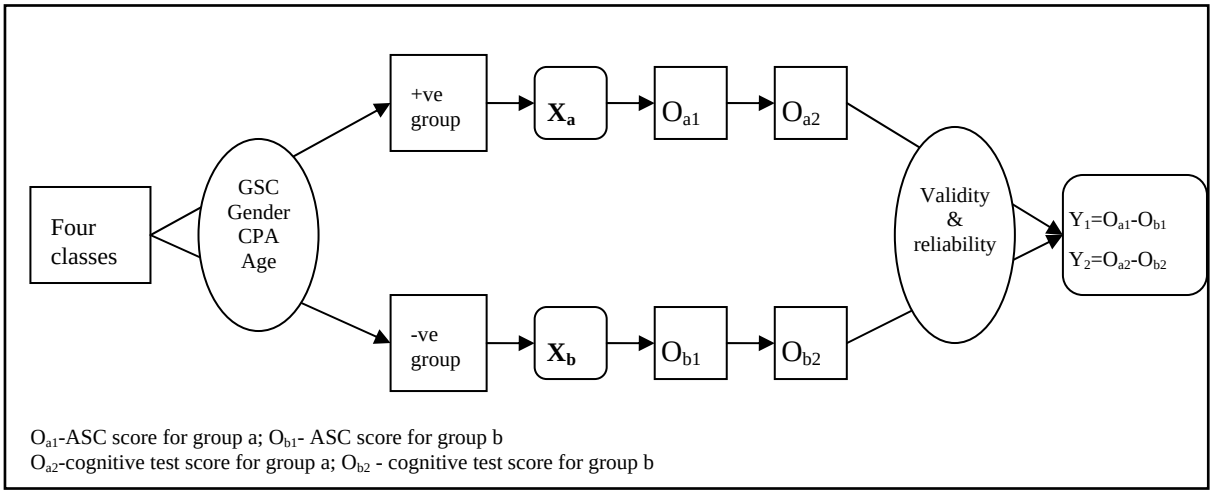

Figure 3 Sequence of activities in the data collection process

Results

The effect of stimulus type on ASC

The group given positive stimulus gave a higher self rating on the ASC ($\bar{x}$ = 3.08, s = 0.42) compared to the group given negative stimulus ($\bar{x}$ = 2.67, s = 0.43). To determine if the difference was statistically significant, an independent *t*-test for equal variance was used as the distribution was normal and the variances were homogeneous (p=.844 > 0.05 on the Lavene's test). The *t*-test results (in Table 4) indicates that the mean difference between the two groups is statistically significant, t = -5.194, p<0.05 (two-tailed, $n_1 = n_2$ = 61, df = 120). Therefore, the null hypothesis was rejected and the result was interpreted as there is a statistically significant difference in the ASC rating between the two groups with the positive group giving themselves higher ASC rating. The effect size is 0.97.

Table 4 *t*-test results on the difference in the ASC between positive and negative groups

Levene's Test for Equality of Variances		*t*-test for Equality of Means		
F	*p*	*t*	*df*	*p (2-tailed)*
.039	.844	-5.194	120	.000

The effect of stimulus type on cognitive performance

The positive group obtained a statistically higher mean on the cognitive test $\bar{x}_{+ve}$=71% as compared to the negative group $\bar{x}_{-ve}$=54%. To test whether the difference in means are statistically significant, the Mann-Whitney *U* test which is a non-parametric counterpart of the independent *t*-test was used as the score distributions were not normally distributed. The results of the Mann Whitney U test shows that there is a statistically significant difference, U= 977.00, p<.05 (two-tailed, $n1$=$n2$=61) with the positive group scoring higher than the negative group.

Table 5 Mann Whitney U test results

	n	Mean Rank	Sum of Ranks
Negative group	61	47.02	2868.00
Positive group	61	75.98	4635.00
Total	122		

	Score
Mann-Whitney U	977.000
Wilcoxon W	2868.000
Z	-4.553
Asymp. Sig. (2-tailed)	.000

Discussion and conclusion

The purpose of the current study was to determine if giving a positive or negative stimulus to engineering students can affect their cognitive performance and if academic self-confidence is the mediating factor. The results indicate that cognitive performance among engineering students is improved when giving positive verbal input and the opposite is observed when given a negative verbal input. These findings is consistent with findings by Zorkina & Nabone (2003), Lovaglia, Lucas, Houser, Thye & Markovy (1998) and Jourden, *et al*. (1991) where participants receiving positive verbal inputs show positive signs and subsequently perform better. From this study, it can be said that the self-confidence is the mediating factor between positive verbal input and cognitive performance.

The study however, uses the quasi-experimental design method because a true experimental design where randomization is a must was not possible. Furthermore, the study only involve mechanical engineering students. In light of this factor, the outcome of the current study may be seen as lacking in generalisability. However as explained earlier under the section on population and samples, there is

some evidence to indicate that the samples are representative of the immediate target population which is mechanical engineering students in Malaysian polytechnics.

Even if generalisability to general engineering population cannot be assured, within the context of this study, the data appear to support the following conclusions; (i) giving students positive verbal input improve their cognitive performance and (ii) academic self-confidence is the mediating variable between positive verbal input and cognitive performance. This finding indicates that students' academic self-confidence can be easily influenced by verbal persuasion which in turn affects students' cognitive performance. This finding has implications on the management of assessments in particular and in teaching and learning in general. In the future, some positive verbal persuasion could be introduced at the beginning of a test or examination to boost cognitive performance of engineering students. Such an act may very well lead to an above average outcome instead of a simple pass for the mediocre performers and who knows may avoid potential failures. For teaching and learning, if the ability of positive verbal persuasion to enhance academic self-confidence which in turn enhance cognitive performance during assessment is accepted, there is no reason why positive verbal persuasion cannot enhance academic self-confidence and cognitive performance during the learning process. Therefore, the power of positive verbal persuasion should be underestimated and should be encouraged as an tool in enhancing academic self-confidence and cognitive performance of engineering students.

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Acknowledgements

The authors would like to thank the Ministry of Higher Education Malaysia for supporting this research under the Fundamental Research Grant Scheme (FRGS).

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