

# **An investigation of the critical factors that foster engineering students' creative thinking, self-efficacy, academic motivation, social support and academic achievement**

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**ABSTRACT:** This study aims to investigate the critical factors of creative thinking, self-efficacy, academic motivation, social support and academic achievement, which influence the learning outcomes of college students. A questionnaire survey was employed to identify the perspectives of 149 engineering college students. The survey used a validated instrument, which included 59 question items adapted from four validated instruments: college self-efficacy inventory, creative thinking scale, multidimensional scale of perceived social support and academic motivation scale. A series of statistical analyses generated some crucial findings: 1) there were significant and positive relationships among these variables; 2) the academic achievement of students was accumulatively developed through continuous and interactive processes of its influential factors; and 3) the external performance of students was found to be mutually affected through reciprocal, hierarchical and moderated effects rather than any single-factor effect. In the light of these findings, the authors discuss the implications, conclusions and recommendations for colleges, university policy-makers and educational policy makers.

## **INTRODUCTION**

University is a crucial place for college students to develop their knowledge and skills, such as creative thinking, decision making, finding solutions, and to understand how self-learning strengthens them as they enter their future employment careers and helps them to become successful [1]. Previous studies indicate that students' learning achievement was closely related to intrapersonal factors, such as academic motivation, self-efficacy and social support [2]. Learning comes through experiences, producing relatively permanent changes in understanding, attitude, knowledge, information, ability and skill [3]. A successful employee should have good soft skills, such as leadership skills, team work, creative and critical thinking, and wisdom in solving problems [4].

Creative thinking is essential for generating original ideas and for performing jobs better in the future. Many industries outperform their competitors in the workplace through their creativity and innovation [5]. Additionally, creative achievements are fundamental to progress in the generation of high-quality, original and elegant solutions to complex or novel problems [6]. Creativity also plays a key role in invention, innovation, problem-solving and improvement in the value of people [7]. Furthermore, self-efficacy is an essential factor of predicting academic outcomes, such as achievement, effort and attainment [8]. Students who have better developed personality, achievement motivation and academic self-efficacy show higher career aspiration [9]. Similarly, students who have high self-efficacy tend to have good academic outcomes, be self-motivated, perform self-learning and manage their goal progression [10].

On the other hand, academic motivation contributes to academic achievement, as well as inspiring students to persist more in their studies and reducing the extent of student dropout from the school [11]. More specifically, the self-motivation of students has become a critical factor in achieving academic success [12]. In other words, academic achievement can be developed by increasing the academic motivation of students [13]. Furthermore, motives, expectations and preparedness are some of the factors that also affect students' academic performance, as well as learning achievement [14].

## **LITERATURE REVIEW**

Social support refers to the experience of being valued, respected, cared about and loved by others who are present in one's life [15]. Social support provided by others includes appraisal of various situations, effective coping strategies and emotional support.

Previous studies suggested that an increase in social support may lead to a decrease in psychological problems among students [2]. They added that knowledge and understanding in this area could help educators, counsellors and psychologists to design and develop proper intervention programmes to reduce psychological problems among students.

Information and ideas gained from this research could help them face, manage and handle psychological problems. Therefore, enhancing knowledge and strategies in controlling psychological problems among students may help to increase their academic achievement.

Student achievements are becoming the professional-educational concern goals in every period of study. Achievement is the competence of a person in relation to a domain of knowledge preferred in the educational or psychometrics fields. This is sometimes characterised by the degree of implication required on the part of the student to give a response, and by the type of reference to a cognitive process made explicit in the measurement tool [16]. Several variables play important roles in increasing the achievement of students, including parents' education, marks in graduation, daily cafeteria hours, participation in co-curricular activities, daily study hours, punctuality, solving genuine problems, innovative thinking, equality and equity, and motivation by parents [17].

Motivation is recognised as a complex concept connected to self-respect, self-efficacy, internal control, external control and goal orientation [18]. There are four types of motivation: extrinsic regulation, introjected regulation, identified regulation and intrinsic regulation [19]. Competence is another basic need that supports intrinsic motivation. The need for competence is satisfied when individuals feel that they are developing skills and mastering the activities they are performing [20]. In addition, environments provide support for competence and autonomy fostering intrinsic motivation. With regard to social support, family members, especially parents, play an important role in giving support to the learning activities of students. In order to internalise values, objectives and desires that their parents appreciate, children need to be prepared through autonomous support, structure and engagement from their parents [21]. One of the most important motivational beliefs for student achievement is self-efficacy, which concerns beliefs about their ability to perform a task or an activity.

Self-efficacy is an important factor in social cognitive theory and considerable research has been conducted in various fields in the past decade [22]. He described self-efficacy as *...the belief in one's capabilities to organise and execute the courses of action required to produce given attainments* [22]. Furthermore, research has shown that the link between self-efficacy and outcomes is strongest when the specificity of the efficacy assessment matches the criterion [23]. For this reason, self-efficacy has been operationalised and studied within a variety of domains. Recently, a new domain of self-efficacy beliefs has been proposed for the college student population, that of college self-efficacy or the confidence that students have in completing college-related tasks. Empirical research has demonstrated that self-efficacy is more predictive of academic performance than other cognitive variables; it can also predict later success and is an important cognitive mediator of competence and performance in cognitive processes [24].

Creativity is a matter of generating new ideas to form alternative solutions for the countless problems encountered in the workplace or in daily life [25]. Previous studies noted that creative thinking helps students to recognise the knowledge they are learning, and it can help learners with dialogue, persuasion and respect. It can also help them to accept opinions and link the intellectual variables with each other [26].

## RESEARCH OBJECTIVES

The aim of this study was to investigate the crucial factors influencing college students' learning achievement through some potential factors, such as creative thinking skills, self-efficacy, academic motivation, social support and academic achievement, which may create interactive effects in a real educational setting. There are two research questions in this study:

- Are there any correlations among creative thinking skills, self-efficacy, academic motivation, social support and academic achievement?
- How do creative thinking skills, self-efficacy, academic motivation and social support affect academic achievement?

## Research Methodology

### *Population and Sampling Procedures*

There are 1,460 college students in the Mechanical Engineering Department in Taiwan. Using Slovin's formula, the sample size for this study was 313 students. Students were randomly selected to participate in the survey as a sample according to a purposive sampling strategy: 165 questionnaires were returned by the participants after a two-week follow-up. Finally, this study took 149 responses with complete and valid information for further analysis.

### *Data Collection and Data Analysis*

This study employed a questionnaire to identify crucial factors influencing the learning achievement of college students from potential factors, such as creative thinking skills, self-efficacy, academic motivation, social support and academic achievement. In gathering the academic achievement data, grade point average (GPA) was included in the instruments, as well as the demographic information. College students who participated in the survey took approximately 15-20

minutes to complete the questionnaire. The data were analysed using SPSS 21 and an Amos software package. Descriptive analysis and structural equation modelling (SEM) among all of the variables were conducted.

### Research Instruments

Composite questionnaires were used to gather data due to their ability to collect data within a limited period of time. Fifty-nine items were adapted from four existing validated questionnaires, including college self-efficacy, creative thinking skills, perceived social support and academic motivation, these are: a) college self-efficacy inventory (CSEI). The CSEI uses 15 items, including course self-efficacy (7 items,  $\alpha$  0.89), roommate self-efficacy (4 items,  $\alpha$  0.82) and social self-efficacy (4 items,  $\alpha$  0.90); b) creative thinking scale (CTS).

The CTS contains 12 items to measure four dimensions, including fluency (3 items,  $\alpha$  0.60), flexibility (3 items,  $\alpha$  0.93), elaboration (3 items,  $\alpha$  0.78) and originality (3 items,  $\alpha$  0.88); c) multidimensional scale of perceived social support (MSPSS). The MSPSS comprises 12 items, each with three behavioural dimensions: family support (4 items,  $\alpha$  0.88), friend support (4 items,  $\alpha$  0.90) and significant other (4 items,  $\alpha$  0.61); and d) academic motivation scale (AMS). The AMS consists of 20 items to collect data related to students' motivation in their studies, including un-motivation (4 items,  $\alpha$  0.86), external regulation (4 items,  $\alpha$  0.83), introjected regulation (4 items,  $\alpha$  0.85), identified regulation (4 items,  $\alpha$  0.81) and intrinsic regulation (4 items,  $\alpha$  0.87).

### Research Finding

#### Descriptive Statistics

Table 1 shows minimum, maximum, mean, standard deviation (SD), Z-Skewness, and Z-Kurtosis of college students' perceptions of intrapersonal factors influencing their learning achievement. As the results in the table show, the mean (84.37, 56.77, 39.16 and 47.91) and SD for academic motivation show higher scores than results for self-efficacy, creative thinking and social support variables (9.68, 6.89, 7.45 and 5.75, respectively).

Table 1: Descriptive statistics (N = 149).

| Variables                | Min.  | Max.   | Mean  | SD   | Z-Skewness | Z-Kurtosis |
|--------------------------|-------|--------|-------|------|------------|------------|
| Academic motivation      | 45.00 | 100.00 | 84.37 | 9.68 | -4.28      | 2.91       |
| College self-efficacy    | 38.00 | 71.00  | 56.77 | 6.89 | -0.74      | -0.18      |
| Creative thinking        | 19.00 | 60.00  | 39.16 | 7.45 | -0.31      | 0.08       |
| Perceived social support | 25.00 | 60.00  | 47.91 | 5.75 | -2.96      | 2.92       |

#### Correlations among Variables

The results of Pearson's product-moment correlation coefficient indicate significant positive correlations among the variables (Table 2). Additionally, there are high correlations between creative thinking and self-efficacy (0.539\*\*); academic motivation and self-efficacy (0.358\*\*); social support and self-efficacy (0.222\*\*); academic achievement and self-efficacy (0.278\*\*); creative thinking and academic motivation (0.215\*\*); creative thinking and social support (0.185\*); creative thinking and academic achievement (0.225\*\*); academic motivation and social support (0.399\*\*); academic motivation and academic achievement (0.169\*). In contrast, there is an insignificant correlation between academic achievement and social support (0.044).

Table 2: Results of correlations among variables.

| Constructs              | Self-efficacy | Creative thinking | Academic motivation | Social support | Academic achievement |
|-------------------------|---------------|-------------------|---------------------|----------------|----------------------|
| 1. Self-efficacy        | 1             |                   |                     |                |                      |
| 2. Creative thinking    | 0.539**       | 1                 |                     |                |                      |
| 3. Academic motivation  | 0.358**       | 0.215**           | 1                   |                |                      |
| 4. Social support       | 0.222**       | 0.185*            | 0.399**             | 1              |                      |
| 5. Academic achievement | 0.278**       | 0.225**           | 0.169*              | 0.044          | 1                    |

#### Structural Equation Model

One of the more important aspects in structural equation model (SEM) is modelling the relationship among variables. In this study, one step modelling was conducted to measure SEM. The latent constructs in the present study included self-efficacy, creative thinking skills, social support, academic motivation and academic achievement. The output of the model utilised (Figure 2) shows that the fit model fitness output is appropriate according to the criteria. According to critical fit index: relative Chi-square (CMIN/DF) = 0.199 (< 5.0); goodness fit index (GFI) = 0.999 (0.8-1);

and RMSEA = 0.000 (0.01 -0.08). Thus, this measurement, which is based on the framework model, is the best model and satisfies the data (Table 3).

Table 3: Output results of hypothesised model fitness.

| Indices       | Model fitness            | Criteria                       | Suggestion    |
|---------------|--------------------------|--------------------------------|---------------|
| Chi-square    | 0.397<br>( $p = 0.000$ ) | $p > 0.001$ ;<br>H0 = rejected | H0 = rejected |
| Chi-square/df | 0.199                    | < 5                            | Accepted      |
| GFI           | 0.999                    | 0.8-1                          | Accepted      |
| RMSEA         | 0.000                    | < 0.08                         | Accepted      |

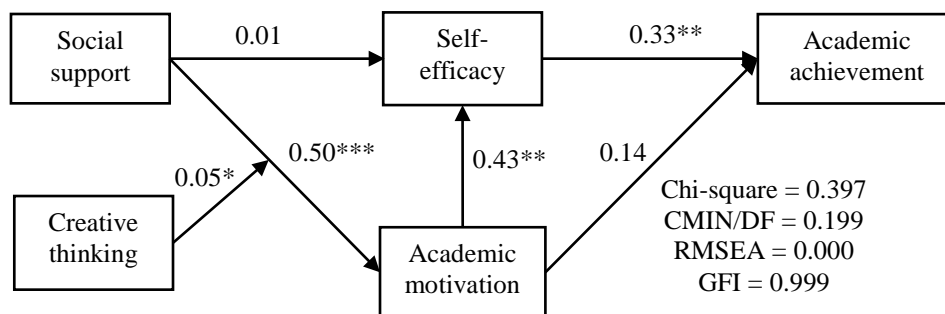


Figure 1: Model fit from the SEM output.

## DISCUSSION, CONCLUSIONS AND SUGGESTIONS

The results of Pearson’s product-moment correlation coefficient address the second research questions. As presented in Table 2, this study indicates that there are significant positive correlations between variables. It is clear that there are inter-correlations among each variable.

When students are supported significantly, their creative thinking, academic motivation, self-efficacy and academic achievement all increase, and *vice-versa*. In other words, it can be said that changing any variable value will affect the other variables. This condition excludes the variables of academic achievement and social support as there is an insignificant correlation between them. The systematic changes in the value of social support do not directly change the students’ academic achievement.

The fixed model fit outputs of SEM on Figure 1 and in Table 3 are adequate for answering the question. The results from the fixed model indicate that: 1) social support had a significant positive effect on academic motivation (path coefficients 0.50,  $p < 0.001$ ) within the moderation factor of creative thinking. Nevertheless, there is an insignificant effect of students’ self-efficacy (path coefficients 0.01,  $p > 0.05$ ); 2) the academic motivation accordingly drives the students’ self-efficacy significantly (path coefficients 0.43,  $p < 0.001$ ) and is indirectly related to academic achievement (path coefficients 0.14,  $p > 0.05$ ); and 3) students’ higher self-efficacy significantly affects academic achievement (path coefficient 0.33,  $p < 0.01$ ). These findings confirm that there are well-built interlocking relationships among the five variables, even though each construct has its own specific function.

This study concludes that support from family or friends has a direct effect on students’ self-efficacy. In addition, increased support will increase students’ motivation to study. On the other hand, creative thinking strengthens the positive relationship between social support and academic motivation; there are differences between students who have high creative thinking and those with low creative thinking, which strengthens the positive relationship between social support and academic motivation. The proactive mechanism of students’ self-efficacy is proved to be the essential mediating factor of academic motivation in initiating academic achievement. In other words, motivation does not directly increase students’ GPA, but self-efficacy improves their academic achievement.

Finally, taking the major findings into consideration, this study proposes the following suggestions for the improvement of the learning achievement of college students:

1. University policy makers should add formal social programmes to the curriculum, such as extracurricular activities. Not only do these programmes grow social support networks among the college students, but they also increase their academic motivation and self-efficacy.
2. University members should encourage parents to provide positive support to their children as they study in order to enhance their academic achievement. When college students have the opportunity to talk about their daily life problems to their family, they can manage their psychology in order to motivate themselves and find ways of solving problems/tasks to gain better academic achievements.

3. College students should force themselves to participate in social activities in order to promote their creativity and other soft skills. Moreover, by participating in social activities, college students gain more friends with whom to socialise, which affords them support from their peers and better academic achievements.

## REFERENCES

1. Mitchell, G.W., Skinner, L.B. and White, B.J., Essential soft skills for success in the twenty-first century workforce as perceived by business educators. *Delta Pi Epsilon J.*, 52, 1, 43-53 (2010).
2. Dzulkifli, M.A. and Yasin, A.S., The effect of social support and psychological problems on students' academic performance. *Proc. 2nd Inter. Conf. of Teaching and Learning* (2009).
3. Phye, G.D., *Handbook of Classroom Assessment: Learning, Achievement, and Adjustment*. USA: Academic Press (1997).
4. Che-Ani, A., Ismail, K., Ahmad, A., Ariffin, K. and Razak, M.Z.A., A new framework for Universiti Kebangsaan Malaysia soft skills course: implementation and challenges. *Inter. Educ. Studies*, 7, 8, 1-10 (2014).
5. Tanner, D., Applying creative thinking techniques to everyday problems. *The J. of Consumer Marketing.*, 9, 4, 23 (1992).
6. Mumford, M.D., Medeiros, K.E. and Partlow, P.J., Creative thinking: processes, strategies, and knowledge. *The J. of Creative Behavior*, 46, 1, 30-47 (2012).
7. Allen, K.R., *New Venture Creation*. (6th Edn), Mason: South Western Cengage Learning (2012).
8. Jansen, M., Scherer, R. and Schroeders, U., Students' self-concept and self-efficacy in the sciences: differential relations to antecedents and educational outcomes. *Contemporary Educational Psychology*, 41, 13-24 (2015).
9. Kim, M. and Yun, S., A study on the nursing student with academic self-efficacy, motivation and career aspiration. *Indian J. of Science and Technol.*, 8, 226-230 (2015).
10. Khanekheshi, A. and Farahnaz Azizi, T.A., Social comparison of self-efficacy and self-regulation between the student with school refusal behavior (SRB) and the students without (SRB), and the relationships of these variables to academic performance. *I-Manager's J. on Educational Psychology*, 6, 3, 9-16 (2013).
11. Soom, C.V. and Donche, V., Profiling first-year students in STEM programs based on autonomous motivation and academic self-concept and relationship with academic achievement. *PLoS One*, 9, 11 (2014).
12. Ekpe, I., Adelaiye, M.O., Adubasim, E.I. and Adim, V.C., The moderating effect of self-motivation on the relationship between parents' socio-economic background and children's academic performance at Nigerian universities. *Asian Social Science*, 10, 21, 73-79 (2014).
13. Tiwari, V., Tiwari, P.S.N. and Sharma, K., Academic motivation and school performance among students. *Indian J. of Health and Wellbeing*, 5, 4, 437-441 (2014).
14. Byrne, M., Flood, B., Hassall, T., Joyce, J., Montañó, J., González, J. and Tourná-Germanou, E., Motivations, expectations and preparedness for higher education: a study of accounting students in Ireland, the UK, Spain and Greece. *Accounting Forum*, 36, 2, 134-144 (2012).
15. Gurung, R.A.R., *Health Psychology: A Cultural Approach*. Belmont CA: Thomson Wadsworth (2006).
16. Algarabel, A. and Dasí, C., The definition of achievement and the construction of tests for its measurement: a review of the main trends. *Psicológica*, 22, 43-66 (2001).
17. Ahmad, M.R., Pervaiz, M.K. and Aleem, M., Factors affecting the students' academic performance. *J. of Educational Research*, 13, 1, 252-262 (2010).
18. Harlen, W. and Crick, R.D., Testing and motivation for learning. *Assessment in Educ.*, 10, 2, 169-207 (2003).
19. Maulana, R., Opdenakker, M., Stroet, K. and Bosker, R., Changes in teachers' involvement versus rejection and links with academic motivation during the first year of secondary education: a multilevel growth curve analysis. *J. of Youth and Adolescence*, 42, 9, 1348-71 (2013).
20. Levesque, C., Copeland, K.J., Pattie, M.D. and Deci, E.L., *Intrinsic and Extrinsic Motivation*. In: Peterson, P., Baker, E. and McGaw, B. (Eds), *International Encyclopedia of Education*. (3rd Edn), Oxford: Elsevier, 6, 618-623 (2010).
21. Grolnick, W.S., Deci, E.L. and Ryan, R.M., *Internalization within the Family: the Self-determination Theory Perspective*. Canada: John Wiley & Sons (1997).
22. Bandura, A., Self-efficacy: toward a unifying theory of behavior change. *Psychological Review*, 84, 191-215 (1977).
23. Barry, C.L. and Finney, S.J., Can we feel confident in how we measure college confidence? A psychometric investigation of the college self-efficacy inventory. *Measurement and Evaluation in Counseling and Develop.*, 42, 3, 197-222 (2009).
24. Rangel, Y.S., Humberto Blanco, H., Blanco, J.R., Lopez-Walle, J., González, M.A. and Mendoza, G., Academic self-efficacy in first year students' college of health sciences. *Educ. J.*, 3, 3, 153-158 (2014).
25. Lau, J.Y.F., *An Introduction to Critical Thinking and Creativity: Think More, Think Better*. Hoboken: New Jersey, John Wiley & Sons, Inc. (2011).
26. Sdouh, W.M., The effect of using the strategies of brainstorming and computer education in academic achievement and the development of creative thinking skills of sixth grade students in Jordan and their attitudes towards learning mathematics. *European Scientific J.*, 9, 13 (2013).