

Factors Affecting Project Based Learning Intention of Engineering Students



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Abstract

The factors affecting the project-based learning intention (PjBLI) of engineering students have been studied using theory of planned behaviour (TPB). Descriptive study was carried out utilising quantitative technique. Primary data were collected through cross sectional survey, utilizing seven point Likert scaled questionnaire. The respondents were final year students of Nepal Engineering College. Statistical tool (SPSS) was used for analysis. The result shows that the levels of both the PjBLI and the attitude of students (ATTI) towards project-based learning (PjBL) are high followed by the level of perceived behavioural control (BC). However, the level of subjective norm (SN) is relatively lower. There are no significant differences in PjBLI, ATTI, SN and BC among students from different departments. However the BC (perception of self efficacy or capability) of female students is higher than that of male students. Regression analysis shows that 42.2 and 19.3 percentages of PjBLI are affected by SN and ATTI respectively. The study concludes that additional effort is essential to improve SN (support from project supervisor, department and colleague) which in turn helps to improve PjBLI of students and their performance.

Keywords— *project-based learning, intention, attitude, regression, academic performance*

I. Introduction

In a study, Shakya (2011) found 21 percent of engineering graduates in Nepal unemployed while 77 percent unsatisfied with their job due to low pay and poor working environment [10]. Hands on experience and exposure to real work environment are essential qualifications for engineering students to become competent for getting jobs once they enter into job market. Project-based learning (PjBL), in one way or the other, helps students getting hands on experience while they execute project work. Therefore, the PjBL contributes to address unemployment problem for engineers. The PjBL initiated with collaboration between education and industrial sectors will provide greater exposure to real work environment and hands on experience. Such initiative motivates students towards (PjBL) and improves their overall performance. Thus PjBL not only improves students' overall performance but also helps them to become competent in the job market.

The scope of study is confined to the Nepal Engineering College as it is the first not-for-profit social academic institute, and the largest engineering college affiliated to the Pokhara University. The students enrolled at this college are from diversified cultures and geographical locations; and therefore, they are considered representative samples of bachelor level students in Nepal.

Project based learning approach (PjBL) has been adopted in Nepal Engineering College and projects are assigned to the final year students as a credit course in addition to small projects assigned during each semester. The effectiveness of the PjBL depends upon the intention and attitude of students towards the PjBL. According to theory of planned behaviour behavioural intention is affected by three factors namely attitude towards the behaviour, subjective norms and perceived behavioural control [4]. The study on the effectiveness of the present project based learning approach is important to identify the need for any modifications of existing approach. In this context, this study has analysed the factors affecting the project-based learning intention (PjBLI) utilizing theory of planned behaviour (TPB).

The prevalent tendency of engineering students giving less time to the project work can be attributed either to the compact curriculum for which they have to give more time for other subjects or to their poor attitude and intention towards the project work. According to Karaman and Celik (2008) and ChanLin (2008) the learners in project-based learning (PjBL) perform better in skill development, general ability and knowledge compilation than those who do not use project-based learning [11][8]. These findings indicate the importance of PjBL for student to improve their skill, knowledge and the overall performance. The tendency of students giving less time for project work, if not investigated and corrected on time may lead to continuous poor performance of students in terms of knowledge and skill development. This is the educational issue which need immediate attention. In the context of this problem following research questions are raised.

- To what extent students' attitude (ATTI), subjective norm (SN) and perceived behavioural control (BC) affect their project-based learning intention (PjBLI).

- How PjBLI, ATTI, SN and BC differ between students from two different departments.
- How PjBL, ATTI, SN and BC differ between the male and female students

II. Literature review

Project-based learning (PjBL) improves students' positive learning attitude towards technology (Mioduser and Betzer, 2007; Tseng, Chang, Lou and Chen, 2011)[2][6]. According to Thomas (2000), the PjBL is an active learning practice in which students acquire necessary knowledge while resolving problems that appear in the project; whereas traditional passive learners only receive second hand knowledge [5]. However the effectiveness of PjBL, according to Thomas (2000), depends upon the materials of PjBL, the extent to which the project is relevant to the level of the learners, the complexity of the project, provision of appropriate support, the learners' prior knowledge and teamwork skills [5]. These literatures show that PjBL is affected by attitude of the learners, support they get, teamwork and their perception about their self efficacy or capability for performing the project. The theory of planned behaviour (TPB) has been successfully utilized in the studies (Linan & Chen, 2006, McStay, 2008) similar to the present study to describe the factors affecting human intention and behaviour [3][1].

According to the theory of planned behaviour (Ajzen, 2015), human behaviour is guided by three kinds of considerations: beliefs about the likely consequences or other attributes of the behaviour (behavioural beliefs), beliefs about the normative expectations of other people (normative beliefs), and beliefs about the presence of factors that may further or hinder performance of the behaviour (control beliefs) [4]. In their respective aggregates, behavioural beliefs produce a favourable or unfavourable attitude toward the behaviour; normative beliefs result in perceived social pressure or subjective norm; and control beliefs give rise to perceived behavioural control, the perceived ease or difficulty of performing the behaviour. In combination, attitude toward the behaviour, subjective norm, and perception of behavioural control lead to the formation of a behavioural intention. The model representing the theory of planned behaviour is presented in figure 1.

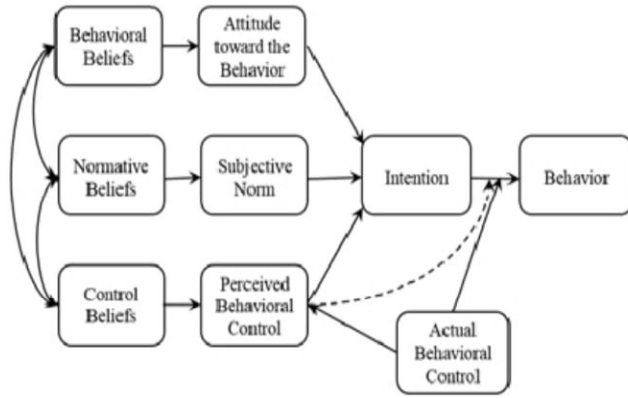


Fig. 1 A model showing theory of planned behaviour (Ajzen, 2015)

In the present study the PjBLI represents students’ project-based learning intention which is considered as dependent variable. Students’ attitude towards project-based learning practice is represented by ATTI, The aggregate of the support from department, supervising teachers and colleague is represented by SN, and the perception of students about their self efficacy or capability to perform the project is represented by BC. The variables ATTI, SN and BC are considered as independent variables. The theoretical framework for the present study is presented in figure 2 and the definition of dependent and independent variable is presented in the table I

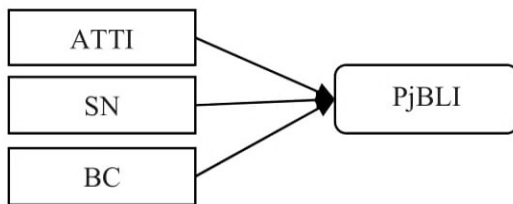


Fig. 2 A model showing theoretical framework

TABLE I
Definition of variables

Variables	TPB Model	Model for Present Study
Dependent	Intention	PjBLI
Independent	Attitude towards the behaviour	ATTI
	Subjective Norm	SN
	Perceive Behavioural Control	BC

In a study, Tseng et al. (2011) analysed the effectiveness of the PjBL in the four different subjects named as science, technology, engineering and mathematics; and found the PjBL most effective in case of engineering subject followed by science and then technology while mathematics being least affected [6]. This finding suggests that the effectiveness of PjBL differs with the type of subjects or courses in which it is applied. Therefore, a hypothesis is drawn and the null hypothesis is set as:

Null hypothesis (H1): There is no significant difference between students from two departments in terms of their intention (PjBLI), attitude (ATTI), support (SN) and perceived self-efficacy (BC).

In another study conducted to find the effectiveness of PjBL applied to mathematics for high school students in South Australia, Rajkin (2017) found differential effectiveness of PjBL for males and females with female preferring traditional method over PjBL and males finding PjBL enjoyable and beneficial [9]. This finding suggests that the effectiveness of PjBL differs between male and female students. Therefore, another hypothesis is set as:

Null hypothesis (H2): There is no significant difference between male and female students in terms of intention (PjBLI), attitude (ATTI), support (SN) and perceived self-efficacy (BC).

III. Methodology

A. Research Design

The field-based survey research, cross sectional in nature is selected for this study. The data was collected through sample survey at one point in time utilizing questionnaire. The respondents are the final year students studying in Nepal Engineering College. The data are numeric and they can be statistically operated. Therefore, quantitative research design is utilized for this study which quantifies and generalizes results from the sample to population.

The questionnaires designed for seven point Likert scale are utilized to obtain responses from respondents to examine the factors that affect students’ project-based learning intention (PjBLI). The tested questions,

used for similar kind of studies, are modified and contextualized. The questionnaires can be found online at <https://bit.ly/2OJoLli>.

B. Data Collection

The samples were randomly selected from each department. The final year students are selected as the respondents because they are assigned with the whole day project work during their final year study.

Ten sets for questionnaire were provided in paper for each department and students are also asked to respond through Google-form. The responding students are randomly selected randomizing their college roll numbers. Only 72 students responded within the time frame. Since there are a minimum of three questions for data collection for each construct (variable), the effective sample size becomes 216.

There were 400 hundred final year students at the time of survey, and the number is the sampling frame for this study. The minimum required sample is calculated using formula (1) suggested by Yamane (1973), and found to be 80 with 10% error.

$$n = \frac{N}{1+N(e)^2} \tag{1}$$

where :

N = sampling frame = 400

e = allowable error = 0.1

The number of sample 216 is well above the minimum required number 80, and therefore the samples are sufficient for this study.

C. Reliability and Validity

Reliability is ensured through Cronbach’s alpha assessment of internal consistency of the questionnaire used for measurement of each construct. The alpha values are found as 0.75, 0.73, 0.6 and 0.6 for the construct SN, ATTI, PjBLI and BC respectively. The alpha value above 0.6 is sufficient to ensure internal consistency of indicators used to measure human behaviour (Cohen et al., 2007)[7].

According to Cohen et al. (2007), validity is a matter of degree of an instrument that in fact measure what it seeks to measure[7]. The questionnaire had been used successfully in similar kind of previous

studies (Linan and Chen, 2006; McStay, 2008) to measure human intention and behaviour [3][1]. Those questionnaires are adapted and contextualized for this study to ensure validity.

D. Analysis

Normality of data distribution is ensured through skewness and kurtosis of the data distribution. The data distribution having both skewness and kurtosis within the range from -2 to +2 is considered normal enough for performing parametric tests. The table II shows that values are within the range for all data distribution: PjBLI, ATTI, SN and BC. Therefore the parametric tests including t-test and multiple regressions are used for data analysis. The figure 3 shows histogram showing normality of data distribution of the variable BC.

TABLE II
Measure of Normality of data distribution

	PjBLI	ATTI	SN	BC
Skewness	-1.098	-1.222	-1.135	-.930
Kurtosis	.716	.862	1.403	.249

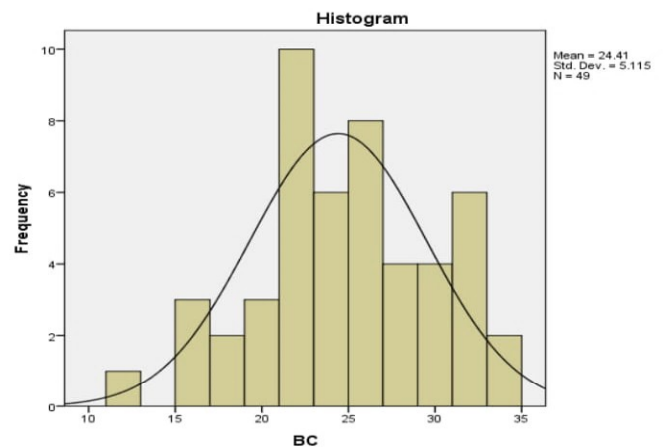


Fig. 3. A histogram showing normality of data distribution

When two questions or scales used to measure the same construct are highly correlated then the question becomes redundant. Collinearity of the scales used for this study is checked using SPSS statistical tool. The variance inflation factor (VIF) for each case is found to be less than 2. The VIF less than 3 is considered sufficient to ensure that the scales are not collinear.

Independent sample t-test is used to test the hypotheses at 95 percent confidence level, and multiple regression analysis is carried out to test the effect of

independent variable (IV) on dependent variable. The equation 2 shows the regression equation utilised for this study.

$$PjBli = \text{Constant} + B1(ATTI) + B2(SN) + B3(BC) \quad (2)$$

where,

B1, B2 and B3 are beta coefficients

PjBli is the project based learning intention,

ATTI is the attitude towards PjBL,

SN is the subjective norm, and

BC is the perceived behavioural control

E. Ethical Consideration

This study has considered all ethical components (Cohen et al., 2007) right from the beginning data collection procedure to the preparation of final report [7]. Due consideration was given for avoiding offensive, discriminatory or other unacceptable words and language in questionnaires which may harm the dignity of respondent. The responses they provide are used only for the purpose of study. Confidentiality, respondents' right to privacy, personal matter or sensitivity of information is preserved in many ways; for example, the respondents' responses are coded and the statistical results are drawn from the total sample. Not, a single student is brought under a separate analysis.

In the process of data analysis, the statistical techniques that were used by the previous researchers and validated by statisticians are utilised. Acknowledgement of works of other authors used in this dissertation, the honesty in data processing, use of references materials, are also considered for this research.

IV. Results

The descriptive statistics shows that the level of the attitude (ATTI) of the students towards the project-based learning (PjBL) is the highest (94.1%) followed by the level (93.7%) of PjPLI intention. However, the level of SN is the lowest (77.6%). These figures indicate that the students have high level of readiness and high positive attitude towards project-based learning approach. The percentage scores are presented

in the table III.

TABLE III
Level of Variables in Percentage

Variables	Score Percentage	Std. Deviation
PjBli	93.7	1.491
ATTI	94.1	1.548
SN	77.6	6.058
BC	82.3	2.541

Independent sample t-test shows that there is no significant difference between students from any two different departments in terms of their PjBli, ATTI, SN and BC. The result of the independent sample t-test at 95 % confidence level between the students from the architecture and electrical department is presented in the table IV. The t-test results show that the p-values are 0.475, 0.451, 0.689 and 0.384 for the data distribution of the variables PjBli, ATTI, SN and BC respectively. The p-value for each of the data distribution is greater than 0.05. The t-test was repeated between architecture and each one of other departments. The p-value in each case is found to be greater than 0.05. Therefore, null hypothesis is accepted; which mean that there is no significant difference between students from any two departments in terms of PjBli, ATTI, SN and BC. In another word, students' intention and attitude towards PjBL are similar in all departments; and there are no significant differences between the students from any two departments in terms of the level of support they get and their perception about their capability for performing the project work.

The result differs with the result of the previous study (Tseng, 2013) in which the effectiveness of PjBL differs among four subjects named as science, technology, engineering and mathematics (STEM) [6]. The difference can be attributed to the fact that the respondents in the present study are all engineering students though they are from different departments. However, Tseng (2013) analysed the effectiveness of PjBL applied to four different subjects named as STEM for the same group of students [6].

TABLE IV

Independent sample t-test between sample students from electrical and architecture departments

Variables		Levene's Test for Equality of Variance		t- Test for Equality of Means
		F	Sig.	Sig. (2-tailed)
PjBLI	Equal variances not assumed	.000	.994	.475
ATTI	Equal variances assumed	2.816	.105	.451
SN	Equal variances assumed	17.914	.000	.689
BC	Equal variances assumed	2.216	.148	.384

Another independent sample t-test shows that there is no significant difference between male and female students in terms of PjBLI, ATTI, and SN. However, they are significantly different in terms of BC. In another words female student's perception about their capability is better than that of the male students though their intention and attitude towards the PjBL are similar. The results are presented in the table V. The p-value in case of data distribution of variable SN is below 0.05. Therefore the null hypothesis is rejected and alternate hypothesis is accepted which means that there is significant difference between male and female students in terms of BC.

The descriptive statistic shows that the mean score of female students in terms of BC is higher than that of male students, which means they perceive their capability higher than that of their male colleague. However, the p-value for each of the data distribution of variable PjBLI, ATTI and SN is greater than 0.05. Therefore, null hypothesis is accepted for each of those data distribution, which means that there is no significant difference between male and female students in terms of PjBLI, ATTI and SN.

TABLE V

Independent sample t-test between male and female students

Variables		Levene's Test for Equality of Variances		t-test for Equality of Means
		F	Sig.	Sig. (2-tailed)
PjBLI	Equal variances assumed	.079	.781	.708
ATTI	Equal variances assumed	1.142	.291	.653
SN	Equal variances assumed	2.403	.128	.459
BC	Equal variances assumed	3.296	.076	.028

The cause and effect relationship between the dependent variable (PjBLI) and the three independent variables (ATTI, SN and BC) is obtained utilizing multiple regression analysis. The regression equation is presented as equation (3). The beta coefficients for the equation are presented in the table VI.

$$PjBLI = 12.65 + 0.195 ATT + 0.422 SN - 0.003 BC \quad (3)$$

where,

PjBLI is the project based learning intention,

ATT is the attitude towards PjBL,

SN is the subjective norm, and

BC is the perceived behavioural control

TABLE VI

Beta coefficients of multiple regression equation

Model	Constant/ Variables	Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1	(Constant)	12.650	3.024	
	ATTI	0.186	0.129	0.193
	SN	0.104	0.033	0.422
	BC	-0.002	0.080	-0.003
Dependent Variable: PjBLI				

The equation (3) shows that any one unit of variation in SN will cause 42.2 percent variation in PjBLI when other variables are kept constant. Similarly, the effect of ATT on PjBLI is 19.5 percent. However, the effect of BC on PjBLI is negligibly low. This results indicate the effect of SN on PjBLI is the highest followed by that of ATT. In another words any small additional support in terms of equipment and facilities from the concerned department, proactive inquiry from project supervisor, and active involvement of project group members together will significantly improve the PjBL intention of students. Additional support (SN) from department, teachers and friends also increase the positive attitude (ATT) of students. In that case, the aggregate affect of both SN and ATT on PjBLI will be even higher than the individual effect of SN.

V. Conclusions And Recommendation

The level of support from concerned department, supervising teachers and project partners or colleague together is measured by the variable called subjective norm (SN); and the students' attitude towards project based learning (PjBL) is measured by the variable called attitude (ATTI). One unit changes in the level of SN and ATTI affects 42.2 and 19.3 percent changes in the students' project-based learning intention (PjBLI). The SN also has indirect positive effect on ATTI; which mean that improvement in SN has multiplying positive effect on PjBLI. Therefore, the study concludes that any additional small effort to improve SN (support from project supervisor, department and colleague) significantly improves PjBLI of students and their performance.

The students in architecture department normally execute project work larger in numbers than the students do in other departments. The independent sample t-test shows that there is no significant difference between the students from architecture and electrical department in terms of PjBLI at 95 percent confidence level. With this finding, it is concluded that PjBLI is not affected by the number of project. In other words, increasing the number of project does not improve students' intention.

With the significant differences between male and female students in terms of behavioural control BC, the study concludes that female students perceive that they are more capable in performing the project in

comparison to the perception of male students about their capability or self-efficacy.

The result of a quantitative study is better interpreted when the result is compared and correlated with the interviews collected during a qualitative study. Human attitude and behaviour are better interpreted with mixed method research in which both quantitative and qualitative approaches are utilized. The author recommends for a qualitative study in future based on the present quantitative study in order to explain in depth why engineering students showing such intention and behaviour. Moreover, further research with respondents from all other engineering colleges is also recommended for generalizing the findings to a larger population.

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