A Study of the Effectiveness of The Contextual Lab Activity in the Teaching and Learning Engineering Statistics at the Universiti Tun Hussein Onn Malaysia (UTHM)

Zulkarnain Md Amin
zulkarn@uthm.edu.my

Nafisah Kamariah Md Kamaruddin
nafisah@uthm.edu.my

Universiti Tun Hussein Onn Malaysia (UTHM)

Abstract: *Inaccurate concept in statistics contributes to the assumption by the students that statistics do not relate to the real world and is not revelent to the engineering field. There are universities who introduced learning statistics using statistics lab activities. However the learning is more on the learning how to use software and not to enhance the knowledge in statistics. Thus this reasearch was done to test the effectiveness of the contextual lab activities in learning engineering statistics for the engineering students in UTHM. The objectives of this research is to identify the level of understanding, motivation, and acceptance between the students who had gone through the contextual lab activity and the non contextual lab activity based on the questionnaire. The quiz result was measured using the independent t-test. This research is done using the quasi-experiment. There were 265 civil, mechanical and electric students who were taking BSM 2922 Engineering Statistics for their 2nd semester session 2007/2008. The sample consisted of 155 students which were divided into two groups : 72 engineering degree students in the treated group and 83 engineering degree students in the control group. The treated group followed the contextual lab activity while the control group followed the non contextual lab activity. The findings showed that there is no significant difference between the level of understanding and motivation from both groups. However there is a significant difference for the acceptance level between both groups. The findings also show that there is a significant difference for the Postest mean score between the two groups. The treated group who had gone through the contextual lab activity scored higher than the non contextual . In conclusion, the contextual lab activity is able to help the engineering statistics students in their learning process.*

1. Introduction

The ultimate objective of the Malaysian Vision 2020 is that Malaysia will be a fully developed country by the year 2020 [12]. The sixth challenge in the Vision 2020 is "the challenge of establishing a scientific and progressive society, a society that is innovative and forward-looking, one that is not only a consumer of technology but also a contributor to the scientific and technological civilisation of the future". Since then a lot of methods of teaching and learning with the aid of technology have been introduced so that the students will not only to learn the theory or concept but also will be exposed to the technology. As for the Centre for Science Studies in the Universiti Tun Hussein Onn Malaysia (UTHM), the centre introduced mathematics and statistics computer lab in the process of teaching and learning mathematics and statistics. The reason was not to replace the lecture or tutorial but to enhance the knowledge in mathematics and statistics.

The challenge in mathematics education is finding the best way to teach mathematics. Mathematics is essentially a structured hierarchy of proposition forged by logic on a postulation base. However, nowadays the teaching of mathematics is more on focusing the mathematical

procedures [8]. In 1997, the Technical Education Department under the Ministry of Education, Malaysia, introduced the contextual concept in the teaching and learning mathematics and science subjects in all the Malaysian technical secondary schools. The Ministry got the idea from the Center for Occupational Research and Development in Waco, Texas, USA when the Malaysian education officers, technical lecturers and teachers attended courses at the centre [9]. Through the contextual concept, the students were able to understand abstract concepts through concrete experiences. Students prefer this method because usually they learn mathematics very mechanistic, which is, memorizing the formula and solving problems using the formula [7]. Not only the students are able to learn faster but the workplace and lab activities help students to develop critical thinking skills [10].

Inaccurate concept in statistics contributes to the assumption by the students that statistics do not relate to the real world and is not relevant to the engineering field. There are universities who introduced learning statistics using statistics lab activities; however the learning is more on the learning how to use software and not to enhance the knowledge in statistics. Due to this reason, the implementation of contextual concept is used in the statistics computer lab activities in UTHM. Researches had been done to compare the treated group of students who did the contextual lab activity with the control group who did not do any lab activity. However before this, there was no research comparing between students who use the contextual lab activity with the non-contextual lab activity. Thus this research was done to test the effectiveness of the contextual lab activity in learning statistics for the engineering students in UTHM. The objectives of this research were as follow:

1. To determine whether there is any statistical significant difference in the levels of understanding, motivation and acceptance between the contextual with the non-contextual groups.
2. To determine whether there is any statistical significant difference in the test results between the contextual with the non-contextual groups.

The conceptual framework of this research was adapted from [3]. The dependent variable of this study was the achievement test. The researchers investigated whether the use of the contextual concept in the lab activities influenced the students' achievement in the statistics test as compared to the use of the non-contextual concept in the lab activities. Both groups were taught by the same lecturer to eliminate the extraneous variable.

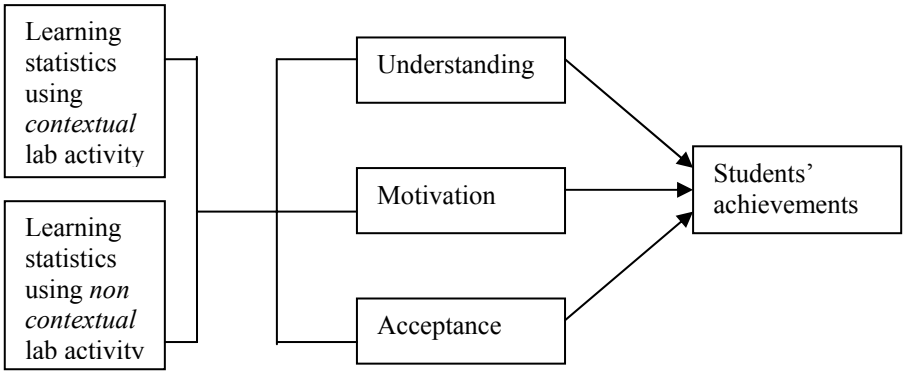

Figure 1.1 : Conceptual Framework

2. Literature Review

There are many definitions of the contextual learning. The definition that the Technical Education Department uses is the one that was given by the Center for Occupational Research and Development in [4].

> The Contextual learning means learning that incorporates examples which are drawn from everyday experiences in the personal, societal and occupational life and which provide concrete hands-on applications of material to be learned.

Contextual Approach was introduced for the students' technical and career preparation or Tech Prep by the Center for Occupational Research and Development, Texas, USA. Contextual approach is one of the Tech Prep elements According to Kolb's Experiential Learning Theory, the students learn best by thinking and doing [5]. In the contextual approach, the lab activities or mathematical experiments help students to study by this method. According to CORD, one of the key elements in the contextual approach is to carry out learning in workplace setting, where possible [4].

It will be great if the students can relate the formulas and theories that are taught in the classroom to their everyday lives or their future jobs. Is not easy to bring students to the real life atmosphere, let say a company. Thus if we cannot bring them to the companies, we need to simulate the workplace. In the lab practical, besides making them understand the concept, the students also work in environment or group projects that simulate the workplace. In the contextual approach, students engage in problem-solving investigation that integrate skills and concept from many content areas, students works autonomously to construct their own learning, and culminate in realistic products [2]. By using the lab activities or mathematical lab in the contextual approach, it helps them to understand the concept better as the concept of experiential learning explores the cyclical pattern of all learning from Experience through Reflection and Conceptualizing to Action and on further Experience [5]. In the first project by the Ohio State University College of Education and Bowling Green State University, the definition of contextual teaching and learning was developed as the conception of teaching and learning that helps teachers relate subject matter content to real world situations and motivates students to make connection between knowledge and its applications to their lives as family members, citizens, and workers; and engage in the hard work that learning requires [11].

3. Research Methods

This research focused on the contextual concept in the statistics lab activities for the second year degree engineering students from the Faculty of Civil, Electrical, Mechanical Engineering, UTHM. The population for this research was all the second year engineering degree students, which consisted of 6 classes, from the Faculty of Civil, Electrical, Mechanical Engineering, UTHM. One class from the Electrical Engineering Faculty and one class from the Mechanical Engineering Faculty was selected as the treated group while another one class from the Electrical Engineering Faculty and another one class from the Mechanical Engineering Faculty was selected as the control group. The treated group will use the contextual concept in the statistics lab activities while the control group will use the non-contextual concept in the statistics lab activities. The treated group had to get a real data by interviewng people before the group can analyzed the data while the control group use a set of data given to the group.

In this research, a quasi-experimental research design was used. The research instruments were the pre-test, questionnaires and post-test. The students were given a pre-test before they did the lab activities. After the lab activities, they were given the questionnaires and post-test. Researchers designed questionnaires which consisted of 4 main sections as given in Table 1. Likert scale was used as a form of measurement. Interview was also carried out to complement the quantitative study.

Table 1 *Four sections in the questionnaire*

Section	Category	Item No	Data Analysis Method
A	Background	1 – 4	Percentage
B	Understanding	1 – 10	Score mean and std dev
C	Motivation	1 – 10	Score mean and std dev
D	Acceptance	1 – 13	Score mean and std dev

Researchers analyzed data in section B, C and D through mean score. The mean score of the respondent for each section is interpreted by adapting from Landell and Jamian in [6] as shown in the Table 2.

Table 2 *The mean score of the respondent*

Mean Score Interval	Interpretation	Level
1.00 – 3.50	Do not agree	Low
3.51 – 3.60	Not totally agree	Moderate
3.61– 5.00	Agree	High

Before the questionnaires were given to the respondents, a pioneer test was done where ten degree students were randomly selected to answer the questionnaires. From the pioneer test, the *Alpha-Cronbach* value are shown Table 3:

Table 3 *Pioneer Test*

Section	Category	Items	Alpha-Cronbach
B	Understanding	10	0.649
C	Motivation	10	0.729
D	Acceptance	13	0.612

The values of Alpha-Cronbach are all greater than 0.6 and according [1] that mean the validity are high.

3. Results and Discussion

The respondents background is as in Table 4.

Table 4 *Respondents background*

Number of students Faculty	Treated Group	Control Group
Mechanical Engineering	39	48
Electrical Engineering	33	35
Total	72	83

The descriptive statistics and t-test for the pre-test is shown in Table 5 and 6.

Table 5 *Descriptive Statistics for pre-test*

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pre-test	treated	72	2.54	1.150	.136
	control	83	2.42	1.072	.118

Table 6 *t-test for pre-test*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre-test	Equal variances assumed	1.540	.217	.672	153	.503	.120	.179	-.233	.473

Since the sig. for the Levene's Test =.217> 0.05, the value of p was taken from the equal variances assumes row. Since p = .503 > 0.05, there is no significant difference between the two groups. Since there is no significant we assume the two groups had the same cognitive level.

In Section B, C and D, the researchers wanted to survey the students' perception towards their understanding, motivation and acceptance, respectively, from the statistics lab activities. The descriptive statistics and t-test for the questionnaire in section B is shown in Table 7 to 12.

Table 7 *Descriptive Statistics for Understanding*

	Group	N	Mean	Std. Deviation	Std. Error Mean	Interpretation	Level
Understanding	treated	10	3.62700	.241249	.076290	Agree	High
	control	10	3.65500	.196426	.062115	Agree	High

In Section B, there were ten items. The overall value of the mean score for the contextual group is 3.627 (σ = 0.241) which is high while the overall value of the mean score for the non-contextual group is 3.655 (σ = 0.196) which is also high.

Table 8 *t-test for Understanding*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Understanding	Equal variances assumed	.062	.806	-.285	18	.779	-.02800	.09838	-.23469	.17930

Since the sig. for the Levene's Test = .806> 0.05, the value of *p* was taken from the equal variances assumed row. Since *p* = .779 > 0.05, there is no significant difference between the two groups. The two groups had the same level understanding.

Table 9 *Descriptive Statistics for Motivation*

	Group	N	Mean	Std. Deviation	Std. Error Mean	Interpretation	Level
Motivation	treated	10	3.16600	.314226	.099367	Not Totally Agree	Moderate
	control	10	3.32500	.486558	.153863	Not Totally Agree	Moderate

In Section C, there were ten items. The overall value of the mean score for the contextual group is 3.166 (σ = 0.314) which is moderate while the overall value of the mean score for the non-contextual group is 3.325 (σ = 0.487) which is also moderate.

Table 10
t-test for Motivation

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Motivation	Equal variances assumed	3.469	.079	-.868	18	.397	-.159000	.183160	-.543805	.225805

Since the sig. for the Levene's Test = .079> 0.05, the value of *p* was taken from the equal variances assumed row. Since *p* = .397 > 0.05, there is no significant difference between the two groups. The two groups had the same level of motivation.

Table 11 *Descriptive Statistics for Acceptance*

	Group	N	Mean	Std. Deviation	Std. Error Mean	Interpretation	Level
Acceptance	treated	13	3.62000	.318205	.091858	Agree	High
	control	13	3.34357	.208238	.055654	Not Totally Agree	Moderate

In Section D, there were thirteen items. The overall value of the mean score for the contextual group is 3.620 (σ = 0.318) which is high while the overall value of the mean score for the non-contextual group is 3.345 (σ = 0.208) which is moderate.

Table 12 *t-test for Acceptance*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Acceptance	Equal variances assumed	.478	.496	2.658	24	.014	.276429	.104006	.06177	.49108

Since the sig. for the Levene's Test = .496> 0.05, the value of p was taken from the equal variances assumed row. Since p = .014 < 0.05, there is significant difference between the two groups. The treated group scored higher than the control group for acceptance. The two groups had the different level of acceptance. Lastly the result of the post-test is given in Table 13 and 14.

Table 13 *Descriptive Statistics for post-test*

	Group	N	Mean	Std. Deviation	Std. Error Mean
Post-test	treated	72	8.00	1.601	.189
	control	83	6.23	1.971	.216

Table 14 *t-test for post-test*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post-test	Equal variances not assumed	16.990	.000	6.169	152.369	.000	1.771	.287	1.204	2.338

Since the sig. for the Levene's Test = .000< 0.05, the value of p was taken from the equal variances not assumed row. Since p = .000 < 0.05, there is significant difference between the two groups. The treated group, which is the contextual group, did better than the non-contextual group.

5. Conclusion

In this research, from the students perception, both groups felt that the lab activity helped them to understand statistics concept and motivated them to learn statistics. However the contextual group scored higher than the control group for acceptance. From the observations of the activity and the interview with the students, both groups were more actively involved with the lab activity but few students from the non-contextual group commented that they prefer memorizing the formula and

then use in the exercises. In addition they felt the lab activity was a burden to them. The contextual group felt that they want more activities especially related to their engineering subjects. From the findings, the contextual group scored better in the test. This is because the method of teaching and learning using contextual concept, which use 'hands-on', and *'minds-on'* activities that related to the real world is able to attract the students' interests and stimulate them to learn statistics. In conclusion, the contextual lab activity is able to help the engineering statistics students in their learning process.

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