

Using Project Based Learning in Statistics Course to Develop the Statistical Literacy for College Students

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Abstract

Using project based learning in the course of Statistics for Career to develop the statistical literacy was conducted with the group of students from Pattani Vocational Education College and Pattani Fisheries and Agriculture Technological College who enrolled the course as a core subject in the first semester of academic year 2017. The course composed of theories with practices section and project section in the parallel form. The sample were twenty-three students from both colleges and evaluated by the task skills, the project performance, the final test, and the SATS-36. The findings revealed that after attending class, the attitudes towards statistics evaluated by SATS-36 was significantly higher than before learning, the mean of the statistical literacy for college students was also above 70 percent, and also showed with the eight projects such as the project of the donut/roti consumption satisfaction and study on taste satisfaction of Takoyaki of consumer in Pattani province.

Keywords: Teaching statistics, Statistical literacy, Attitudes towards statistics, Project based learning

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Introduction

Under Section 16 of the Vocational Education Act BE 2551, both the Vocational Training Institute and the Agricultural Vocational Institute are vocational and technological higher education institutions that promote academic and practical professional highly skilled, teaching, research, transfer academic and technology, and preserve religion, arts and culture, and the environment. As well as providing academic and professional services to the society, and under Section 42 of the Vocational Education Act BE 2551, such institutions have the power to offer undergraduate degrees in the subjects taught at the institution as continuing vocational diploma. (The Government Gazette, 1998). Nowadays, most undergraduates in Thailand are in the academic field, who are in dire need of the required industry graduates. The Office of Vocational Education Commission operating line to meet the domestic labor market. The first version of the course will be offered in 2013 and will have lower tuition fees than public and private universities. All degree programs will be taught in a bilateral manner. The establishment cooperated in the curriculum and send a lecturer to help teach and to accept students in the establishment. The curriculum requires students to work in the workplace for at least one year from a two-year course.

Bachelor's Degree Program in Technology of the vocational institute's curriculum is structured into a curriculum that includes a course in life skills, the professional skills and free choice in the life skills category, there are Statistics for Careers, which cover the content, the use of statistical methods for occupational research, data collection, analysis, synthesis and interpretation and including the use of statistical programs in occupations, so the management of the courses taught above to achieve statistical literacy to meet life-purpose curriculum objectives should be taken seriously, according to the definition of statistical literacy. There are many meanings such as Wallman (1993) defined that it is possible to understand and critically evaluate the statistical results that permeate our daily lives with coupling the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions. For Schield (1999), statistical literacy is the ability to read and interpret data: the ability to use statistics as evidence in arguments. In addition to literary literacy is a competency: the ability to think critically about statistics. Similarly Gal (2004) stated that statistical literacy is the ability to interpret, critically evaluate, and communicate about statistical information and messages. The teaching and learning to develop statistical literacies, as defined above, can be achieved by using statistical presentations, or critiques of statistical ideas or issues in the news. (Garfield & Chance, 2000; Gal, 2002). Alternatively, active learning and introducing activities where students are able to construct knowledge, collaborative group work with computers and data. (Garfield, 1993; Roseth, Garfield & Ben-Zvi, 2008).

Project based learning is the learning method that places students at the center of the learning process, the teacher leads the students to the learning that follows the project objectives. The project based learning process involves an in-depth learning process with systematic learning management to get useful and applicable results, to create motivation, and to reinforce necessary living skills (Moursund, 1999; Koparan &

Güven, 2014). Project based learning has more workflow and requires more time for operation. The learning process involves interaction and cooperation among learners, between learners and teachers. More importantly, when the teacher implements the project and the project is completed, the learners will feel proud of themselves. This generates motivation to learners to perform better projects in the future. In a project-based learning management classroom, students are divided into groups of different sizes. The project enables learners to deeply understand the ideology and standard of project-making. It can reinforce lifelong working skills and behavior. The project also provides the learners with an opportunity to solve community problems, or survey future careers. (Koparan & Güven, 2014)

Based on the concept and process of learning, the focus is on the use of project-based learning activities in the field of career statistics to develop intrinsic motivation, collaborative skills, flexible and effective problem solving skills, and ultimately self-directed learning leads to further statistical literacy for the students from Pattani Vocational Education College and Pattani Fisheries and Agriculture Technological College.

Methods

Participants

The target group were 11 students in food and nutrition of Pattani Vocational Education College and 12 students in aquaculture technology of Pattani Fisheries and Agriculture Technological College, who are registered students for the Statistics for Careers Semester 1, academic year 2017, and the content of the course including descriptive statistics, graph and explanation, population and sample, sampling techniques, testing hypothesis, one sample and two sample tests, analysis of variance, and chi-square test. The above-mentioned subjects take 15 weeks from May 15 to September 15, 2017 to complete the course which consisting of 60 periods.

Procedure

This instructional activity to develop statistical literacy provided the students with three persons per group, each of them presenting issues of interest related to the disciplinary field, then design the widget, data collection, data analysis leads to conclusion. In the data analysis phase, the data is collected by analyzing descriptive statistics and graphing patterns. For the topic of testing hypothesis, one sample and two tests, analysis of variance, and chi-square test will provide theoretical and practical knowledge, together with analysis of project data from actual data collected. The teaching activities were shown in Table 1.

Table 1. Schedule of learning activities

Week	Project	Lecture and laboratory
Week1-2	present issues of interest	descriptive statistics
Week3-4	tool design	graph and explanation
Week5-6	data collection	population and sample
Week7		sampling techniques
Week8-9	data analysis	testing hypothesis
Week10-12		one sample and two sample tests
Week13-14		analysis of variance
Week15	present the project	chi-square test
Week16	final test	

Data Collection

Performance appraisal evaluate the task skills, the project, and the final score including the survey of attitudes towards statistical subjects, the tools were as follows.

1. Five lesson plans include a performance assessment form for each unit which using Stat Rally activities for individual or group quizzes, the number of Rally 5 times for a total of task skills score 30 points.

2. The project evaluation form was divided into four levels: Introduction and method, results and discussion, final draft, and group presentation. There are five levels of rubric scoring, which are excellent, very good, good, moderate, and should be developed. A total of project score 50 points.

3. Objective and subjective test including the theoretical content and describing the results from the statistical packages. A total of final score 20 points.

4. Schau's Survey of Attitudes towards Statistics (2003), with a 36-step backward translation process, categorized the questions into 6 areas according to Schau's concept including effort, affect, cognitive competences, difficulty, value, and interest. The scale of 1 instead of strongly disagree, and 7 instead of strongly agree. The survey was built online, with the URL as <https://goo.gl/forms/CJJ8nq5FigDU4stL2>.

The evaluation uses mean and standard deviation to show the mean value of final scores and attitudes toward the course, and one sample test to test the difference of mean scores against the criteria, as well as using an independent sample test to compare differences in scores of the average combined between the two target groups.

Results

The results of the project based learning were used in the 15-week course of Statistics for Careers to develop statistical literacy, the researcher measured the task skills by Stat Rally, the project performance skills by draft the introduction and method and group presentation to the final report as shown some activities in Figure 1., and the

results of the descriptive statistics of the task and project performance as well as the final exam shown in Table 2.



Figure 1. Some activities from Stat Rally and group presentation to develop statistical literacy

Table 2. Descriptive statistics of the task skill scores, the project scores and the final test scores

		Pattani Vocational Education College				Pattani Fisheries and Agriculture Technological College			
		Mean	S.D.	Min	Max	Mea	S.D.	Min	Max
	Full score								
Task skills	30	18.80	4.22	8.13	22.75	18.24	3.62	13.38	22.88
Stat Rally#1	5	3.61	.35	3.00	4.00	2.88	.99	1.88	4.38
Stat Rally#2	5	2.86	1.43	0.00	3.75	2.61	1.83	0.00	5.00
Stat Rally#3	5	4.09	1.05	0.00	5.00	3.68	1.86	0.00	5.00
Stat Rally#4	5	4.32	1.45	0.00	5.00	4.50	0.39	4.00	5.00
Stat Rally#5	5	3.91	1.95	0.00	5.00	4.57	0.37	4.00	5.00
Project	50	42.17	1.62	38.67	44.50	43.50	4.03	36.17	47.34
Introduction & Method	10	8.58	1.47	5.67	9.67	8.33	1.61	5.67	9.33
Results & Discussion	15	12.68	.78	12.00	13.50	14.19	.59	13.50	15.00
Final Draft	15	14.18	.87	13.00	15.00	13.55	1.21	12.00	15.00
Group Presentation	10	6.73	1.62	5.00	9.00	7.45	1.37	5.00	9.00
Final test	20	13.77	6.32	3.57	20.00	16.99	5.17	7.50	20.00
Total	100	74.73	7.09	65.01	83.02	78.72	11.62	58.55	92.88
One sample test	mu = 70	t = 2.23 p = .050				t = 2.49 p = .032			
Independent sample test		t = -.97 p = .342							

From Table 2, the mean scores on the task skills, the project, and the final test of students from Pattani Vocational Education College were 18.80 42.17 and 13.77 respectively, and the mean scores on the task skills, the project, and the final test of students from Pattani Fisheries and Agriculture Technological College were 18.24 43.50 and 16.99 respectively.

The analysis of the difference of total mean scores against the criteria, and to compare differences in average scores between the two targets groups was shown in the bottom of Table 2. It was found that the total mean scores was significantly different with the criteria as well as both two groups ($t = 2.23, p = .050$ for students from Pattani Vocational Education College, and $t = 2.49, p = .032$ for students from Pattani Fisheries and Agriculture Technological College). Besides, the comparison between total mean scores of the two target groups was non-significantly different with $t = -.97$ and $p = .342$. It could imply that the students shown the literacy of statistics by project based learning above 70 percent and not different from both groups.

Some findings from developing the statistical literacy in the class of Statistics for Careers with project based learning became eight interesting projects. The titles were as follows:

1. A study of donut taste satisfaction.
2. A study on the satisfaction of roti-flavored flavors.
3. Study on the satisfaction of the beverage booths.
4. Study on the satisfaction of the beverage shops.
5. Study on the satisfaction of cracker consumption.
6. Study on customer satisfaction in canned fish.
7. Study on taste satisfaction of Takoyaki.
8. Study on customer satisfaction in Budu.

Table 3. Mean pre-treatment responses on attitudes subscales by Group

	Pattani Vocational Education College		Pattani Fisheries and Agriculture Technological College		t	p
	Mean	S.D.	Mean	S.D.		
Effort	4.64	.88	4.80	.88	-.430	.672
Affect	3.83	.53	3.26	1.03	1.605	.126
Cognitive competence	3.79	.50	3.89	.51	-.444	.662
Difficulty	3.61	.52	3.31	.71	1.069	.299
Value	3.97	.22	4.43	.55	<u>-2.353</u>	<u>.040</u>
Interest	4.45	.64	4.25	1.38	.439	.666

Table 4. Mean post-treatment responses on attitudes subscales by Group

	Pattani Vocational Education College		Pattani Fisheries and Agriculture Technological College		t	p
	Mean	S.D.	Mean	S.D.		
Effort	4.91	.48	5.00	.81	-.281	.783
Affect	4.29	.40	4.33	.44	-.200	.844
Cognitive competence	4.27	.48	4.27	.42	.000	1.000
Difficulty	4.14	.50	4.03	.77	.356	.727
Value	4.13	.50	4.37	.34	-1.134	.276
Interest	4.97	.75	5.09	.60	-.369	.718

Table 5. Paired t-test responses on attitudes subscales for Pattani Vocational Education College students

	Pre-treatment		Post-treatment		t	p
	Mean	S.D.	Mean	S.D.		
Effort	4.64	.88	4.91	.48	-.791	.440
Affect	3.83	.53	4.29	.40	-2.051	.056
Cognitive competence	3.79	.50	4.27	.48	<u>-2.113</u>	<u>.050</u>
Difficulty	3.61	.52	4.14	.50	<u>-2.242</u>	<u>.039</u>
Value	3.97	.22	4.13	.50	-.820	.434
Interest	4.45	.64	4.97	.75	-1.610	.126

Table 6. Paired t-test responses on attitudes subscales for Pattani Fisheries and Agriculture Technological College students

	Pre-treatment		Post-treatment		t	p
	Mean	S.D.	Mean	S.D.		
Effort	4.80	.88	5.00	.81	-.471	.645
Affect	3.26	1.03	4.33	.44	<u>-2.843</u>	<u>.016</u>
Cognitive competence	3.89	.51	4.27	.42	-1.668	.116
Difficulty	3.31	.71	4.03	.77	-1.976	.067
Value	4.43	.55	4.37	.34	-.282	.782
Interest	4.25	1.38	5.09	.60	-1.597	.131

From Table 3-4, the mean and standard deviation pre-treatment of the responses on attitudes towards statistics of students indicated that the two groups of students gave their highest opinion on Effort, whereas the mean and standard deviation post-treatment of the responses indicated that the two groups of students gave their highest opinion on Interest. Students from Pattani Vocational Education College comment on Interest and Value in the second and third rankings and the lowest was on Difficulty, whereas the students from Pattani Fisheries and Agriculture Technological College comment on Value and Interest in the second and third rankings and the lowest was on Affect of pre-treatment.

On the other hand, students from Pattani Vocational Education College comment on Effort and Affect in the second and third rankings and the lowest was on Value, whereas the students from Pattani Fisheries and Agriculture Technological College comment on Effort and Value in the second and third rankings and the lowest was on Difficulty of post-treatment. It found that both groups have comments on all sides in a way to agree. Excluding Pattani Fisheries and Agriculture Technological College students, the pre-treatment comments on Affect and Difficulty were in disagreement. The above results show that both groups of students view the statistical subjects as interesting, appreciate value in statistics and was dedicated to learning statistics. Therefore, it is possible to develop intellectual knowledge, even if the statistical subjects were difficult. However, when comparing the mean of the opinions from the two groups, the mean score of the opinions on the Value of the items was significantly different at the 0.05 level with $t = -2.353$, $p = .040$.

From table 5-6, the finding revealed that after attending class, the attitudes towards statistics evaluated by SATS-36 was significantly higher than before learning. Therefore, students from Pattani Vocational Education College remark on Cognitive Competence and Difficulty with $t = -2.113$, $p = .050$ and $t = -2.242$, $p = .039$ respectively, whereas the students from Pattani Fisheries and Agriculture Technological College remark on Affect with $t = -2.843$, $p = .039$.

Discussion

To conclude, the project based learning improved the statistical literacy via the task skills, the project performance, and the final test as can be seen from the average scores which was above 70 percent. In addition, it was found that the total mean scores was significantly different with the criteria as well as both two groups but the comparison between total mean scores of the two target groups was non-significantly different. The findings were consistent with several studies. For instance, the study of Fillebrown (1994) involves with using projects in an elementary Statistics course for non-science majors. It reveals that the projects made the course much more enjoyable to teach, it requires more than the usual effort as well as students but it was well worth the time. The study of Carnell (2008) involves with the effect of student-designed data collection project on attitudes toward Statistics. It found that inclusion of a project may not significantly impact students' attitudes toward statistics. James, Anthony, and Michael (2013) study students' experiences and perceptions of using a virtual environment for project based assessment in an online introductory statistics course, it revealed that perceptions of the use of the Island for project-based assessment were very positive. Qualitative feedback provided insight into how the Island-based projects may help to develop students' statistical thinking. Moreover, Kuenkaew and Nopparit (2016) developed the instruction model and study the result of using the instruction model for 21st century learners to promoting statistical thinking among higher education students, it revealed that all students of the target group were higher statistical thinking level in every aspect; most of students were quantitative level of statistical thinking and positive attitude.

For the level of opinion on the attitudes towards statistics of the two groups of students, it was found that the students considered the statistical subjects to be interesting, appreciate value in statistics and was dedicated to learning statistics. Therefore, it is possible to develop intellectual knowledge, even if the statistical subjects are difficult. The results were consistent with Arumugan's (2014) study with undergraduate students in Malaysia, and some consistency with the research of Judi, Ashaari, Mohamed, and Wook (2011) studied with undergraduate students in the same country. It was found that the Affect and the Value gave an average of similar level of opinion. While students in Malaysia give an average score on the Effort, the Cognitive Competence, and the Difficulty higher than this result. Besides, the Interest aspects gave the opposite result to this research. It also consistent with the research by Bond, Perkins, and Ramirez (2012) who studied with undergraduate students in the United States and found that the Difficulty and the Value gave an average of similar levels of opinion. While students in the United States provide an average level of the Effort and the Cognitive Competence higher than this study, whereas the Affect and

the Interest gave the opposite result. The result may be due to the nature of the learning that is being cultivated in the culture as well as the different lifestyles, or at different times. According to Torteeka (2014), concludes that Chinese students have a better attitudes towards statistics subjects than Thai students in relation to their educational development policies.

In short, conducting the project based learning in teaching statistics to developed statistical literacy for the students from Pattani Vocational Education College and Pattani Fisheries and Agriculture Technological College made the learners tend to focus on the tasks or the real practice more than the contents of the lessons. Nevertheless, the instructor might have to work harder in each step in order to draw and develop the students' skills perfectly. For doing project, it was noticeable that the students were not good at writing the significance of the problem and the discussion because of the lack of experience.

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