

Students' Perceptions of Problem Solving through a Pair Instruction Technique in Calculus Class

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Abstract - This research aimed to study: 1) the integration of the instruction of a calculus class of Information Technology Department, the Faculty of Management Sciences and Information Technology (FMIT), Nakhon Phanom University (NPU); 2) the improvement of instructional process efficiency; and 3) students' satisfaction of Pair Instruction technique (PIT). The sample of this study composed of 33 randomized students from the 3rd and 4th year student at NPU. A five-rating scale questionnaire with 97% confidence level was used to collect data. Percentage, mean, standard deviation, dependent t-test were used to analyze the obtained data. It was found that all items asking students' satisfaction of PIT in calculus class got the highest mean in every facet. The students were happy with the PIT. They thought that the PIT was more useful than a conventional instruction, could increase their solutions, provided them with better perception, helped them with team working, and helped them helped them obtain better grades. According to the face-to-face interview, from 30 students of the sample, it can be concluded that 84.85 percent of the students needed information technology practical and the PIT in their classes. They thought that the technique improved their perceptions and provided them with a collaborative work environment.

Keywords - Team Work, Learner-Centered, Pair Instruction Technique, Calculus

I. INTRODUCTION

Classroom instruction research is essential for developing effective instructional protocol and improvement. To develop appropriate learning, it is recommended that instructors should perform classroom evaluations to enhance instructional methodologies. Due to limited classroom time greater emphasis should be put on collaborative student process which provides students with a more engaging learning. Furthermore, collaborative projects allow for greater idea exchange and the students can learn from one another.

In this study, the researcher used learner-centered approach for educational technique and adopted John Dewey's "Learning by doing" [1] as her instructional approach.

This paper outlines a research study conducted at a Thai university with students from a faculty of Information and Communications Technology. It investigated student with the integration of the instruction of a calculus class and the improvement of instructional process and do students' satisfaction of Pair Instruction technique (PIT).

II. LITERATURE REVIEW

Because it is a well-known and worldwide-accepted approach. The students were provided with hands-on activities, which changed the role of students from "the receivers" to "the learners" and the role of the teacher was changed from "the instructor" or

“the informant” to “the learning facilitator”. The learning process focuses on the learners so they are the center of the process or learner-center. Learner-centered learning is essential for practical especially for courses in information technology (IT). Mostly the courses are practical courses especially for calculus. IT students studying calculus have to use theoretical calculus to solve mathematical problems. Learning was created by student’s hands-on activity. The researcher employed PIT to promote direct interaction between students, which encourages learning exchanges, and group cooperation. Group cooperation created positive relationship, common goals, opinion exchange among members and responsibility sharing on group’s outputs. It is an academic skill and coexistence with democratic society development. In addition, it provided in-depth learning and preparing the students for his real working situation in the future. Higher education sectors should aim to produce graduates who have specific skills as well as generic skills important in contemporary workplace settings. Educators know that group work and group assignments can benefit students in various ways. Group work helps students to develop interpersonal and teamwork skills which are much valued in the workplace and society in general. Campbell [2] introduced in-depth learning. Anyhow, Terry, William and Mahnckel employed Pair Instruction technique (PIT) to teach fundamental programming [3]. In addition, Gulatee and Homma [4] also employed PIT to conduct a research on Content Management Software teaching. The results of the study were congruent with those of Terry et.al.

PIT, which was employed by the researcher, helped the students with practical. The approach provided them with socialization, the increasing of working confidence, the building of learner-centered instruction and teamwork. It also improved students’ grades as a whole [4]. There were various ideas on PIT.

Anyhow, Da Silva, Prikladnicki, Hannay and others found that effective communication

and teamwork were essential factors for working success and PIT. The factors created better learning environment, increased social interaction, grades, confidence and students’ interest in courses [5, 6].

Plagens pointed out that Collaborative Learning helped the students to solve their problems and learner-centered approach, collaboration and practical were the best learning method [7]. Anyhow, Gulatee and Masek found that teamwork had a problem, the delegation of work. It was very difficult to get all efficient members because of they had different skills, competence and aptitudes [8]. Even though there were various problems with students’ group working, any research supporting student’s collaboration, socialization, cooperation, hands-on activity was a good teaching approach providing considerable success for students [9].

Wray found that pair working did not always bring success especially in ineffective collaboration due to non-sharing partner or uncooperative partner [10]. Members with some difficult personality such as, the saboteur, the bully, the martyrs, the whiner and the free rider or so on presented problems and challenges to the pair working [8]. Research by Brandyberry and Sharen (2006) identified five types of team members that may cause problems in teams. The first type is the Free rider who does not contribute and leaves most of the work to others. The second type is the Whiner who complains about everything, while the third type is the Martyr who willingly accepts more tasks than others, but complains about it. The forth type is the Bully who always intimidates other team members and the fifth type is the Saboteur who likes to make changes without other team members’ approval [11].

Thus successful pair work depended on relevant factors, which could be concluded that there should be further study on suitable team member’s personality for highest teamwork success [5].

Storch and Aldosari also found that the future outcome of pair work depended on their relationship and activities [12].

Higgins indicates that classroom instruction is not the only key component of successful students but it also needs student collaboration which provides the students with communication skills, leadership, decision making and doing something themselves [13].

However group assignments have many benefits, students also encounter problems when working in teams. Frey, Fisher, and Everlove (2009) found that group assignments caused dilemmas and tensions for team members which included restless students, unequal workloads, lack of accountability and too little learning for the effort involved [14]. It is important that students group together with the right group members working together were more powerful than a team made up of the smartest students not working together well [15]. Furthermore, other research has found that a major problem when working on an assignment in a team, is the conflict between group members who have different ideas and opinions which can cause any crash at any time during the process [16]. To form an effective group, students must have good relationship between the members and a mixture of the necessary skills, knowledge and willingness to perform the task at hand.

PIT inspired the researcher to conduct a research on calculus teaching approach because calculus learning needs hands-on activities to create student's skills and understanding.

III. RESEARCH METHODOLOGY

The procedure for data collection was as follows:

1. The opinion questionnaires were given to 44 third-year and fourth-year students of the MIT in 2/2014 Academic Year who were taking Calculus course with PIT.

2. Thirty-three questionnaires (75 %) were returned to the researcher.

3. Every pair of student was interviewed.

4. The obtained data was analyzed by using a statistical program.

Frequency and percentage were used to analyze the data.

1. Satisfaction level on Calculus course using PIT was analyzed by using mean and standard deviation.

2. Students' opinion on the Calculus course in facets such as sex, age and class was analyzed by using frequency, percentage, dependent paired t-test and ANOVA.

3. The students' pre-test and post-test scores were compared by frequency, percentage and dependent paired t-test.

4. Questionnaire reliability was analyzed by using Cronbach's Alpha Coefficient.

5. To obtain in-depth data, an open-ended opinion questionnaire was used to collect qualitative data by using Face-to-Face Interview technique.

IV. RESULTS

This research has six parts Part I: Background analysis, Part II: Satisfaction levels on PIT in Calculus class. Part III: Comparison of Likert's average scores of the respondents classified by sex, age group and year after using PIT in the Calculus class. Part IV: Analysis of pre and post scores from exams of the respondent by using dependent paired t-test after using PIT in the Calculus class. Part V: In-depth interview.

• Part I: Background Analysis

According to 33 returned questionnaires from third-year and fourth-year students from the FMIT, 18 male respondents and 15 female respondents, most of the respondents (75.8%) aged between 18-27 years and were the 4th year students (57.6%).

**TABLE I
BACKGROUND ANALYSIS**

Sex of respondents	Number (n=33)	Percent (100.0)
Female	15	45.5
Male	18	54.5
Age of respondents	Number (n=33)	Percent (100.0)
18-22	13	39.4
23-27	12	36.4
28-32	2	6.1
32 and over	6	18.2
Year of respondents	Number (n=33)	Percent (100.0)
3 rd Year	14	42.4
4 th Year	19	57.6

• Part II: Satisfaction levels on PIT in Calculus class.

Mean and standard deviation were employed to express the respondents' satisfaction on PIT.

Likert Scale is a five point scale which is used to allow the students to express how much they agree or disagree with a particular statement. To analyze the data it is coded as follows:

- 4.51-5.00 Strongly agree
- 3.51-4.50 Agree
- 2.51-3.50 Neutral
- 1.51-2.50 Disagree
- 1.00-1.50 Strongly disagree

**TABLE II
THE ANALYSIS OF SATISFACTION LEVELS ON PIT IN CALCULUS CLASS**

Statements	\bar{x} *	SD**	Meaning	Rank order
1. I am happy with PIT.	4.42	.708	Agree	1
2. I think PIT helps me solve my learning problem better than my studying alone.	4.33	.692	Agree	2
3. I think PIT empowers me to solve my study problems.	4.30	.684	Agree	4
4. I think PIT helps me to understand my study better.	4.21	.740	Agree	5
5. I think PIT helps me learnt Par to work as a team.	4.30	.684	Agree	4
6. I think PIT helps me get better grades.	4.21	.740	Agree	5
7. In sum, I love PIT in Calculus class.	4.33	.736	Agree	3

\bar{x} * = Mean, SD** = Standard Deviation

From Table II, each opinion statement can be ranked and interpreted as follows:

No.1: The students were happy with PIT (\bar{x} = 4.42, S.D. = .708 and Meaning = agree).

No.2: The students thought PIT helped them solve their learning problems better than their studying alone. (\bar{x} = 4.33, S.D. = .692 and Meaning = agree).

No.3: In sum, The students loved PIT in the Calculus class. (\bar{x} = 4.33, S.D. = .736 and Meaning = agree).

No.4: The students thought PIT empowered them to solve their learning

problems and helped them learn to work on a team. (\bar{x} = 4.30, S.D. = .684 and Meaning = agree).

No.5: The students thought PIT helped them understand their learning better and helped them to get better grades. (\bar{x} = 4.21, S.D. = .740 and Meaning = agree).

According to the data analysis above, it was found that the students agree with every facet of satisfaction with PIT in Calculus class at high level (“Agree”).

Overall, PIT for Calculus class has satisfied the IT students because they mostly express “Agree”.

- **Part III: Comparison of Likert's average scores of the respondents classified by sex, age group and year after using PIT in the Calculus class.**

**TABLE III
COMPARISON OF LIKERT'S AVERAGE SCORES OF THE RESPONDENTS CLASSIFIED BY SEX**

		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
SCORE	Equal variances assumed	.076	.785	-.949	31	.350	-.244	.258	-.770	.281
	Equal variances not assumed			-.947	29.766	.351	-.244	.258	-.722	.283

**TABLE IV
COMPARISON OF LIKERT'S AVERAGE SCORES OF THE RESPONDENTS CLASSIFIED BY AGE GROUP**

ANOVA

Like this method

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.590	3	.530	.976	.417
Within Groups	15.744	29	.543		
Total	17.333	32			

**TABLE V
COMPARISON OF LIKERT'S AVERAGE SCORES OF THE RESPONDENTS CLASSIFIED BY YEAR**

ANOVA

Like this method

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.590	3	.530	.976	.417
Within Groups	15.744	29	.543		
Total	17.333	32			

By using ANOVA test for Likert's average scores (\bar{x}) of the respondents classified by sex, age group and class after using PIT in the Calculus class, it was found that sexes, age groups and classes demonstrate that there was no significant difference between the classified group ($P > 0.05$).

- **Part IV: Analysis of pre and post scores from exams of the respondent by using dependent paired t-test after using PIT in the Calculus class Part.**

**TABLE VI
COMPARISON OF STUDENT'S AVERAGED PRETEST AND POSTTEST SCORES (\bar{x}) IN THE CALCULUS COURSE THROUGH PIT**

n	\bar{x}		S.D.	
	Pre-test	Post-test	Pre-test	Post-test
33	23.39	39.20	7.49	8.58

From the Table VI, it can be seen that the average score of the students' post-test (39.20) is higher than the average score of the students' pre-test (\bar{x}). In sum, it can be concluded that PIT helped the students increase their knowledge in Calculus.

TABLE VII
COMPARISON OF STUDENT'S AVERAGED PRETEST AND POSTTEST SCORES (\bar{x})
IN THE CALCULUS COURSE THROUGH PIT BY USING DEPENDENT PAIRED T-TEST

Paired Samples Test

	Paired Differences				t	df	Sig. (2-tailed)	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower				Upper
Pair 1 Pre-Post	-15.80	6.15	.91	-17.63	-13.98	-17.433	45	.000

From the Table VII, we can see that there is a statistically significant difference between student's mean score from the pre-test and post-test in the calculus course through PIT ($p < 0.05$). It can be concluded that PIT helped the student improve their calculus grade.

• **Part V: In-depth interview**

In order to know the student's opinion and suggestions of Pair Technique instruction, we administered the open-ended questionnaire in a face-to-face in-depth interview. We begin with structured interview and then do a follow up interview by using open-ended questions so the respondents can freely express their opinions and open their attitude. We recorded the interview, promised the respondents to keep secret and will erase the recording after we have finished the research.

The first question is "What do you think about PIT for calculus course?"

The second question is "Would you like PIT to be used by other practical?"

V. CONCLUSIONS

In conclusion, most of the respondents loved PIT approach for their Calculus classes. Students need to be involved in a group assignments because this can improve the students' collaborative, co-operative and critical thinking skills. It also improves students' communication, and conflict management skills. As well as, giving students a better understanding of how others work. The team skill they gain would improve their

employability after graduation. However, some students expressed that unskilled partners can make them work harder than their studying alone. To form an effective group, students must have complementary skills, knowledge and willingness to perform the task at hand. Research by Brandyberry and Sharen (2006) identified five types of team members that may cause problems in teams. The first type is the Free rider who does not contribute and leaves most of the work to others. The second type is the Whiner who complains about everything, while the third type is the Martyr who willingly accepts more tasks than others, but still complains about it. The fourth type is the Bully who always intimidates other team members and the fifth type is the Saboteur who likes to make changes without asking other team members' approval [17]. As a result, pair technique enhances and improve the communication among peers and encourages students to ask questions of each other. This will make students to be more ambitious in their calculus practical. Furthermore, the students successively gain confidence from one another to try different approaches to solving problem. This will lead to enhances deeper learning. Additionally, working in pairs provides some students to improve attendance and practical assessment results.

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(Arranged in the order of citation in the same fashion as the case of Footnotes.)

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