

Effects of adapted Class wide peer tutoring on Students' Achievement and Perception towards learning Mathematics in Asia Pacific University, Malaysia

Sireesha Prathi Gadapa

School of Mathematics, Accounting and Quantitative Studies, Asia Pacific University
Malaysia
sireesha.prathi@staffemail.apu.edu.my

Rajasegeran Ramasamy

School of Mathematics, Accounting and Quantitative Studies, Asia Pacific University
Malaysia
rajasegeran@staffemail.apu.edu.my

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Abstract

The main purpose of this study is to explore the effectiveness of Adapted Class Wide Peer Tutoring (ACWPT) on teaching and learning of mathematics module for undergraduate students in Asia Pacific University (APU), Malaysia. Class Wide Peer Tutoring (CWPT) is one of the instructional strategy to meet the requirements of a rapidly diversifying student population. This paper adapted CWPT such that the lecturer worked collaboratively with peer leaders to guide low performing students. ACWPT strategy is to group low performing students with a peer leader to achieve learning outcomes of the module. This paper examines the impact of ACWPT on enhancing low performing students' mathematical skills. Existing module assessments is used as a tool to measure the effectiveness of ACWPT. ACWPT develops the peer leaders' responsibility and accountability for peer learning as well as consolidate their own learning which creates a win-win situation for all students. In this study, 271 participants from three different computing cohorts went through successful ACWPT approach. The findings of this study showed that ACWPT exhibited improvement in mathematics achievement and positive perception towards learning mathematics. Participants of ACWPT states that the active discussion of ideas within small clusters not only increase interest and also encourages motivation which leads to activity based learning. The course achievement indicated that 95.6 % of the students able to meet substantial learning outcomes and improved their achievement. Finding shows ACWPT provides a learning community platform that increase opportunities to understand mathematical skills by having positive social interaction between the participants.

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1. INTRODUCTION

Peer tutoring basically refers to an instructional method that use pairings of high performing students to coach the low performing students in a class-wide setting or in a common venue under the supervision of a lecturer (O. Omoroghomwan, 2017). CWPT was developed by researchers at the Juniper Gardens Children's project in Kansas in the 1980's (Maheady, Harper, Mallette, & Karnes, 2004). Research suggest that students who are enrolled in a CWPT study, in a variety of different subjects (i.e., math, reading, science, social studies, general music), acquired skills faster, retained more information, and made greater advances in academic achievement when compared to traditional instructional strategies (Kamps et al., 2006; Veerkamp, Kamps, & Cooper, 2007; Lawson and Trapenbury, 2012; Spencer, Scruggs, & Mastropieri, 2003). In CWPT, each student has turn to be the tutor and the tutee. The adapted class wide peer tutoring (or ACWPT) is a teaching strategy in diverse class room in terms of mathematics ability. The aim of the treatment is to uplift students' ability especially those with low mastery of fundamental mathematical skills to understand the course material as other mainstream students. This treatment is also able to develop a learning community with positive interaction between the high performers and low performers. It's built up the confidence level of low performers as they able to understand and participate actively in ACWPT treatment and also in lectures and tutorials. Interaction between high performers and low performers promotes deep understanding of the course material. The high performers are able to consolidated their learning by recalling their knowledge in the process of assisting the low performers. This will also increase their confidence level through communicating with other students.

2. LITERATURE REVIEW

Class wide peer tutoring (CWPT) is an alternative method in the teaching & learning

process of Mathematics courses. Peer tutoring as an instructional method which paired high performers with low performers promotes learning and developed a learning partnership with the instructor played an interactive role in an active learning environment (Chopra, 2019; Costantini, 2015). An action research on the effectiveness of CWPT in teaching mathematics was conducted on high school students in Samarinda, Indonesia showed the achievement of students increased from 60 % to 90% in a semester (Hartini, 2019). Studies also showed that students actively involved in the CWPT compared to their behavior previously in conventional method (Coddington et al., 2019; Hartini, 2019). CWPT is also known as peer mediated instruction (PMI). PMI is suitable in teaching fundamental mathematics skills as it provides more opportunity to individualize attention and positive feedback compared to conventional teaching (Borders, 2019). Studies showed that PMI managed to increase the fluency of fundamental mathematics skills and also the students' participation in the learning process (Borders, 2019; Field, 2019). A study on CWPT effect in the social interaction showed students able to express their evaluation on their own mathematics work and used variety of communication ways to complete the task in group (Byrne, J., & Prendeville, P. 2019, Common et al., 2019). CWPT is an alternative strategy to address individual needs of students especially in large classroom which is also able to increase the learning interaction and social instruction between the peers and instructors that led to development of learning communities (Ramasamy & Gadapa, 2019)

3. PROBLEM STATEMENT AND METHODOLOGY

3.1 Statement of the problem

Mathematics is a compulsory module for students from BSc in Computing, BSc in Information Technology and BSc in Computing Graphics/Multimedia. The usual cohort for each intakes is about 250 to 280 students. The students come from various countries with

different pre-university qualification, such as A-Level, SAM, AUSMAT, STPM, Matriculation, Foundation programs resulting to huge diversity in terms of prior knowledge in fundamental mathematics skills. The situation creates two extremes groups i.e. the excellent performers' and the low performers' students besides the average performers. These low performer students are not able to perform due to lack of mastery of fundamental mathematical skills their and not able to relate the applications of what they learn. As the result they are not able to participate actively in teaching and learning process. In addition, some students are not able to keep with the teaching pace. Some of the low performers has low confidence and not sure on how to approach the lecturer. Lecturers don't have any opportunities in the class room to address this problem, so ACWPT is an alternative technique that provide individual attention to these students. As mathematics course highly sequential and the inability of students to master the mathematics skills will lead to the high probability of not achieving the learning outcomes of subsequent course. This situation leads to adapt the idea of class wide peer tutoring (CWPT).

3.2 Objectives of the study

The aim of this study is to evaluate the effect of ACWPT treatment on achievement of mathematical skills for undergraduate students in APU. Specifically, the objectives of this study include the following:

- Objective 1: To improve the students' mastery of fundamental mathematics.
- Objective 2: To increase the achievement of learning outcomes of the module.
- Objective 3: To develop learning communities with social interaction between high performers and low performers.
- Objective 4: To enhance students' understanding of the teaching & learning materials.

Objective 5: To develop leadership skills and confidence level of peer leaders.

3.3 Methodology

3.3.1 Treatment Design

This study employed the adapted class wide peer tutoring treatment. It examined the possible effects of adapted class wide peer tutoring on students' achievement and perception towards learning mathematics in Asia Pacific University, Malaysia. This study sampled a population of undergraduate students from academic year 2018-2019 (September intake), degree level 1, first semester core mathematics module with module code, AQ010-3-1-MCFC: Mathematical Concepts for Computing was chosen over a period of 14 weeks. This module introduces basic computing mathematical concepts that are needed for their further study in degree level 2. This module is designed to elaborate the relationship and interdependence of mathematics & computing. The topics that include in this module are Number Base System, Set Theory, Relations & Functions, Discrete Probability, Logic & Boolean Algebra and Graphs & Trees. There were total 271 students registered with this module from different intakes. All 271 students went through the lecture and tutorial classes for 2 weeks (a total of 6 face to face contact hours) according to university schedule. After 2 weeks' lecture class, a constructive formative assessment was conducted to all students to gauge the level of understanding among students and to classify excellent, average and low performer students. The outcome of the formative assessment is used to categories the students into peer leaders, controlled and experimental groups according the APU undergraduate grading criteria. A threshold is fixed according the APU undergraduate grading criteria. The below flowchart represents the flow of ACWPT treatment.

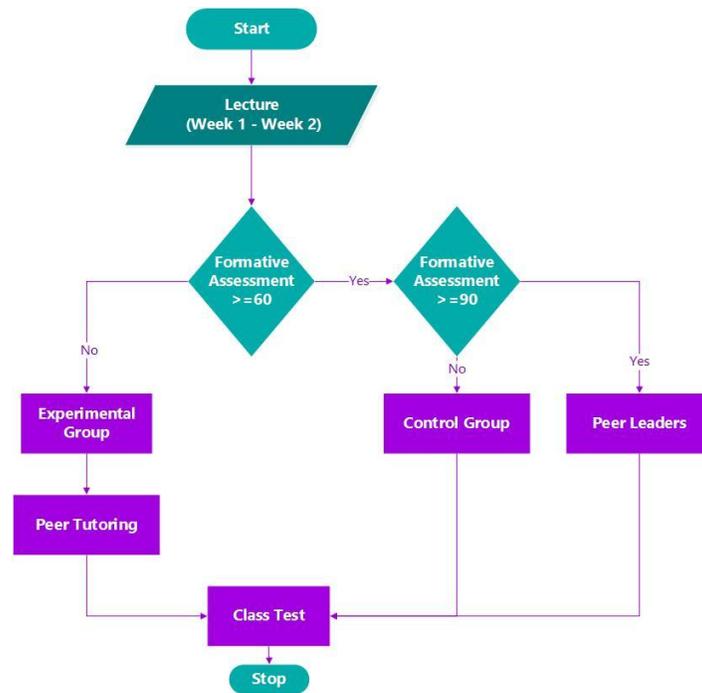


Fig. 1: Flowchart for ACWPT treatment

The table below illustrates the thresholds for each category.

Marks	Alphabetical Grade	Grading point	APU Classification	Category	Threshold
80 -100	A+	4.0	DISTINCTION	Peer Leader	≥ 90
75 – 79	A	3.7	CREDIT	Control Group	$61 \leq x \leq 89$
70 – 74	B+	3.3			
65- 69	B	3.0			
60- 64	C+	2.7	PASS	Experimental Group	≤ 60
55-59	C	2.3			
50-54	C-	2.0			
40-49	D	1.7	FAIL (MARGINAL)		
30-39	F+	1.3	FAIL		
20-29	F	1.0			
0-19	F-	0			

Table 1: APU Grading Criteria & Categories Threshold

A total of 25 students as peer leaders were chosen for this study based on formative assessment results with a threshold of 90 and above. A total of 75 students as experimental group were chosen for this study based on

formative assessment results are approximately average and below average according to APU's grading criteria. The remaining 171 students are categorised as control group. The following shows the summary of the selection result.

Category	Number of Students	Percentage
Peer Leader	25	9.2%
Control Group	171	63.1%
Experimental Group	75	27.7%

Table 2: Summary of Categories

An individual briefing was conducted to all peer leaders and experimental group on ACWPT treatment. The roles and responsibilities of peer leaders are

- ✓ acts as peer coach for the experimental group members on relevant fundamental skills
- ✓ able to identify the weakness of experimental members in solving problems and guide step by step to solve mathematical problems.
- ✓ accountable for experimental members' progress
- ✓ refer to facilitator if encountered any issue whenever necessary
- ✓ avoid assume the role of lecturer

After a scheduled lecture class, ACWPT treatment slotted for 2 hours weekly from week 3 until week 14 and the treatment is scheduled after the lecture class every week. This treatment focused on assisting experimental group students to master the fundamental knowledge hence lead them to understand the material taught in the lecture of the week. Two facilitators were in class to support the peer leaders. All the peer leaders were clearly notified the objective and aim of the session by the facilitators. Both experimental and control groups received the "Teaching & Learning materials" for the specific topic which has been discussed during the lecture class. The ACWPT treatment, 3 experimental group students were assigned to one peer leader every week randomly to avoid the single nationality students in one group. The peer leader takes the role to facilitate the depth

and breadth of basic knowledge and skills which will gradually leading to understand "Teaching and Learning materials and hence to solve relevant problems. The peer leader takes the responsibility and accountability of the peer members learning within the stipulated time. During this process, the role of each peer leader and member was observed by the facilitators, making sure that there was sufficient assistance and cooperation between them to achieve the final outcome of the ACWPT treatment. The facilitators observed the interaction between peer leaders and members, gave hints or clarifications, provided encouragement, and interfered when necessary in a favorable way in order to enable successful achievement of the task. The ACWPT treatment was conducted for 12 weeks from week 3 until week 14 and the following topics are covered.

- Week 1 & 2: Number Base System
- Week 3: Set Theory
- Week 4: Relations & Functions
- Week 5: Discrete probability
- Week 6 & 7: Logic & Boolean algebra
- Week 8 & 9: Graphs & Trees
- Week 10: Introduction to Statistics
- Week 11 & 12: Normal Distribution

After conducted every 4 weeks for ACWPT treatment, a summative assessment was conducted for both experimental group and control group. The summative assessments are used as a tool to measure some of the objectives of the study and is scheduled as in the following table.

Week	Type of Assessment	Weightage
Week 5	Summative Assessment 1	35%
Week 10	Summative Assessment 2	35%
Week 15	Summative Assessment 3	30%

Table 3: Summative Assessments

4. FINDINGS AND DISCUSSIONS

The ACWPT treatment used results from formative assessment, summative assessments, overall grades, observations and students survey. The results showed the improvement of the marks in their summative assessment. This 12 weeks' study showed that the nature of peer leader's explanations was improved as they need to guide the peer members. The below table shows the significant improvement in summative assessment and meets the requirements of "Objective 1: To improve the students' mastery of fundamental mathematics" and "Objective 2: To increase the

achievement of learning outcomes of the module", "Objective 4: To enhance students' understanding of the teaching & learning materials".

Summative Assessment	Pass (%)	Fail (%)
1	74.7%	25.3%
2	90.7%	9.3%
3	95.8%	4.2%

Table4: Results of Summative Assessment

The figure below shows the outcome and growth of 75 experimental group students in summative assessment 1, 2 and 3.

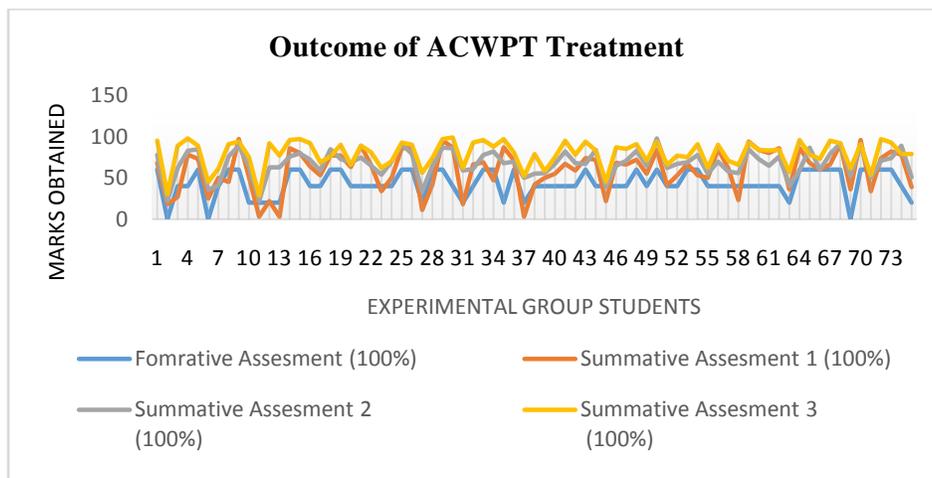


Fig. 2: Outcome of ACWPT treatment

At the end of ACWPT treatment, an online survey was conducted for both peer leaders and experimental group members via Google forms. The following are some of the survey questions on the participation of experimental group members. For each question a five point Likert scale analysis was used to collect data on student ideas of ACWPT treatment. The level of students' preference

toward ACWPT treatment has been divided into five categories; Strongly Disagree, Disagree, Neutral, Agree and Strongly Agree. Questions were based around the following perceptions.

- Q1. ACWPT treatment develop learning communities with social interaction between high performers and low performers.

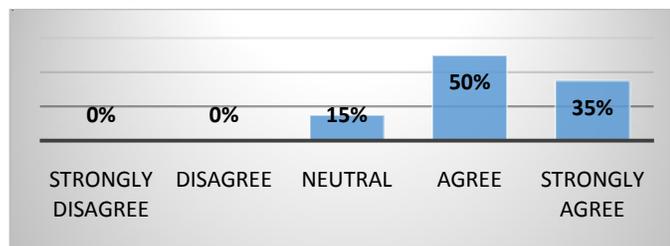


Fig. 3: Students feedback on developing learning communities

85 % of the respondents stated that they developed learning communities and meanwhile 15 % stated neutral which meets “Objective 3: To develop learning communities with social interaction between high performers and low performers”.

Q2. The ACWPT treatment has helped to understand content of the module.

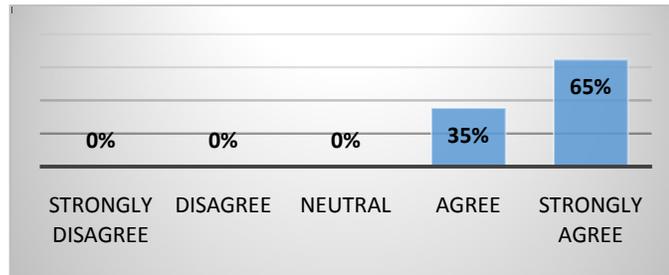


Fig. 4: Students feedback on ACWPT treatment to understand content of the module
100 % of the respondents stated that ACWPT treatment has helped to understand the content of module.

Q3. The ACWPT treatment develops leadership skills and confidence level of peer leaders.

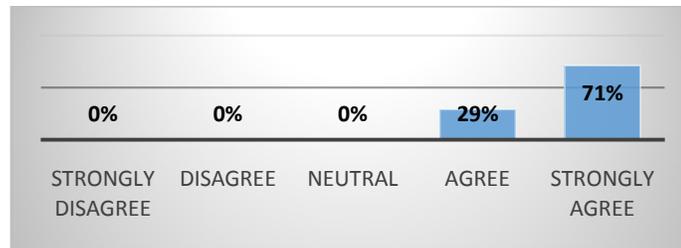


Fig. 5: Students feedback on developing leadership skills

100 % of the respondents stated that ACWPT treatment develops leadership skills and confidence level which meets” objective 5: To develop leadership skills and confidence level of peer leaders”.

Q4. Purpose and benefits of small groups’ discussions is helpful in mathematics learning.

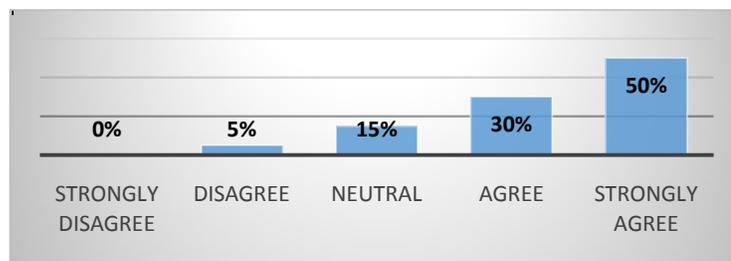


Fig. 6: Students feedback on benefits of small groups’ discussion

80 % of the respondents stated that they understand the course better by attending this project meanwhile 15 % stated neutral and 5 % stated they don’t.

The response from the experimental group showed that majority of them enjoyed and participated actively. The peer leaders responded

on experimental group members enjoyed the class and they understand the module better through their participation in this ACWPT

treatment. The survey of relevant questions to the participation level showed that the students actively participated in ACWPT treatment and benefited from the treatment.

5. CONCLUSION

The study found that implementation of ACWPT treatment in classrooms, showed evidence that students had improved the academic achievement growth in mathematics and they developed strong learning communities where they enjoyed learning in groups. ACWPT showed that it changes the perception of learning mathematics and excited to learn mathematics through this method. ACWPT is an enjoyable way of learning where the students are more open, comfortable with their peer leader and learn willingly in this kind of environment. From the outcome of study, this research concluded that ACWPT treatment is an effective strategy for the students to learn from each other. This study has found that almost all of the participants preferred to have ACWPT activities in other mathematics module. This study managed to develop a platform for both peer leaders and members to interact directly with each other which is helpful to encourage learning activities among them. Through ACWPT, the peer leaders strengthen and consolidated whatever they have learned before. ACWPT does not only help the students academically but also benefits the students in developing their confidence level, communication and social skills. So it directly benefits both peer leader and the members. Apart from benefiting students, this treatment saves the lecturer's time as they are not required to address each individual separately. Instead of engaging external tutors, the students themselves are able to assist in this treatment which saves cost. As for management, the lower the failure rate, the retention rate will increase which bode well for them. This study recommends ACWPT especially in diverse class rooms. Workshops and seminars should be organized for the educators on the use of class wide peer tutoring.

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