

# EFFECTIVENESS OF PEER MENTORING IN ENHANCING THE MATHEMATICAL PROBLEM SOLVING SKILLS OF COLLEGE STUDENTS IN BICOL UNIVERSITY

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## ABSTRACT

The students' performance in mathematics across levels in the country has been persistently low as shown by 2003 TIMMS results where the Philippines is ranked 41<sup>st</sup> among 45 countries (Mullis, Martin, Gonzalez & Chrostowski, 2004). An institutionalized peer-mediated academic support system can help in addressing the student's academic needs and problems. The Institutionalized Peer Academic Assistance Program (I-PASS) in Mathematics was implemented to enhance the problem solving skills of 60 BEED students of BU College of Education with BSED Mathematics major students as mentors during the 1st Semester SY 2012- 2013. Data were gathered using parallel pre-test and posttest results in problem solving, documentary analysis, focus group discussions, interview and questionnaires for mentees, mentors, and concerned officials of the college. The student's peer mentoring program was found effective in terms of enhancing the problem solving skills of both mentors and mentees whose test results showed a mean gain of 3.72 and 4.74, respectively. The t-test of the I-PASS and non-I-PASS participants' posttest results in problem solving in Mathematics ( $t = 0.002484143$ ,  $p < 0.01$ ) revealed a significant difference. Its features such as open to all students, free, voluntary, based on learning needs, used developmentally appropriate learning materials, individualized and group learning strategies, supervised by discipline experts, and based on pedagogical principles, were acceptable to all the stakeholders, contribute to make the program academically sound and valid, and help ensure its sustainability. The students' participation in peer mentoring led to useful insights and favorable beneficial experiences. The university-wide implementation of I-PASS can help in proactively minimizing the students' difficulties in mathematical problem solving.

**Keywords:** peer-mentoring, marginalized students, peer assisted learning, at risk students, student support system

## INTRODUCTION

Academic institutions are expected to adhere to excellence and access in the fulfilment of their mandate. Adherence to excellence and access ensures that the students are provided with the education they need to become effective social catalysts and fulfilled self-actualized persons. Given the services and programs that promote students' welfare, marginalization of students

remains a major issue in higher education institutions.

In Bicol University, the 2011 survey on special population shows that 65.78 percent of the students have experienced one or more types of marginalization due to financial difficulties, academic deficiencies and socio-emotional difficulties due to dysfunctional families. Out of the 861 students or 10% of the officially enrolled students during school year 2010-2011, 157 students or 18.23 % earned academic deficiencies, most of whom incurred incomplete marks while some students had poor ratings or ratings lower than 2.5 or failing marks (Bercasio & Cabrillas, 2012). Efforts and initiatives to help the students with academic difficulties are available, but many of the identified high-needs students are still not provided with effective and appropriate institutionalized assistance or services by the university. For instance, Peer Tutoring in Mathematics and Science already ceased its operation, while the Reading Program is only confined to the College of Education. Likewise, of the four offices in the university concerned with student services, none planned and implemented a comprehensive program for special population with academic deficiencies except for the BUCS/RSTC and BUCE (Bercasio, 2012).

The student's academic deficiencies are exemplified in the depressing performance of students in mathematics which is an issue of national magnitude. The students' performance in mathematics across levels in the country has been persistently low, if not dismal as shown by the 2003 Trends in Mathematics and Science Study results where the Philippines ranked 41st among 45 countries (Mullis et al., 2004). At the local setting, the performance level in mathematics of students in the different levels has been generally low (Bañas, 2007; Malasa, 2001; Fajardo, 1997; Vargas, 2012). The identified difficulties in Mathematics of Bicol University students must be addressed adequately and properly (Ardales, 1990; Lina, 2002; Cabrillas, 2012).

In mathematics education, problem solving is an important skill. Kirkley (2003) asserts that problem solving is a basic learning skill. Although Filipino students believed that all word problems can be solved by simple step by step procedure and word problems are not important (Sangcap, 2010), the National Council of Teachers of Mathematics (n.d.) claims that problem solving plays a significant role in mathematics. In view of the critical importance of problem solving, this study is conceived with the end of assisting pre-service teachers improve their problem-solving skills in Mathematics.

Literature on marginalized students across levels and on programs posits strong recommendations to make continuing undertakings to help at risk students (Hess, 1992; Grannis, 1992; Goodwin, 2000). Considering students who are academically at-risks or disadvantaged, mathematics is an identified area of difficulty. Taking into account the complex intellectual activity, the nature of difficulties which the student faces in solving problems is varied, ranging from perceptual difficulties to those concerning his cognitive self-regulation (Căprioară, 2015). Local studies have confirmed that Filipino learners have deficiencies in mathematics. In the elementary level, Bañas (2007) found out that the performance level of the pupils in Mathematics III-IV, specifically on rational numbers, decimals, fractions, and percent, was generally low. In the secondary level, second year students had difficulties in rational expressions (Malasa, 2001), third year students were weak in Mathematical problem-solving particularly quadratic equation and rational expressions (Fajardo (1997), and fourth year students had low proficiency in conceptual and procedural understanding in Algebra

(Vargas, 2012). In Bicol University, students in different levels encountered difficulties in different areas in mathematics (Ardales, 1990; Lina, 2002; Cabrillas, 2012). In these cited studies, lessons, activity or worksheets and instructional materials were proposed as interventions to address the students' difficulties in mathematics.

Addressing the students' academic needs and problems through an institutionalized academic support system, is important to help students maximize their learning potentials and cope with academic demands in the university. Peer-mediated or Peer Assisted Learning (PAL) is an appropriate academic support to students across levels and disciplines. Researches have shown its effectiveness in enhancing mathematical skills (Presbitero, 2002; Balangat, 2004) and in promoting positive attitude towards learning, improved motivation to learn, and active collaborative learning with peers (Barquilla, 2012). A study revealed that irrespective of the type of measure and type of learner (low achievers with and without disabilities and average achievers), students in peer tutoring classrooms demonstrated greater reading progress (Fuchs, Fuchs, Mathes, & Simmons, 1997). Another study found that PAL students grew more on reading comprehension and reported more positive beliefs about working hard to improve reading. However, PALs and contrast students grew comparably on reading fluency and reported similar beliefs about being and wanting to become better readers (Fuchs, Fuchs, & Kazdan, 1999). Lundblom and Woods (2012) found out that teaching idioms with class-wide peer tutoring (CWPT) was flexible, effective, and time-efficient in a general education classroom setting.

In the context of the existence of special population due to certain academic problems and identified lack of mathematical proficiency, and benefits of peer mediated learning, this study on the effectiveness of the Institutionalized Peer Academic Assistance Program (I-PASS) is deemed significant, relevant and exigent.

## **OBJECTIVES**

This study aimed to identify the effectiveness of Institutionalized Peer Academic Assistance Program (I-PASS) in Mathematics in enhancing the problem solving skills of the students belonging to special population and make documentation of the pilot implementation of the said student support program. Specifically, the objectives are as follows: (1) Identify and describe the features of I-PASS; (2) Identify the effectiveness of I-PASS in enhancing the problem solving skills of the students; and (3) Describe the mentoring experiences, challenges encountered, and insights gained by student mentors and student mentees.

## **THEORETICAL FRAMEWORK**

This research is anchored on the human rights framework, specifically the Education for All (EFA) Framework as well as on Vygotsky's theory of zone on proximal development, and Schoenfeld's view on problem solving. The human rights framework shows that everyone everywhere has the same rights as a result of our common humanity. This framework sets forth a universally agreed set of non-negotiable standards and obligations. These basic standards – also called human rights – set minimum entitlements and freedoms that should be respected by governments. Its basic principles are universality, indivisibility, participation, accountability, transparency and non-discrimination

(National Economic and Social Rights Initiative, n.d.). In particular, quality and accessible education is a right of all, and as provided in the Dakar Framework for Action (2000), education is for all thus all the learning needs of all the children, youth and adults should be met. Making academic support service available to high-needs students is a manifestation of the institution's recognition and promotion of their basic right to quality education.

Supportive of the collaboration in a peer-assisted learning is Lev Vygotsky's theory of zone of proximal development. Vygotsky (as cited by Orey, 2010) stresses the fundamental role of social interaction in the development of cognition as he believed strongly that community plays a central role in the process of "making meaning." Two main principles of Vygotsky's theory on cognitive development are: the More Knowledgeable Other (MKO) and the Zone of Proximal Development (ZPD). The MKO refers to someone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept. The ZPD is the distance between the "actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." Putting forth the constructivist theory of learning, this study then theorizes that problem solving processes are best developed within a constructivist framework which views the learners as generators of knowledge, not simply as receivers or consumers of information.

Problem solving includes a complex set of cognitive, behavioral, and attitudinal components. Problem solving may be better defined as a much more complex and rigorous process of understanding the problem situation, making a plan to find a solution, solving the problem, verifying the solution, and considering alternative solutions or pathways to a solution (Bain, 2010). According to Schoenfeld (1985), four categories of knowledge/skills are needed to be successful in mathematics: (1) Resources - proposition and procedural knowledge of mathematics, (2) heuristics - strategies and techniques for problem solving such as working backwards, or drawing figures, (3) control - decisions about when and what resources and strategies to use, and (4) beliefs - a mathematical "world view" that determines how someone approaches a problem.

The Institutional Peer Academic Assistance Program (I-PASS) is a support service intentionally designed in keeping with the basic right of every learner to equal opportunities to learn. With a support service for students with academic difficulties, the university promotes a culture of inclusion among its academically marginalized sector. This then ensures that the learning needs of students are met and sustained advertently and purposely within their academic stay in the university, thereby, providing them opportunity to maximize their potentials.

As an academic support service, the I-PASS was conceived considering the constructivist framework. The student mentees are guided and assisted by their mentors in a learning scheme that encourages interactive learning and gives them the opportunity to construct their own knowledge through the use of validated developmentally appropriate materials in a non-threatening learning situation. I-PASS in Mathematics focused on problem solving since it is basic to mathematics learning. As a cognitive process that involves conceptual and procedural understanding, lessons on problem solving included in the I-PASS Mathematics Kit follow steps, making the delivery of the lessons during the mentoring sessions systematic.

## MATERIALS AND METHODS

This study used a combination of experimental and descriptive method of research. The experimental method with a pre-test-posttest design was used to identify the effectiveness of I-PASS in enhancing the problem solving skills of the students in Bicol University College of Education during the school year 2012-2013. The descriptive method was used to document the pilot implementation of I-PASS during the first semester of school year 2012-2013 focusing primarily on the feedback, insights and experiences of the student mentors, student mentees, and concerned school officials.

The 60 third year students from the College of Education taking up Bachelor of the Elementary Education were involved as subject- student mentees, and divided into experimental and control groups. The 14 fourth year Bachelor of Secondary Education major in Mathematics students were the subject-student mentors. The key informants (KIs) in the focus group discussion were the mentees, mentors, and the concerned officials of the College consisting of the college dean, assistant dean, student services coordinator, college guidance counsellor, research coordinator, department chairs and program chairs.

Data were gathered using parallel pre-test and posttest in Problem Solving, questionnaires, documentary analysis, interview and focus group discussions. The pre-test and the post-test on problem solving consisted of 25 items covering the following topics: number phrases, number sentences, solving equation, solving number problems, age problems, coin problems, percentage, business problems, motion problems, angle relation, and area and perimeter.

The questionnaires were part of the I-PASS forms. Two Focus Group Discussion (FGD) Guide Questions were used for the student mentors and student mentees, respectively during the culmination of the peer mentoring. Another set of Guide Questions for FGD was used one semester after the culmination of the program to elicit how the peer mentoring experience helped the mentors during the practice teaching, and the mentees during their academics in the succeeding semester. Rubric was used for assessing the I-PASS Handbook (Manual and Mathematics Kit). The documents analyzed included the accomplished activity sheets of the student mentees during the 12 Mentoring Sessions, and the I-PASS forms.

Mean and percentage were used to describe the performance of the students in the pre-test and posttests on problem solving while t-test was used to identify the effectiveness of I-PASS in Mathematics. Percentage and weighted mean were used to organize the data on the assessment of the I-PASS Handbook.

## RESULTS AND DISCUSSION

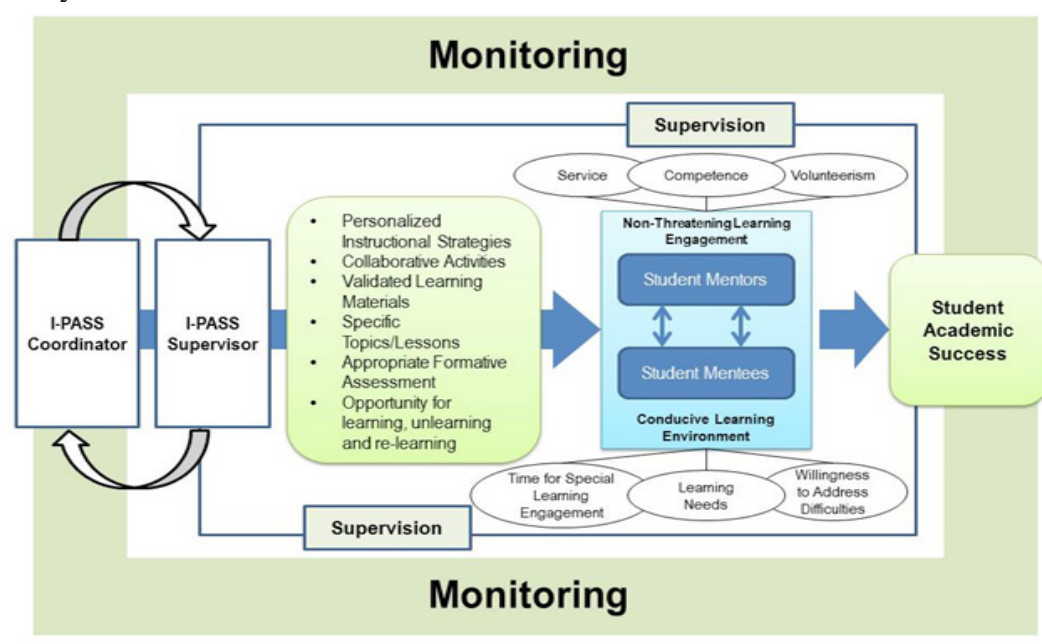
The Institutionalized Peer Academic Assistance Program (I-PASS) is a field-tested academic support system that highlights peer mentoring among students. It includes services such as students' evaluation in identified discipline, student mentor's training, peer mentoring, and student mentors' and mentees' supervision. Its mission is to support students in the pursuit of academic success through early intervention and effective support services that promote individual growth

and personal success through one-on-one or small group peer mediated intervention in identified learning areas. The goal of the program is to promote student success and retention by minimizing academic deficiencies, boost skills development in different areas, improve course completion, foster positive attitude towards learning, strengthen collaborative engagements with peers, and encourage genuine service learning.

**Features of Institutional Peer Academic Assistance Program**

This peer-mediated learning scheme is designed to provide a friendly and sympathetic environment for both the student mentors and mentees. The learning pairs or teams consist a unique learning community called the I-PASS Learning Community which recognizes learning difficulties as opportunities for learning, unlearning and re-learning. The student mentors are given the opportunity to develop enthusiasm for further learning, strengthen competence in specific learning areas, adjust to learners’ diversity, become sensitive and responsive to different learning needs, and foster unity within the learning community and even beyond. The student mentees are given the opportunity to enhance content knowledge and skills in a non-threatening atmosphere, unlearn misconception, if any, and foster enthusiasm for learning and social skills.

The framework of I-PASS principles (see Fig. 1) shows that both the student mentors and mentees engage in interactive learning activities with a non-threatening learning atmosphere in a conducive learning environment. Given the features of the I-PASS as an enabling program in the tertiary level as well as the close supervision and monitoring, both student mentors and mentees are given assistance based on their needs, thus giving opportunity to maximize their academic success. The roles of the supervisor and monitor are crucial to ensure that I-PASS activities such as training of student mentors, validation of materials, orientation of both student mentors and mentees, peer mentoring, and pre- and post-tests are carried out with highest level of efficiency and accuracy.



**Figure 1.** Framework of I-PASS Principles

The I-PASS is guided by the following principles:

1. Learning should be based on identified needs.
2. Personalized instructional strategies through learning pairs or teams aptly address learning challenges.
3. Learning with peers is non-threatening and less stressful.
4. Collaborative learning actively engages both the student mentors and mentees.
5. Learning engagements dealing on specific learning areas address specific difficulties.
6. Conducive peer mentoring environment that provides adequate learning materials and non-graded learning engagement encourages active participation.
7. Formative assessment is important to track difficulties and improvements. Regular and immediate feedback on the students' performance encourages students to perform better.
8. Learning difficulties can be viewed positively as an opportunity for learning, unlearning and re-learning.
9. Close supervision of student mentors ensures proper conduct of the peer mentoring episodes.
10. Peer mentoring is a form of service learning.

The program is an enabling program with the following key features: open to all students, free, voluntary, based on learning needs, uses developmentally appropriate learning materials, uses individualized and group learning strategies, supervised by discipline experts, based on sound pedagogical principles, systematic, and replicability.

Conditions are needed for effectively transmitting knowledge through peer tutoring; namely, (1) The tutor must provide relevant help which is (2) appropriately elaborated, (3) timely, and (4) understandable to the target student; (5) the tutor must provide an opportunity for the tutee to use the new information; and (6) the tutee must take advantage of that opportunity (Webb as cited by Kalkowski, 1995). In the implementation of I-PASS in Mathematics, these conditions were met. The I-PASS mentors provided relevant help to the mentees since problem solving is basic in any mathematics course, and will be needed by the mentees in their academics, practice teaching and licensure examinations. The contents of I-PASS mathematics lessons were delivered to the mentees with adequate discussions using the validated I-PASS Mathematics Mentor's Copy. The mentoring sessions were scheduled during the third year level of the mentees, thus what they would learn will be useful in their future mathematics courses. Specifically, the mentoring in mathematics problem solving was conducted prior to the mentees' taking their Mathematics 6 – Problem Solving. I-PASS mentors explained the lessons in English, and translated in Filipino or dialect if the need arose, ensuring that the explanations were understandable to the mentees. The mentors gave the mentees the opportunity to finish all the activities and exercises in problem solving ensuring that ample time was given for the application of the mathematical concepts discussed. In the mentoring sessions, the mentees took the mentoring opportunity as a support to them. The proposed I-PASS program is an attempt to ensure the continuing undertaking to help at risk students (Hess, 1992; Grannis, 1992; Goodwin, 2000).

### Effectiveness of I-PASS for mathematics in enhancing the problem solving skills of the students

The effectiveness of I-PASS for mathematics in enhancing the problem solving skills of the BEED and BSED students was gauged by determining the difference in the t-test of scores in the pre-test and posttest of the students belonging to both the experimental and control groups. Additionally, the insights gained by the students, whether mentees or mentors, as revealed by the responses in the evaluation forms, focus group discussions, and informal interviews, were included to substantiate the statistical results.

### Effectiveness of I-PASS for Mathematics in Enhancing the Problem Solving Skills of the Mentors

Fourteen fourth year BSED Mathematics major students were identified as student mentors. Prior to the peer mentor's training and peer mentoring sessions, four mentors were found to have excellent problem solving skills, seven were above average and three were average. After the peer mentor's training and peer mentoring sessions, all the student mentors score 21 to 23 or excellent. Results show a mean gain of 3.72 between the pre-test and posttest results (Table 1).

**Table 1.** t-Test of Mentors' Pre-test and Posttest Results in Problem Solving in Mathematics

Pre-test Mean	18.57142857
Posttest Mean	22.28571429
Pre-test SD	2.793241451
Posttest SD	0.825420306
P(T<=t) one-tail	0.000146759
Alpha	0.01

Results of the t-test of the student mentors' pre-test and posttest results in Problem Solving Test revealed significant difference at 0.01 alpha. This means that the student mentors improved their test scores significantly. The experience then as a peer mentor in the Institutional Peer Academic Assistance Program (I-PASS) helped them enhanced their problem solving skills in Mathematics. The exposure of the mentors to the training provided by the I-PASS Supervisor, together with the validated mentoring materials which include specific guides in the delivery of the lessons and activities, were instrumental in refreshing and enriching mathematics skills which were covered by the courses in the previous years.

The student mentors claimed that since that was the first time they were designated as peer mentor, they studied the materials provided, as well as reviewed the concepts covered using other references. Being assigned as peer mentor therefore served as impetus to seriously study the lessons that they would deliver since they did not want to make errors during the peer mentoring sessions. In fact, the mentors stated that their experience as peer mentors served as timely review for the upcoming licensure examination as well as a preparation in terms of content and strategy for the practice teaching in the succeeding semester. Considering the Vygotsky's MKO concept, results revealed that these peer mentors performed their task well as MKO in terms of problem solving in mathematics, and at the same time, improved their own problem solving skills, too.



Although influence of peer learning schemes on the student leaders own development has been underestimated, (Skalicky & Caney, 2010), these results prove that the peer mentors have derived academic and personal benefits from the I-PASS program. In particular, the mentors after graduation are able to apply the skills and attributes developed through the Peer Assisted Study Sessions in the workplace as manifested in the communication, team work, leadership, facilitation and confidence (Chilvers & Waghorne, 2008). These then are supported by researches that report on the leaders’ experience and the beneficial impact of the role for their own learning, personal and professional development and employability (Chilvers & Waghorne, 2008; Ford, Thackeray, Barnes, & Hendrickx, 2015; Malm, Bryngfors, & Mörner, 2012; Zacharopoulou, Giles, & Condell, 2015).

**Effectiveness of I-PASS for mathematics in enhancing the problem solving skills of the mentees**

Findings showed that the mentees still encountered difficulties in problem solving. However, the difficulties have been reduced. Twelve lessons for one hour per session reduced the difficulties of students. It could then be stated that additional time per session may lead to further reduction of difficulties. In fact, the mentees themselves suggested that every session should have at least one and a half hours so that they would be able to finish the different activities. Also important to mention is that additional sessions should be made available to mentees who need more practice exercises. This means more worksheets should be prepared in case some mentees need additional examples and exercises. Aside from performance in the formative tests and the posttest, it is necessary to mention about the attitude of the students towards mathematics. Initially, most of the students claimed they did not like the subject, but after the peer mentoring sessions, all the students claimed that they have changed their attitude towards mathematics. The improvement in score may not be evident immediately, however, with a favorable attitude towards learning mathematics, the mentees will be encouraged to study further in the subject, and in the long run, further improve their problem solving skills.

**Table 2.** t-Test of mentees’ pre-test and posttest results in problem solving in mathematics

Statistical Results	Experimental Group (I-PASS Participant)	Control Group (Non-I-PASS Participant)
Pre-test Mean	9.133333333	9.133333333
Posttest Mean	13.86666667	11.63333333
Pre-test SD	1.008013866	1.008013866
Posttest SD	3.059561985	2.355965771
Pearson Correlation	0.140133778	0.210055953
P(T<=t) one-tail	1.45037E-09	1.37102E-06
Alpha	0.01	0.01

The t-test of the student mentees’ pre-test and posttest results in Problem Solving Test reveals significant difference at 0.01 alpha (Table 2). The results mean that the student mentees improved their test scores significantly, thus their exposure to the Institutional Peer Academic Assistance Program (I-PASS) in Mathematics Problem Solving helped them enhanced their problem solving

skills in Mathematics. Their exposure to peer mentoring using validated materials called I-PASS Mathematics Kit was effective in addressing their difficulties in mathematics problem solving. It can be stated therefore that both the strategy of mentoring and content of the I-PASS problem solving course were useful and effective in lessening their difficulties.

Over-all, with the guidance of the peer mentors as MKOs, the mentees were able to attain development in their problem solving skills in mathematics specifically addressing their difficulties with the use of the validated lessons and materials. In the peer learning set-up, with the non-threatening atmosphere due to the absence of grading and the presence of a peer who were considered as friends, and small group mentoring, the mentees were able to address their difficulties which they claimed they have experienced since high school.

For the non-I-PASS participants, the t-test also revealed significant difference both at 0.01 alpha. Although the students did not participate in the peer mentoring, they showed improved performance in the parallel posttest. The improvement can be attributed to some moderating factors which include the mathematics subjects taken during the semester. These mathematics courses are believed to have helped the non-I-PASS participants to improve their problem solving skills.

**Table 3.** t-Test of I-PASS and Non-I PASS participants’ posttest results in problem solving in mathematics

X Posttest Mean (I-PASS)	13.86666667
Y Posttest Mean (Non I-PASS)	11.63333333
X SD	9.36091954
Y SD	5.550574713
P(T<=t) one-tail	0.002484143
Alpha	0.01

It is interesting to note that though the t-test for the pre-test and posttest results of the I-PASS mentees and the non-I-PASS participants both revealed significant difference, the t-test of the I-PASS and Non-I-PASS Participants’ post test results in problem solving in Mathematics revealed a significant difference at .01 alpha. This means that the students who attended the mentoring sessions improved their problem solving skills in mathematics better than those who did not attend the mentoring sessions. In addition to the t-test results, sample activity sheets of mentees showing their performances in the different formative assessment tools are included to illustrate the mentees’ improvement in specific problem solving skills. The peer mentoring proved to be an effective supplement to the regular courses in mathematics and therefore supports the effectiveness of peer assisted learning as an approach in enhancing mathematical skills of students (Presbitero, 2002; Balangat, 2004).

In addition to the t-test results, it is deemed necessary to show sample activity sheets of mentees showing their performances in the different formative assessment tools. These activity sheets were used to give the mentees ample opportunity to have practice on the different topics related to problem solving.

**Challenge Yourself**

1. In a class, there are the same number of boys and girls. If 20% of the girls and 10% of the boys have honors, what percent of the class have honors?

$$100\%$$

$$50\% \text{ are boys}$$

$$50\% \text{ are girls}$$

$$20\% \text{ of } 50\% \text{ are girls/honors}$$

$$10\% \text{ of } 50\% \text{ are boys/honors}$$

$$0.2 \times 0.5 + (0.1 \times 0.5) = \text{honors pupils}$$

$$0.1 + 0.05 =$$

$$0.15 = \text{honors}$$

$$15\%$$

2. If 20% of my allowance is for fare and 30% of the remaining is for projects, how much is allotted for other expenses if my allowance is P2,000?

$$400 - 0.2 - 20\% \text{ for fare}$$

$$600 - 0.3 - 30\% \text{ for project}$$

$$2000 - \text{total allowance}$$

$$\text{total allowance} = 2,000$$

$$\text{fare } 20\% \text{ of } 2000 = 400$$

$$\text{project } = 30\% \text{ of } (2000 - 400) = 540$$

$$\text{other expenses} = 2000 - (400 + 540)$$

$$= 1060$$

**Evaluate Yourself**

1. A factory has 3,000 workers. 75% of the work force is men. If 10% of the women are married, how many women are not married?

$$\text{total workers} = 3,000$$

$$\text{men work} = 75\% \text{ of } 3,000 = 2,250$$

$$\text{women} = 750$$

$$0.1 \leftarrow \text{married} \leftarrow 10\% \text{ of } 750 = 75$$

$$750 - 75 = 675$$

$$675 - \text{women not married}$$

2. Ten percent of my money is 40% of Cora's money. If my money is P2,500, how much is Cora's money?

$$0.40 \cdot \text{Cora's money} = 0.10 \cdot 2,500$$

$$0.40x = 250$$

$$0.4x = 250$$

$$x = \frac{250}{0.4} = 625$$

let x = money of Cora

3. A merchant bought monobloc chairs at P450 each. How much should he sell them to get a profit of 25% of the cost?

$$450 - \text{amount of monobloc chairs each}$$

$$25\% \rightarrow 0.25 \text{ of } 450 = 112.5$$

$$450 + 112.5 = 562.5$$

4. After spending P3,000 for food, Mrs. Cruz has only P9,000 left for other family needs. What percent of her salary is allotted for food?

$$9,000 + 3,000 = 12,000 - \text{total salary}$$

$$3,000 - \text{spent for food}$$

$$\frac{3,000}{12,000} = \frac{300}{1,200} = 0.025$$

5. A math game started with 16 contestants. If 50% of the contestants are eliminated every round, after how many round will a winner be declared?

$$16 - \text{total \# of contestants}$$

$$50\% \Rightarrow 0.50 \text{ of } 16 = 8$$

$$8 - 4 = 4$$

$$4 - 2 = 2$$

$$2 - 1 = 1$$

$$1 - 0 = 0$$

$$0 - 1 = -1$$

$$-1 - 1 = -2$$

$$-2 - 1 = -3$$

$$-3 - 1 = -4$$

$$-4 - 1 = -5$$

$$-5 - 1 = -6$$

$$-6 - 1 = -7$$

$$-7 - 1 = -8$$

$$-8 - 1 = -9$$

$$-9 - 1 = -10$$

$$-10 - 1 = -11$$

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$$-85 - 1 = -86$$

$$-86 - 1 = -87$$

$$-87 - 1 = -88$$

$$-88 - 1 = -89$$

$$-89 - 1 = -90$$

$$-90 - 1 = -91$$

$$-91 - 1 = -92$$

$$-92 - 1 = -93$$

$$-93 - 1 = -94$$

$$-94 - 1 = -95$$

$$-95 - 1 = -96$$

$$-96 - 1 = -97$$

$$-97 - 1 = -98$$

$$-98 - 1 = -99$$

$$-99 - 1 = -100$$

**Challenge Yourself**

1. The sum of the ages of three boys is 48. What will be the sum of their ages in 5 years?

$$\begin{array}{r} x + x + x = 48 \\ 3x = 48 \\ \hline x = 16 \end{array} \quad \begin{array}{r} x + 5 = 21 \\ x + 5 = 21 \\ x + 5 = 21 \end{array} \quad \underline{63}$$

2. The difference between the ages of two girls is 4 years. What will be the difference of their ages in 10 years?

$$\underline{\quad} - \underline{\quad} = 4$$

3. Jao is 20 years younger than his Yaya. In 5 years, he will be  $\frac{1}{3}$  as old as his yaya. How old is Jao now?

Yaya =  $x + 20$   
Jao =  $x$

$$\frac{1}{3}(x+5) = x+20+5$$

$$3x+15 = x+25+15$$

$$3x+15 = x+40-15$$

$$3x-x = 40-15-15$$

$$2x = 10$$

$$\frac{2x}{2} = \frac{10}{2}$$

$$x = 5$$

**Evaluate Yourself**

1. Three more than thrice Ted's age is 30. How old is Ted?

$$\begin{array}{r} 3x + 3 = 30 \\ 3x = 30 - 3 \\ 3x = 27 \\ \hline x = 9 \end{array}$$

2. Angelito is 12 years old. His uncle is thrice as old. How old is his uncle by the time Angelito is 18 years old?

Angelito = 12  
Uncle =  $12 \times 3 = 36$

$$12 + 6 = 18$$

$$36 + 6 = \boxed{42 \text{ years old}}$$

3. Two years from now, the sum of the ages of a quintuplet is 40. How old is the quintuplet now?

$$\begin{array}{r} q_1 + q_2 + q_3 + q_4 + q_5 = 40 \\ 8 + 8 + 8 + 8 + 8 = 40 \\ -2 \quad -2 \quad -2 \quad -2 \quad -2 \\ \hline 6 + 6 + 6 + 6 + 6 = \boxed{30} \end{array}$$

4. Robert is 45 years old. If his age is  $\frac{3}{4}$  of his brother's age, how old is his brother?

Robert = 45

$$15 \text{ years old}$$

Activity Sheet 2

Plate 1. Sample Activity Sheets of Peer Mentee on Solving Age and Percentage Problems

In sample activity sheet 1, a mentee's solutions and answers to age problems are shown. It can be gleaned from the output that during the practice exercises, the mentee answered all the three items incorrectly. It is particularly important to note that he was unable to translate to mathematical statement the word problem. His mentor showed and explained to him the correct solutions and answers. After paying attention to the elaboration of his mentor, he performed better in the succeeding exercise. He answered two items correctly, and earned 1 point for a partially correct answer out of the four items. He still made errors in the solving of age problems, but he was able to solve problems and explain his solutions confidently towards the end of the session.

In solving problems involving percentage, a mentee encountered confusion during the practice exercise. Although she can speak about percentage, as she claimed it has been in the previous topic in high school, she made no correct answers in the two items as shown in Activity Sheet 2. Because of this, her mentor decided to explain the solutions carefully. Afterwards, she tried solving five problems by herself where she answered three items correctly. This made her confident, saying that she never expected she would answer any item correctly.

These sample activity sheets of peer mentees show their improvement in specific problem solving skills. As shown in the sample mentees' outputs (See Plate 1), the mentees still made mistakes in the evaluation part. Nevertheless, the improvement in the problem solving skills, as revealed by the actual solutions of the mentees, together with the oral explanations of their solutions and answers, is discernible. Given the limited time of one hour to about one and a half hours, the mentees were able to solve some of the problems correctly even under time pressure. The non-threatening learning atmosphere stimulated the mentees to pursue problem solving despite making errors. Since they were not labelled and graded by their peer mentors, they considered the errors as normal part of learning and re-learning the problem solving process. This affirms the positive impact of the Peer Assisted Study Session (PASS) scheme on students who attend, whether local or international students (Dawson, van der Meer, Skalicky, & Cowley, 2014; Dancer, Morrison, & Tarr, 2015).

### **Mentors' and mentees' experiences, challenges and insights**

**Mentor's experiences, challenges and insights.** The mentors described their participation in I-PASS as challenging, interesting and worthwhile. Their engagement as peer mentor was a first-time experience, therefore they had some intimidations at the start and time-related problems, but they were eventually able to adjust. Since, this was their first time to act as a real teacher although in a small group, they considered mentoring as challenging. Some claimed that they have already forgotten some of the topics covered by the program, so they spent time to do further readings, which improved their conceptual understanding, and eventually their problem solving skills. Unintentionally, the mentors claimed that their participation as peer mentors prepared them for practice teaching and licensure examination in a pressure-free ambiance. They were able to apply what they have learned from their professional education courses in their actual mentoring. All of the mentors said "maraming natutunan" such that their weaknesses have been changed into strengths. Other comments were on the clarity of mathematical concepts ("nagkaroon ng linaw ang mga bagay na nagpapagulo sa aming isipan").

**Table 4.** Recurring Themes along Academic Background, Experiences, Challenges Encountered and Insights Gained by Peer Mentors and Mentees

	Recurring Themes	
	Mentors	Mentees
<b>Academic Background</b>	Qualified and confident to teach mathematics subjects to peer	Encountered difficulties in mathematics and other subjects like Science, English and Professional Education courses subjects to peer
<b>Peer Mentoring Experiences</b>	Coordinated with mentees beyond the mentoring sessions Peer mentoring served as beneficial experience for future teaching career Observed peer mentees to have gained skills in and positive attitudes towards mathematics Enhanced the sense of responsibility in helping other learn	Most mentees coordinated with mentors beyond the mentoring sessions Peer mentoring addressed the specific difficulties in problem solving, gained better understanding of concepts Peer mentoring in mathematics served as a preparation for the future course which is Mathematics 6 – Problem Solving Peer mentoring served as beneficial experience for future teaching career Develop a sense of responsibility for one’s own learning improvement
<b>Challenges Encountered</b>	Time-related Problems (more time needed for the sessions, conflict of schedule) Mentees encountered difficulty in understanding some lessons	Encountered difficulty in understanding some lessons Other challenges were time-related Problems (more time needed for the sessions, conflict of schedule so a mentor was absent)
<b>Insights Gained</b>	Peer mentoring experience enhanced the teaching skills, served as review of different mathematics concepts, developed confidence and social skills of the mentors.	Peer mentoring experience addressed specific difficulties, and was a useful preparation for the future teaching career

In addition to the content of the program, the mentors learned how to approach mentees who at the start were strangers to them, how to communicate with them, and how to treat them in a friendly and non-threatening manner. They admitted that they also learned how to exert effort in explaining the concepts well so that the mentees would understand, as well as would focus on what they do. They also noted their sense of responsibility, confidence, discipline, commitment to service, sense of volunteerism and social skills. They also reported that they developed enthusiasm for further learning, adjusted to learners’ diversity, and became sensitive and responsive to different learning needs.

The mentors highly recommend the program to other top performing students because they consider the I-PASS as “an enabling activity that boosts their confidence” Other courses or areas which I-PASS should cover are Sciences subjects and English focusing on communication skills.

**Mentees’ experiences, challenges and insights**

The mentees described their participation in the program as a happy and worthwhile experience. Although they admitted that they were tempted to go home instead of attending the peer mentoring sessions at the start, they then became fully engaged in the mentoring sessions which they considered as a training for practice teaching, allowing them to experience “how to explain to different kinds of students.” The topics included in the program, as claimed by the mentees were

important although some of them were difficult to digest or understand. Although the one-hour session has not been enough to discuss concepts and finish activities for the difficult topics, they claimed that their specific difficulties were addressed, and that they had adequate preparation for their upcoming mathematics course on problem solving.

Moreover, the mentees claimed that they enhanced their sense of responsibility, discipline, commitment, and social skills. They have learned to manage their time better, making sure they attend the peer mentoring sessions on time without sacrificing attendance to regular classes and other school activities. They also claimed that they have strengthened their commitment to learn mathematics, which they showed through regular attendance to the peer mentoring sessions and by seriously answering the different required activities, thereby complying with the provisions of the Commitment Form.

On the whole, the mentees are given the opportunity to enhance their content knowledge and skills in a non-threatening atmosphere, unlearn misconception, if any, and foster enthusiasm for learning and social skills. The mentees highly recommend the program to other students because they described their participation in the peer mentoring sessions as “true learning, with less pressure, and with free snacks.” The mentees also requested other courses or areas which I-PASS should cover such as Physical Sciences, chemistry, and English such as Reading and Grammar.

In the light of the human rights framework which posits that everyone everywhere has the same rights as a result of our common humanity, it can be deduced that since the needs of the students involved in the peer mentoring program, at least in terms of academic difficulties in mathematics problem solving, were effectively addressed, the institution has manifested a proactive effort to promote the basic right of the students to quality education. This supports the human rights framework by promoting the basic right of the students to equal opportunities to learn. In particular, the favorable experiences and insights of both the peer mentors and mentees indicate that the peer mentoring program is an effective academic support program which may be sustained to ensure that the university is not causing undue disadvantage to the high-needs or at-risk students. On the whole, this shows the positive impact of peer learning like Peer Assisted Study Session on the participants (Dawson et al., 2014) especially the value of peer learning in enhancing the social and academic integration of students (Emmelinea, Katrienab, Pietera, Biekea, Toma, Nadineab & Koena, 2016), as well as gaining skills such as communication, team work, leadership, facilitation and confidence which can be applied in the workplace (Chilvers & Waghorne, 2008). Additionally, the peer assisted learning scheme is reported to have benefits in one’s learning, personal, professional development and employability (Chilvers & Waghorne, 2008; Ford et al., 2015; Malm et al, 2012; Zacharopoulou et al., 2015).

### **Revised I-PASS Manual and Mathematics Kit**

The I-PASS MANUAL provides the guidelines for the implementation of the program. It serves as the protocol which is replicable in other course or subject areas. The manual is composed of the following sections: Overview; Mission; Rationale; Feature of I-PASS; Services Offered by I-PASS; Benefits of I-PASS to Student Mentors and Mentees; Recruitment and Selection of Supervisors, Student Mentors and Mentees; Terms and Duties of I-PASS Coordinator and Supervisors; Terms

and Duties of I-PASS Student Mentors; Terms and Duties of I-PASS Student Mentees; I-PASS Record Maintenance and Reportorial Requirements; Utilization of Resources; and Protection of Intellectual Property of I-PASS. The Mathematics Kit included validated parallel pre- and post-tests, lessons for the student mentors and lessons and activities for the mentees.

The suggestions for the conduct of the mentoring sessions included the following: venue for the mentoring sessions, making the mentoring sessions available to more students, having I-PASS for Science subjects, Reading and English, and more volunteer teachers as I-PASS supervisors in other learning areas. The revisions in the content of the I-PASS Mathematics Kit were: separating the lesson on number phrases and number sentences, and adding other examples for problem solving while those pertaining to the presentation/delivery of the lessons were extending of time allotment and providing more logistical requirements.

As evaluated by the officials and stakeholders of the program, I-PASS provided systematic academic assistance to students with identified difficulties in mathematics problem solving. Hence the program is in keeping with the thrust of excellence and access of education. In particular, it supports the existing thrusts for the promotion of student welfare in the university/college. Response to intervention provides a framework (Lundblom and Woods ,2012)to implement an intervention for students. In the same token, the suggestions and comments of various stakeholders of the program provided inputs for the revision of the I-PASS manual and mathematics kit.

## CONCLUSION AND RECOMMENDATION

The institutional peer assisted learning was effective in enhancing the mathematical problem solving skills of the students. In the University, this support program for students represents a continuing undertaking to help at risk students (Hess, 1992; Grannis, 1992; Goodwin, 2000). Both the mentors and mentees significantly improved their problem-solving skills. The features of the program are favorable to all the stakeholders especially the students, contributed to make the program academically sound and valid, and can help ensure its sustainability. The lessons and activities in Mathematics Kit are appropriate for students with difficulties in problem solving, and even those students who want review or enhancement of problem solving skills. The students, either as mentors or mentees, gained useful insights and favorable experiences as students and as future teachers thus affirming the literature on the positive impact of peer learning (Dawson et al., 2014; Emmelinea et al., 2016; Chilvers & Waghorne, 2008; Ford et al., 2015; Malm et al., 2012; Zacharopoulou et al., 2015).

Thus, there is a strong need for the continuing implementation of I-PASS to address the clamor of students and their special academic needs. This program may be integrated in the program of the Office of the Student Affairs and Services (OSAS) and of concerned departments, and may be replicated in other disciplines or areas such as the sciences, English covering grammar and reading, Professional Education courses and other disciplines as deemed needed by student clients. Bicol University and other HEIs should consider institutionalized student support programs that address special academic needs of students in order to lessen marginalization due to academic deficiencies.



## ACKNOWLEDGEMENT

The research team would like to thank Bicol University and Research and Development Center for the financial assistance, and the jurors from Ateneo de Manila University, Philippine Normal University and Bicol University, the BUCE students who were involved in the pilot implementation of I-PASS, and the key informants from BUCE for the invaluable assistance to this research undertaking.

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