UNIVERSITY OF THE PHILIPPINES

Doctor of Philosophy in Education
(Major in Mathematics Education)

Dinah C. Vidad

Students' Mathematics Problem Solving Difficulties and Coping Strategies: A Model Building Study

Dissertation Adviser:

Maria Ana T. Quimbo, Ph.D.
Faculty of Education

Dissertation Reader/Critic:

Ricardo T. Bagarinao, Ph.D.
Faculty of Education

August 2019

Permission is given for the following people to have access to this dissertation:

Available to the general public	(Yes or No)
Available only after consultation with author/dissertation adviser	(Yes or No)
Available only to those bound by confidentiality agreement	(Yes or No)

Student's Signature:
Signature of Dissertation Adviser:

University Permission Page

"I hereby grant the University of the Philippines a non-exclusive, worldwide, royalty-free license to reproduce, publish and publicly distribute copies of this dissertation in whatever form subject to the provisions of applicable laws, the provisions of the UP IPR policy and any contractual obligations, as well as more specific permission marking on the Title Page."

"Specifically I grant the following rights to the University:

a) *To upload a copy of the work in the theses database of the college/school/insitute/department and in any other databases available on the public internet;*

b) *To publish the work in the college/school/institute/depatment journal, both in print and electronic or digital format and online; and*

c) *To give an open access to above-mentioned work, thus allowing "fair use" of the work in accordance with the provisions of the Intellectual Property Code of the Philippines (Republic Act No. 8293), especially for teaching, scholarly and research purposes."*

Student Name over Signature and Date

APPROVAL SHEET

This dissertation attached hereto, entitled **STUDENTS' MATHEMATICS PROBLEM SOLVING DIFFICULTIES AND COPING STRATEGIES: A MODEL BUILDING STUDY**, prepared and submitted by DINAH C. VIDAD, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Education (Mathematics Education) is hereby accepted.

MARIA ANA T. QUIMBO, Ph. D.
Adviser

RICARDO T. BAGARINAO Ph.D.
Reader/Critic

MA. NYMPHA B. JOAQUIN, Ph. D.
Member

JOB A. Nable, Ph.D.
Member

MONALISA T. SASING, Ph.D.
Member

Accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Education (Mathematics Education).

RICARDO T. BAGARINAO, Ph. D.
Dean

ACKNOWLEDGMENT

This dissertation would have not come into reality without the help and support of a number of individuals to whom the researcher is mostly indebted. She therefore would like to extend her deepest gratitude to:

The Department of Science and Technology (DOST), headed by the Secretary, Dr. Fortunato S. dela Peña, and DOST – Science Education Institute Director, Dr. Josette T. Biyo, for granting the scholarship which she enjoyed for 6 years;

Dr. Miriam Pascua, the President of Mariano Marcos State University, and her successors, Dr. Prima Fe R. Franco and Dr. Shirley C. Agrupis and the MMSU Administration for the favorable endorsement of her scholarship and enrolment to the program;

Dr. Maria Ana T. Quimbo, her dissertation adviser, for her untiring effort, professional support, and valuable comments and suggestions which made this paper a reality;

Dr. Ricardo T. Bagarinao, her reader/critic, Dr. Ma. Nympha B. Joaquin, Dr. Job A. Nable, and Dr. Monalisa T. Sasing who composed the dissertation committee for their insightful and constructive comments and suggestions for the improvement of the paper;

Ms. Rhonna Marie R. Verena, the ever always-on-the-go coordinator of the UP-Open University;

Dr. Artemio P. Seatriz, her mentor at MMSU, for his encouragement, pieces of advices and support to finish the degree and for his generosity in sharing his knowledge in research and the statistical tool needed for the research;

Dr. Lawrence A. Eclarin, and Prof. Emely P. Tanagon, for their assistance in checking the validity of the items in the Problem Solving Test;

Dr. Rey John C. Villanueva for initially looking at the grammar and sentence construction of the paper;

Her friends and colleagues at the Mathematics Department of Mariano Marcos State University, their names too many to mention;

Her classmates and friends at the UP-Open University;

The college freshmen during the first semester of SY 2018-2019, the participants of this research endeavor;

Her forever supportive husband, Jennifer "Jeff", and her three dearest children, Dief Yves "DY", Braellah Angeli "Ellah" and Jenina Aprielle "Jenina", her life and sources of inspiration;

Her one and only brother, Dennis for his moral support;

Her parents, her angels who she knows are constantly guiding her in every endeavor she does; and

To the Lord Almighty, the source of all wisdom and knowledge for making all these things possible and become a reality.

D. C. V.

ABSTRACT

Problems, difficulties and pressures abound everywhere. In Mathematics, much has been said and heard of students struggling with problem solving. This study therefore primarily aimed to develop models that could address the problem solving difficulties of students through their coping strategies. Specifically, it aimed to determine the students' strategies in coping with their difficulties along the four phases of problem solving namely: understanding the problem (UP), devising a plan (DP), carrying out the plan (CP) and looking back (LB) according to a) sex and b) academic programs namely:

The study employed case-study-design approach. The respondents of the study involved thirteen classes with 425 college freshmen who were enrolled during the first semester of SY 2018-2019. Two hundred ninety-seven of them composed the model development group while 128 respondents composed the validation group.

Results of the problem solving test revealed the following difficulties of the respondents: a) inability to distinguish the known from the unknown information and inability to identify the type of problem and recall basic concepts in the UP phase, b) inability to transform a problem into a mathematical equation and inability to draw tables/charts out of the information and organize information and connect to a concept in the DP phase, c) inability to completely perform the working procedure systematically and accurately and inability to start with the computational process in the CP phase, and d) inability to complete the checking procedure and inability to start the evaluation of the correctness of the obtained solution in the LB phase.

Moreover, the study revealed that the looking back (LB) phase has the most encountered difficulty, followed by the carrying out the plan (CP) phase. There were more females who encountered the above mentioned difficulties in all phases of problem solving than males. The respondents were likewise grouped into two: STEM-related academic programs and the non-STEM-related academic programs. The study found out that the majority of the male respondents from the STEM-related academic programs encountered the observed difficulties in all phases of problem solving.

The coping strategy questionnaire on the other hand elicited responses from the students on how they deal with their difficulties in each phase of problem solving. Forty-three strategies emerged and were grouped into two: 32 Problem-focused and 11 emotion-focused coping strategies. Association of the two variables led to the development of the two models: Coping strategies by sex by model and coping strategies by academic program by phase. Validation of the two models revealed that they can address the mathematics problem solving difficulties of the students through coping strategies.

The study therefore recommends that teachers should focus on the phases where students find struggling during a problem solving scenario. They need to provide the students activities and tasks that are real-life problems that require them to understand, compute and check their solutions so that they may be able to discover their own learning. It is also recommended that an assessment identifying the problem solving difficulties of students be administered at the beginning of the semester so that appropriate strategies will be implemented by the mathematics teachers. Lastly, another study underscoring an added variable like the track/strand which the student enrolled during his/her senior high school may be conducted.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

Background of the Study

Education in the Philippines is strongly viewed as a pillar of national development and primary avenue for social and economic mobility (Philippine Education for All, 2015). Reasons for such view include the several stages that our country has undergone, namely; a) from the pre-Spanish period and the American and Japanese colonization and occupation to the present, and b) the three government organizations such as the Department of Education, Culture and Sports (DECS), the Commission on Higher Education (CHED) and the Technical Education and Skills Development Authority (TESDA) that handled our educational system.

The government has allocated a high budget for education because of the Filipinos' deep concern for education. However, there are some concerns that need to be closely looked at and resolved, most particularly on the declining quality of education.

In the Philippines, "It started its slow descent during the Marcos era" (Roces, 2006). Results of studies and various educational assessments conducted in the past decades revealed the deteriorating quality of mathematics education in the Philippines. This was revealed by the 2003 Trends in International Mathematics and Science Studies (TIMSS) where the Philippines' 8th grade (2nd year high school) students' skills and competencies in Mathematics ranked a pitiful 42nd out of 46 participating countries while the 4th grade pupils placed 23rd out of 25 participating countries (Carballo, 2009). It should be noted that not only in international and national quests do the students perform alarmingly. The National AdmissionTest or NAT performance showed 54.66 percent and 44.33 percent average scores for 6th graders

and senior high school students respectively. The students performed poorly in the three core disciplines -- Mathematics, Science, English and also in Filipino and Hekasi (social studies, civics and geography) (Roces, 2006).

In the local setting, in the province of Ilocos Norte, in particular, a four-year consecutive-school year analysis (2010 – 2014) showed an average MPS (Mean Percentage Score) of 61.20 percent in Mathematics. Though this value meant average mastery, it was still below the 75% national target (Dep-Ed Ilocos Norte).

The results of the aforementioned studies reveal that one of the many possible reasons for such decline could be that students find difficulties in their mathematics particularly in problem solving. In fact, the researcher herself sometimes hears statements such as:

"Mathematics problems are really difficult.

I did not know how to do it.

That's why I did not finish it.

I don't like Maths."

These traditional statements are often the responses of students when they are asked about their homework and lessons in mathematics problem solving.

What is meant by mathematics problem solving? Mathematics problem solving is not a topic but a process underlying the whole mathematics program which contextually helped concepts and skills to be learned (Ibrahim, 1997; Tambychik & Meerah, 2010). It is the most important topic to learn and also one of the most complex subjects to teach as it involves many skills depending on the four main phases as described by George Polya in 1945, these are: 1) understanding the problem, 2) devising a plan, 3) carrying out the plan and 4) looking back. These multiple steps bring students in a stressing scenario in which they are faced with varied difficulties.

One of the studies that justifies this claim is the study of Tambychik and Meerah (2010). In their research, they showed that students lacked many mathematical skills such as number-fact, visual-spatial and information skill. Information skill was considered as the most critical among them. The insufficient skills mentioned by the researchers are difficulties in all phases of problem solving stated by Polya in 1945.

In addition, carrying-out the plan and looking back were the problem solving difficulties revealed by Siniguian (2017) with his BSEd respondents.

While students are continually faced with difficulties and depression in mathematics problem solving, they also learn how to manage and respond to these difficulties in different ways either cognitively and emotionally. These ways are known as coping strategies. Coping refers to the act of minimizing or reducing stressful events. The acts of coping as described by Frydenberg and Lewis (1993) come in three forms. These are, *solving the problem, reference to others and non-productive coping*. The first two forms are referred to as the adaptive (constructive) coping strategies because they reduce stress while the third form is referred to as maladaptive coping strategies because they increase stress.

Coping strategies are generally classified into two: problem-focused and emotion focused strategies. Problem-focused coping strategies are efforts to do something active to lessen stressful circumstances while emotion-focused strategies involve efforts to regulate the emotional consequences of stressful events. Researches related to these strategies abound in the net, in publications and other forms of research fora and dissemination. One study showed that problem-focused strategies are the most preferred strategies of students, that even in the Western societies, these are more highly valued because of their action-orientation (Lazarus, 1993; Ader & Erktin, 2012). However, respondents of Rioveros' (2013) study, a local

research, revealed that the most prevalent coping strategy was tension reduction followed by emotional engagement, both of which were emotion-focused coping strategies. Next in ranks were problem engagement, physical activity (both of which were problem-focused coping strategies) and avoidance/escapism (emotion-focused coping strategy). The least utilized coping strategy was seeking social support, a form of problem-focused coping strategy.

Few studies, however, have found relationship between coping and gender and course and achievement. As regards sex-typed predispositions, men are expected to use problem-focused coping strategies while women are expected to utilize more emotion-focused coping strategies (Rapson, 1990). In the medical field, it was laid out that nursing students utilized problem solving strategies as their coping strategies (Labrague, et al., 2016). For the education students, engaging in leisure activities, a non-problem-focused coping strategy was found to be their least significant coping mechanism while listening attentively to their mathematics teacher was the students' most significant coping strategy (Bagasol, 2015). Problem-focused coping strategies also showed substantial relationship with students' grades. As a matter of fact, Ader and Erktin's (2012) were able to reveal a correlation coefficient of $r = 0.56$ between problem-focused coping strategies and high grades in mathematics.

In addition, the variables showing their interrelationships are best illustrated and understood using diagrams or graphs. A particular model that showed relational data was first described in a technical paper in 1970 by an IBM researcher named E.F. Codd. Data segments in this model are explicitly joined by the use of tables (Rouse, 2018).

With the information presented, it is the main purpose of the study to build a model showing the relationship between variables with regards how mathematics

problem solving difficulties and coping strategies relate each other along with the sex and the academic program of the students.

Statement of the Problem

This study was conducted to build model/s that helped address students' mathematics problem solving difficulties through their coping strategies. Specifically, the study sought to answer the following questions:

1. What are the common mathematics problem solving difficulties (classified into the four phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex? to academic program?
2. What is/are the most common coping strategy/ies of students in each of the phases according to sex? to academic program?
3. What model/s (representations) can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
    a. the different phases of problem solving?
    b. sex?
    c. academic program?
4. Will the developed model/s fit or apply to other groups of students?

Significance of the Study

This research was undertaken to come up with a model that will address the mathematics problem solving difficulties of students through their coping strategies. Though there is paucity of studies focusing on models describing the difficulties and students' coping strategies in dealing with them, the findings of this study may serve

as a useful information to teachers and school administrators in building theories and implementing practices that can help resolve issues related to the matter.

Preservice Teachers. The developed and validated models will inform preservice teachers that such mathematics problem solving difficulties with corresponding coping strategies do exist in classroom settings. In addition, the models will guide them on how to deal with students having mathematics problem solving difficulties upon entering the teaching profession.

Teachers. Having known of the different models developed would serve as guides in choosing the necessary and appropriate methodologies and strategies that would help alleviate students' difficulties particularly in problem solving. Likewise, teachers can utilize the developed models in creating new models that could help explain and interpret their everyday encounters in the school with their students.

School Administration. The result of the study could support the development of a specific material that incorporates common coping strategies for mathematical problem solving difficulties of the students. In short, the administration can conduct in-service seminar workshops and come up with instructional modules designed for mathematics problem solving difficulty reduction through coping strategies.

Mathematics Education Researchers. The result of the study would help the mathematics education researchers to be mindful and educated of the many possible situations and processes that may arise in the teaching-learning environment most particularly in a mathematics classroom setting. The result would help them to be a better if not the best analyst and could serve as a guide or a reference for more studies in the future. Moreover, the model building framework developed in this study may be used by mathematics education researchers as guide or basis in conducting similar model building studies.

Most of all, this study would contribute to the limited literature associating the students' mathematics problem solving difficulties and their coping strategies.

Scope and Limitation of the Study

This study was conducted in a university in Ilocos Norte during the second semester of the school year 2018-2019. The study involved all first year college students enrolled in the Mathematics for the Modern World subject (MMW) that consisted of 13 intact classes with varied academic programs. It was conducted during the last weeks of the first semester which lasted for 6 weeks starting from November 4, 2018 to December 14, 2018. During this period, the students were taught about the four phases of problem solving by Polya (1945).

The study was based on a researcher developed a test that identified the problem solving difficulties of the students and a coping strategy questionnaire that elicited their coping strategies. The researcher-developed test consisted of a total of 20 routine problems that elicited their sections in the four phases of problem doing. For the test, a total of 20 routine problems that elicited their solutions in each of the four phases of problem solving. The test items were problems in arithmetic, algebra and geometry with topics on operations of algebraic expressions, factors and factoring, equations and applications to word problems. It is however, not the scope of the study to determine which type of problem did the student struggle the most. It was assumed that the sample had enough background on these areas since they had already taken a course in Basic Mathematics or Algebra-related subject in their Senior High School. This test enabled the researcher to identify the problem solving difficulties of the students classified according to the four phases described by Polya (1945). While the coping strategy questionnaire, elicited their coping strategies for

each difficulty they encountered in each phase of problem solving. This questionnaire likewise enabled the researcher to identify the coping strategies commonly used by the students.,

During the implementation of the study, different teachers of the 13 intact classes were tapped. But they were oriented about the study and its procedure. The researcher requested another mathematics teacher to administer the test and coping strategy questionnaire.

Quantitative and qualitative assessments of the students' solutions of the items in the problem-solving test and coping strategy questionnaire were made. The analysis utilized the frequency count of the students' common problem solving difficulties and coping strategies in each phase of problem solving. No inferential statistics was done in analyzing the degree of relatedness of the coping strategies and difficulties.

Due to time constraint, purposive sampling was performed in determining the respondents in validating the developed models. A similar routine problem solving test as in the development of models was administered.

CHAPTER II

REVIEW OF LITERATURE AND MODEL BUILDING FRAMEWORK

This chapter presents the discussions of the different mathematics problem solving difficulties and coping strategies utilized by students based from extensive reading of literatures and studies which had bearing to this present study. The conceptual bases of this study are likewise presented and discussed.

Current Status of Mathematics Education

People always say that, *Mathematics is a subject where students struggle to comprehend and solve mathematical word problems.* According to the State of Mathematics Achievement, the NAEP'S 1990 Assessment of the Nation and Trial Assessment of the States claim that about half of the student populations were graduating from high school with little of the mathematics understanding required by today's high-tech occupations. Apparently, Grade 12 students appeared to have an understanding of mathematics that does not extend much beyond problem solving with whole numbers (Lopez, 2008).

The performance of Philippine students in the international standardized exams in mathematics and science is among the lowest in the world (Banilower, et al., 2013).

The reasons for the low performance of students in problem solving as well as the low-level problem solving ability of students are evident in several researches that have been conducted locally, nationally and even internationally.

The result of the Trends in International Mathematics and Science Study (TIMSS) 2003 revealed that out of the 45 participants in the Math Achievement Test, our country ranked 41, besting Botswana (42), Saudi Arabia (43), Ghana (44) and

CHAPTER II

REVIEW OF LITERATURE AND MODEL BUILDING FRAMEWORK

This chapter presents the discussions of the different mathematics problem solving difficulties and coping strategies utilized by students based from extensive reading of literatures and studies which had bearing to this present study. The conceptual bases of this study are likewise presented and discussed.

Current Status of Mathematics Education

People always say that, *Mathematics is a subject where students struggle to comprehend and solve mathematical word problems.* According to the State of Mathematics Achievement, the NAEP'S 1990 Assessment of the Nation and Trial Assessment of the States claim that about half of the student populations were graduating from high school with little of the mathematics understanding required by today's high-tech occupations. Apparently, Grade 12 students appeared to have an understanding of mathematics that does not extend much beyond problem solving with whole numbers (Lopez, 2008).

The performance of Philippine students in the international standardized exams in mathematics and science is among the lowest in the world (Banilower, et al., 2013).

The reasons for the low performance of students in problem solving as well as the low-level problem solving ability of students are evident in several researches that have been conducted locally, nationally and even internationally.

The result of the Trends in International Mathematics and Science Study (TIMSS) 2003 revealed that out of the 45 participants in the Math Achievement Test, our country ranked 41, besting Botswana (42), Saudi Arabia (43), Ghana (44) and

South Africa (45). According to Tinio, the chairperson of the Alliance of Concerned Teachers (ACT), the students were prepared by their teachers months before the actual tests, and their teachers had to go to a seminar in PNU (Philippine Normal University) in preparation for the review, but still their performance was poor (Federis, 2006). Reports say that the Philippines garnered an average scale score of 378 compared to the top ranking country, Singapore which had an average scale score of 605.

The Examination Board of Malaysia (2009) maintains that the lacking in problem solving skills might be due to many mathematical concepts and skills that had to be applied and integrated during the process of problem solving. Federis (2006) citing Antonio Tinio's comment, claims that public schools do have poor performance in both diagnostic and achievement tests.

In national assessments, the Department of Education showed that achievement rate of fourth year students in Mathematics dropped from 50.70 percent in SY 2005-2006 to 47.62 percent in SY 2006-2007. Education Secretary Luistro told the public the downward trend of achievement levels and survival rates of elementary and high school students based on National Achievement Tests (NAT) from 2005 to 2010. Results showed that the mean percentage score (MPS) of students dropped from SY 2007-208 which posted an MPS of 49.26 to 47.40 in 2008-09 and down to 46.30 in 2009 to 2010 (Ronda, 2011).

The National Achievement Test (NAT), an annual examination given to both Grade 6 and 4th year students to measure the knowledge and master over the subjects like Mathematics, Science, Filipino and Araling Panlipunan also showed a declining performance. In the school year 2011 to 2012, public high school students performed

significantly lower (average of 48.9%) than the scores of public elementary students (average of 66.79%) (Ordinario, 2013).

In a four-consecutive-school year analysis that involved fourth year students in a certain province of Ilocos Norte, students showed an average Mean Percentage Score (or MPS) of 61.20 percent. This percentage simply means that the students have average mastery, but still below the national target which is at least 75 percent.

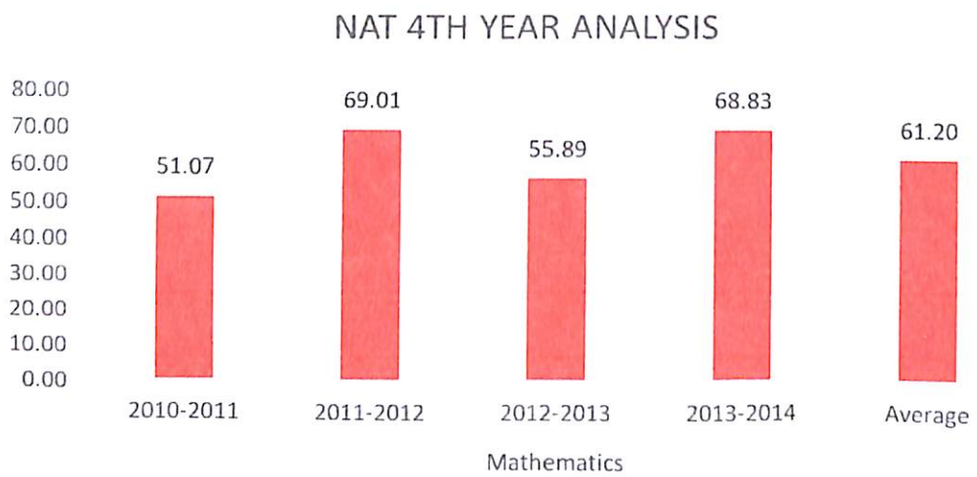


Figure 1. Four-Year Analysis of NAT [Graph courtesy of Dep-Ed]

The other literature mentioned difficulties such as: lack of mathematical skills, deficiency in visual-spatial skill that lead to difficulty in differentiaiing, relating and organizing information meaningfully, incomplete master of number facts, weakness in computation and incomplete mastery of mathematical terms. All of these difficulties can lead to the occurrence of errors and confusion in the process of problem solving that could result in low achievement in mathematics.

Students' Difficulties in Mathematics Problem Solving

Mathematics Problem Solving

Mathematics problem solving is not a topic but a process underlying the whole mathematics programs which contextually helped concepts and skills to be learned (Ibrahim, 1997; Tambychik and Meerah, 2010).

Almost in every level of education, problem solving is at the core of instruction. This is in accordance with what NCTM (1980) said that "problem solving should be the focus of school mathematics" (NCTM, 1980 p. 1; Taplin, (n. d.)).

According to an article of Lester (1987), though problem solving has been the most written about, but possibly the least understood, there has been no suggestions on how to make it the heart of instruction. Instead of programs with coherence and direction, teachers were given story problems, lists of strategies to be taught, and suggestions for classroom activities. If problem solving is to be a prominent goal of mathematics instruction, more serious and thoughtful attention must be given to what it means to make it the center of school mathematics.

Solving mathematics problems is really difficult for students to do and likewise, difficult for teacher to teach. However, the goal of helping children to be better problem solvers is not only an important goal but also the most challenging and exciting one that a teacher can have. It is the job of a teacher to try to develop the ability of the students to solve problems and add other problem-solving techniques (Lester, 1987).

Students' Difficulties

Students are faced with difficulties in solving mathematics problems due to lack of many mathematical skills. They are unable to apply and integrate many mathematical concept and skills during the process of making decisions and problem-solving (Tambychik and Meerah, 2010).

These difficulties are generally categorized in accordance with the steps of Polya (1945).

Difficulty in understanding the problem

Students with this difficulty will find that the students:

- cannot recall basic facts or concepts;
- cannot define the terminologies and notations used;
- cannot identify the type of problem;
- unable to distinguish the known from the unknown;
- cannot rephrase the problem in own words.

Difficulty in devising a plan/strategy

This is the students':

- inability to organize information or connect information to a concept;
- cannot draw pictures, tables or charts out of the information;
- inability to determine a formula or transform problems into mathematical sentences;
- cannot look for pattern/s; and
- cannot perform an experiment.

Difficulty in carrying out the plan/strategy

This is a difficulty which is generally concerned with the systematic working procedure (computational process) in solving the problem ensuring its accuracy.

Difficulty in looking back

This is the inability to evaluate the correctness of the obtained solution. The evaluation should ensure that the solution is consistent with the facts of the problem.

Generally, literatures often emphasize that students encounter varied difficulties in solving problems in Mathematics.

In Algebra for example, teachers often say that there is lack of grasp of essential principles, concepts and process concerned under the prescribed syllabus. Students experience great difficulty in their effective learning of the subject in spite of the best efforts they put in (Chamundeswari, 2014). The study of Didis & Erbas (2015) that involved solving word problems also showed the students difficulty in comprehending the context and hence were unable to form the equation to be solved.

Problem solving involves multiple processes that include problem comprehension, choosing the required information among the data, converting this information into mathematical symbols and reaching a solution through required operations. Although these processes do not necessarily follow a linear path, it is thought that the first and key step of problem solving is reading comprehension problem (Olkun & Toluk, 2004; Ulu 2017).

While in a calculus class, Ferguson (1980) believed that the lone greatest problem in learning pre-calculus mathematics in college is with "reading" deficiencies, where symbols and abstractions are concerned. This deficiency falls under "understanding the problem" of Polya's (1945) phases of problem solving. He added that reading does not simply refer to the ability to pronounce the words or attach names to the symbols, but also the ability to comprehend the material.

The belief of Ferguson was further strengthened by Pearce, et al. (2013), when they proved that reading and understanding the problem had the greatest percentage (45%). This was also supported by second-fifth grade teachers of the United States when they were interviewed. Other difficulties cited by the teachers' responses involved students' ability to devise a plan in solving the problem (35%) and a lack of vocabulary knowledge (13%). Only one though cited the problem on computation.

In 2014, Dela Cruz and Lapinid found that students are hard up in translating worded problems into mathematical symbols, which as described by Polya, is a form of the "devising a plan" phase. Among the 204 Grade 5 students who were subjected to problem solving test that involved the four fundamental operations, 40 percent of them are below the satisfactory level in translating worded problems. Carelessness, lack of comprehension, interchanging values, and unfamiliar words are some of the common difficulties encountered by the respondents in translating worded problems.

In other fields such as Physics, Reddy and Panacheroensawad's (2017) study with 303 participants revealed that the most difficult area in physics problem solving is the students' inability to remember related equations, which is a part of Polya's (1945) "devising a plan" phase. It was also apparent in their study the lack of practice/exercises during classes, lack of understanding the fundamental basics, poor

mathematical skills on necessary understanding of the problem, lack of motivation and inexperience of the teacher. inadequate exercises on specific unit wise physics problems, poor comprehensive skills on definitions, laws and basic principles of physics, and lack of books of materials on problem-solving. In short, the study indicated and revealed that poor mathematical skills and lacking of understanding the problem are the major obstacles in the domain of problem solving skills.

While, in the field of Chemistry, Finney's (n. d.) review of research in problem solving citing the results of Nurrenberg and Pickering (1987) and Sawrey (1990) found that some students could correctly solve problems pertaining to the ideal gas law without being able to represent the behavior of gases at the molecular level. In addition, some students could solve stoichiometry problems without being able to represent the reaction with an illustration. The "abilities" illustrated by the students all fall under the "carrying out the plan" (computational) strategy. They were good at these stage, however, they had difficulties that involved the "devising a plan" stage.

Difficulty in translating word problems in mathematical phrases was also the findings of Sultan (2014), under the devising a plan phase. Her study generally investigated how students solved word problems in algebra. With his, she was able to identify difficulties/challenges encountered by students in solving algebraic word problems.

In Mathematics, after tabulation and classification of occurrence of difficulties as encountered by the third year BSEd (Bachelor of Science in Education) respondents majoring in Mathematics, Siniguian (2017) revealed that carrying-out the plan and looking back were the major phase difficulties in solving mathematical

problems. These were due to the inability to translate problems into mathematical equations and inability to apply correctly mathematical concepts and principles.

In a mathematics class involving non-Mathematics majors in a certain university, Apostol (2017) wanted to detemine the level of problem solving skills and problem solving heuristics of the college students on non-routine problems. Of the five self-structured non-routine problems, it was revealed that the students most commonly used heuristics are making a model or diagram, using a formula, eliminating and considering a simpler case. The first two heuristics are the strategies in the devising a plan (DP) phase, which means that the said students did not struggle much in the said phase.

Between the two sexes, Ganley (2018) was able to observe that there are more female respondents who encountered the difficulties in each phase of problem solving than the male respondents. This implies that the female respondents experienced more difficulties than the male counterparts which could be attributed to their low levels of confidence in their mathematics skills when compared with males.

Student's Coping Strategies

Coping refers to the thoughts and actions that one usually does to deal with a stressful situation (Cliche, 2017). Some coping strategies however, are not as helpful as others. Positive coping strategies give chances to actively work toward solving the problems while negative coping strategies make anyone wear down overtime that often make the stress worse. Some of these positive coping strategies include listening to music, going out with a friend, discussing situations with a friend, making an action plan to solve a problem, or seeking counseling to struggle with stress. A few

of the negative coping strategies likewise involve criticizing oneself, yelling at friends, taking a recreational drug, becoming aggressive or avoiding friends and family. Anybody can become stressed for various reasons in different fields and situations and hence we need to choose different coping strategies. Lazarus and Folkman's (1980; 1985) developed and revised a measure called the *Ways of Coping* which consists of a series of predicates, each portraying a coping action that people sometimes engage in when under stress. They categorized coping strategies into two: problem-focused and emotion-focused coping.

a) *Problem-focused coping* is generally viewed as an adaptive mode of coping that involves actively planning or engaging in a specific behavior to overcome the problem causing distress (Folkman & Lazarus, 1985). The examples of problem-focused coping include planful problem-solving, confrontive/active coping and seeking social/instrumental support such as friends, families, supervisors and mentors.

b) *Emotion-focused coping* involves attempts to regulate the emotions evoked by the occurrence of a stressful event and can be considered active or avoidant (Holahan & Moos, 1987; Ryan, 2013). Also, emotion focused coping may involve the use of behavioral and/or cognitive strategies such as receiving emotional support from friends and family and positive reframing (Ogden, 2004; Ryan, 2013).

How do the students cope with their stressors? There are a variety of these coping strategies, some are better and more effective to student learning than others. The following literature illustrate strategies used by the subject participants in confronting their stresses.

Kahraman and Sungur ((n. d.), as cited in Rioveros, 2013) stated that students cope with learning difficulty in three several stages. The first stage involves students defining the event as an obstacle to their goals. Then, the students think of the possible strategies to handle the negative event, and choose one among them. The last stage involves students applying the decided solution. These stages are manifestations of the theory with the acronym I-D-E-A-S.

Moreover, an examination of the experiences of stress and coping strategies of high school students in a university (Baluyou 1999; Rioveros 2013) revealed that when students experienced situations with affective peers, school and parents, they found it helpful using self-control coping skills. For the cognitive processes, they preferred both self-control and distancing coping skills. For the biological stress factor, students liked it better to deal with the stressful situations like planful-solving coping strategies. Through the study, it was learned that self-control, distancing and planful problem solving were found useful and effective coping strategies by the students.

Although most stressors elicit both types of coping, problem-focused coping tends to predominate when people feel that something constructive can be done whereas emotion-focused coping tends to predominate when people feel that the stressor is something that must be endured (Folkman and Lazarus, 1980; Carver, et al., 1999; Ghana, 2011). Due to their action-orientation, problem-focused coping strategies are more highly valued in Western societies (Lazarus, 1993; Ader & Erktin 2012).

Gender and Coping

Based on sex-typed predispositions, men and women will choose different types of coping strategies, a theory that has been frequently explored. In terms of coping, men would be expected to utilize problem-focused coping more than women whereas women are expected to use more emotion-focused coping than men (Hammermeister and Burton, 2004; Kaiseler, et al., 2012).

The idea that men and women use different kinds of coping strategies was supported by Rapson (1990; Stone and Neale (1984)). Men was reported to use significantly more of direct action, whereas women used more distraction, catharsis, seeking social support, relaxation and other types of coping. In the study of Billings and Moos (1984, as cited in Rapson, 1990), it was found out that women made significantly greater use of information seeking and emotional discharge than men. They also found that men reported less frequent use of active-behavioral, avoidance and emotion-focused coping than did women.

Meanwhile, in a study entitled Gender and Age Differences in How Children Cope with Daily Stress conducted by Rodriguez, et al. (2012), it was presented that girls aged 9 -12 years old scored higher on the problem-focused coping (active solution, telling the problem to someone else, information and guide seeking and positive attitude) whereas boys scored higher on unproductive coping (aggressive behavior).

The findings of Rodriquez were supported by Tamres, et al. (2002) by applying meta-analysis in examining the sex-differences in coping. Women's tendencies to appraise stressors as more severe accounted for sex differences in coping. The study likewise revealed that women were more likely to use strategies that involved verbal

expressions to others or the self – to seek emotional support, ruminate about problems, and use positive self-talk.

The study of Brougham, et al. (2009) which studied the relationship between sex, specific sources of stress, and coping strategies reported that college women had a higher overall level of stress and greater use of emotion-focused coping strategiesthan college men, though overall, the use of emotion-focused coping strategies dominated over problem-focused coping strategies for both men and women.

In another study conducted by Eschenbeck, et al. (2007), it was revealed that with the five subscales identified in their coping questionnaire namely: seeking social support, problem solving, avoidant coping, palliative emotion regulation, and anger-related emotion regulation, girls scored higher in seeking social support and problem solving, whereas boys scored higher in avoidant coping.

Course and Coping

A few studies reveal that students of different courses encounter varied mathematical difficulties, hence, with varied coping strategies.

The study of Bagasol, et al. (2015) which focused on difficulties and coping mechanisms of BEED and the BSEd students disclosed that listening attentively to the teacher was the most significant coping mechanism if one had no focus on math task and easily distracted by the things around him. The use of diagrams and pictures out of the problem and engaging self in leisure activities on the other hand were found to be the least significant coping mechanism for the BEED and BSEd courses, respectively.

In the field of health and medicine, nursing students likewise experience different levels of stress that include caring of patients, assignments and workloads, and negative interactions with staff and faculty. Common coping strategies utilized by nursing students included problem-solving strategies such as developing objectives to resolve problems, adopting various strategies to solve problems, and finding the meaning of stressful events (Labrague, et al. 2016).

Finalyson's (2014, as cited by Quan, 2015) paper studied on mathematics anxiety (stress/difficulties) and strategies that could prevent them among mathematics students. Through survey questionnaire, the participants were able to expressed their personal strategies among which are: relaxing, building self-confidence, practice, studying and doing one's homework and getting help. These strategies are by nature problem-focused coping strategies.

While, amongst general education students, stress-reducing coping strategies were collected through frequency analysis which revealed that the most common coping strategy by the study sample was active coping, a form of problem-focused coping strategy (Okoro, 2018).

Achievement and Coping

While some studies show that few strategies are effective ways of overcoming stresses of difficulties, others illustrate a positive influence on the achievement of the students.

Ader and Erktin's (2012) study, for example, pointed to a strong link between the use of problem-focused coping strategies and achievement in mathematics, but the findings need to be substantiated by further studies. Through Pearson product

moment correlation, the relationship between students' use of coping strategies and their mathematics grades in school were calculated. It was found out that students adopting the use of problem focused coping strategies more frequently can be expected to cope with difficulties which can contribute to the students' achievement in mathematics. In fact, a substantial relationship between the students' use of problem focused coping strategies and their grades ($r = 0.56$, $p < 0.01$) with higher frequencies of use of such strategies relating to higher grades in mathematics in school was revealed.

Problem-focused coping strategies consist of problem engagement or active/approaches which may include trainings on how to go about a particular problem. The study of Chinaveh (2012) which made use of an experimental design involved an experimental group consisting of a researcher-designed intervention which was an integrated set of instructional conditions operationalized in a series of sessions, practice, while the control group was exposed to the usual instruction. The study showed that students with originally low levels of approach coping responses and psychological adjustment increased significantly when they were randomly allocated to a problem-solving training group (experimental group) compared with the non-training control group. This result indicates that the use of problem solving training in the form of practice had a positive effect on coping responses of a group of undergraduate students.

In their study, Perera, et al. (2014) tried to determine the role of optimism and engagement coping in college adaptation. A part of the research hypotheses was that the greater use of engagement coping strategies is directly associated with better academic adaptation. The research sample of incoming college undergraduates,

where they were asked to recall their experiences of stressors related to college life like preparing for and taking examinations, preparing for assessment tasks, tutorials and lectures, making friends, interacting with faculty, delivering oral presentations, and class participation. Later on, this study revealed that the result was consistent with the hypothesis.

It should be noted, however, that the study of Adejumo and Brysiewicz (1998, as cited by Carnwell & Harrington, 2001) suggests that while the respondents appeared to use and adopt the mixture of problem-focused and at other times emotion-focused coping strategies, the targeted respondents may still have needed guidance to understand how some of the less adaptive strategies could impede the achievement of their goals.

Furthermore, coping strategies come in many forms, either one faces the difficulties he is facing with, or make ways to avoid the stress or the situation, or others just ignore and just move on. The literature presented illustrate the positive result of strategy on engaging with the problem. This engagement either brings an increase in achievement or turns a passive learner into an active one.

Modeling Students' Coping Strategies

The Need for Modeling

Models, as described by Turchin, et al. (n.d.) are compact descriptions of the system structure and can provide derivation of specific predictions from theory that can be tested with data. Depending on the purpose, one can develop different models for the same empirical system.

In addition, according to an article (Mehta, 2019), model building or mathematical modelling uses mathematics to represent, analyze and make predictions or otherwise insight into real-world phenomena. It is an iterative process that involves open-ended problems that require students to make genuine choices about what assumptions to make. Because of its iterations, modelling has been gaining more attention because of the benefits it offers because of its ability to demonstrate understanding through different representations.

Existing Models

Following are reviews of models that have been developed to describe system structures and how they provided predictions from theory coupled with tested data.

The study of Kirikkanat and Soyer (20187) was a path analysis model of academic success in a group of university students, which included the variables of academic confidence and psychological capital with a mediator variable – academic coping. The results revealed that academic confidence and psychological capital had pivotal direct and indirect effects on academic success via the mediator variable - academic coping. Also. academic coping had also a direct influence on academic success.

Moreover, predicting the students' mathematical academic underachievement in an Islamic Azad University and the appropriate strategies in mathematical academic achievement to be applied using the Data Envelopment Analysis (DEA) model was the focus of the study of Moradi and Amiripour (2017). The study uncovered the varied reasons of academic underachievement in mathematics through a survey. Among these include the intangibility of mathematical concepts and the abstract nature of

mathematics, inefficiency and traditional teaching methods, unfriendly class atmosphere, high volume of prescribed books and the large number of students in a classroom, inappropriate methodology and the like. It is recommended that factors such as those mentioned should be presented in the form of a conceptual model and the effects of these factors on the academic underachievement of the students in mathematic courses be investigated and compared to the students from the different faculties.

Meanwhile, some time in 2009, a study of Ernst, on one hand, wanted to analyze components, sequencing and challenges associated with technology education students. It focused on the identification and development of problem solving models that factor societal, cultural and economic considerations. It further investigated individual problem solving strategies concerning methods, solutions and abilities through a question survey instrument. The results revealed that there is no apparent effect on initial component selection of problem solving modeling whether challenged with environmental or manufacturing issues. But overall, participants challenged with the manufacturing issue developed problem solving models that necessitate the design of tangible artifacts which are considered to be important components for manufacturing students in the teacher preparation program (Ernst, 2009).

On the other hand, Houghton, et al. (2012) presented another model of the relationship among emotional intelligence, self-leadership, and stress coping among management students. The model suggested that effective motion regulation and self-leadership, as mediated through positive affect and self-efficacy, has the potential to

facilitate stress coping among students. This implied that basic emotion regulation and self-leadership strategies could be included in introductory management courses to potentially increase management students' abilities to cope with stress. Moreover, having the potential to generalize the workplace, emotion regulation and self-leadership strategies may be better taught to management students so as to effectively manage stress in future careers.

Meanwhile, a music professor observed that problem solving is seldom addressed directly within much the music teacher education curricula, and research in music education has not examined problem solving systematically. In a 49 video-recorded lessons taught by six renowned artist teachers, the researcher was able to observe problem solving that has occurred. When a solution to a problem came about as the result of both teacher and student involvement, the researcher identified the problem-solving behaviors that were differentiable as performed by teacher or student. Five components, synonymous with problem-solving behaviors observed in other fields, emerged as identifiable behaviors that contributed to problem solution: establish goals, evaluate, conceive and consider options, apply principles, and decide and act. To confirm this model, she coded every observable behavior within 18 full-length lessons. Almost every on-task behavior was describable in terms of the proposed problem-solving framework (Roesier, 2016).

In the field of combinatorics, topics are becoming common due to the K-12 curriculum (Lockwood, 2013). However, studies on combinatorics education show that students face difficulties when solving counting problems; the students' ways of thinking at a level that facilitates deeper understanding of how students conceptualize counting problems has not yet been addressed. Thus, in 2013, a theoretically and

empirically model was developed. This was a model of student's combinatorial thinking related to counting and has been refined through analyzing students' counting activity. The study presented the relationships between formulas/expressions, counting processes and sets of outcomes were elaborated. The usefulness and potential explanatory power of the model were demonstrated through examining data both from a study which the author (that is. Lockwood) conducted, and from existing literature on combinatorics education. The model was meant to be an initial attempt of providing ideas and common language that researchers can utilize in evaluating their own students' combinatorial thinking and activity (Lockwood, 2013).

The control-based model of coping of Coiro, et al. (2017) examined associations between interpersonal stress, coping strategies and symptoms. The study was conducted because they claimed that the ways that college students cope with stress may be a critical factor in determining which students are at risk for impairing mental health disorders. The results of the study revealed that students who experience more stress reported more depression. In addition, there was less use of engagement coping strategies and greater use of disengagement coping strategies. The engagement coping strategies accounted for a significant portion of the association between stress and mental health symptoms.

Coping Strategies of Students in the STEM/non-STEM related programs

In the field of medicine, a STEM-related academic program poses a variety of stress to students that may affect their well-being and may hamper of academic performance of the students. Thus, Madhyastha (n. d.) wanted to determine the stress and coping mechanisms of these students. Results show that female medical

students used problem-focused coping strategy of seeking instrumental support more than male students. Males on the other hand were found to use self-blame, a maladaptive coping strategy more than female students. Among the avoidant coping strategies, male students used denial significantly more than female students.

The students of nursing, also a pre-medical course usually are faced with various types of stress. In order to assess the methods of coping with stress among nursing students, Inamloo, et al. (2012) conducted this study. Through a Coping Inventory for Stressful Situation and demographic questionnaire, they were able to show that the problem-oriented, emotion-oriented and avoidance-oriented styles were the most frequent styles used by the nursing students.

ADDIE'S MODEL

This is a 5-phase systematic instructional design model with the acronym ADDIE meaning; a) Analysis, b) Design, c) Development, d) Implementation, and e) Evaluation. The outcome of each phase is fed into the next as this model illustrates a sequence of phases.

Analysis. In this phase, the learning problem, goals and objectives, student's needs, existing knowledge and other relevant characteristics are identified and presented.

Design. This includes a systematic and specific process of specifying learning objectives, assessment instruments and lesson planning are determined in here.

Development. This phase is where the content/plan is developed.

Implementation. The plan is put into action, after which, its effectiveness is evaluated.

Evaluation. This phase includes formative and summative evaluation. Formative evaluation is present in each stage of the ADDIE process. Summative evaluation provides opportunities for feedback from the users. Revisions are made as necessary (Castagnolo, 2008).

Models of Coping Strategies by Sex

The Coping Complexity Model of Hudson (2016) depicts the stressors, coping processes and the various responses that are possible. The coping process is initiated by a stressor. The stress experience can present at an individual, group, community or cultural level. It is also influenced by the timing, number and nature of the stressors and the specific personality traits involved. Generally, the study aimed to describe the complex phenomena of coping involving the stressors, influencing factors and responses of coping.

The Model of Coping Modes originated from the monitoring-blunting construct, and is related to the repression-sensitization conception and expands concepts of vigilance and cognitive avoidance with an underpinning of cognitive motivational approach. It emphasizes that a person is stimulated to avert the situation and perceive the stressor in an ambiguous manner in the presence of the stressor (Sincero, 2012)

A regression model which was multilevel-mediated was fit to Programme for International Student Assessment achievement, strategy use, gender, and family-and school-level socioeconomic status (SES). Strategies such as understanding, summarizing and control were found to relate significantly and positively to achievement. These strategies were used more by females and students attending higher SES schools. In contrast, males and students attending lower SES schools

tended to use a greater number of learning strategies that did not relate to achievement, including memorization and elaboration (Callan et al., 2017).

In addition, Duran's (2016) study through an academic survey revealed differences between attitudes and approaches of students from different types of high school and the first grade of university towards problem solving in chemistry. No significant differences were found among high schools, but there was between high school and university students. There was also a significant difference between female and male students in terms of their attitudes and approaches towards problem solving in chemistry.

Another study which aimed to analyze the role played by age and gender on the coping strategies of Andalusian students to cope with situations of daily stress was conducted. Situations included the family, health, school and peer interaction. Using the Childhood Coping Scale, results showed that girls scored higher on the coping strategies: active solution, telling the problem to someone else, information and guide seeking and positive attitude whereas boys scored higher on aggressive behavior (unproductive coping). The study wanted to prove the importance of age and gender in the study of children's coping in daily situations. Such usually happens because they have direct implications on the assessment and psycho-educational intervention on the area of stress and coping (Morales, et al., 2012).

Our society nowadays demands our time and resources that results in stress that promotes a decline in psychological adjustment. With an alarming number reporting high levels of stress and other stress-related problems, a study which addressed the need for a comprehensive model of emerging adult adjustment in the context of stress and coping variables was conducted. It highlighted the importance of

accounting for differences between males and females. The results of the structural equation modeling suggested that stress, social support, coping and adjustment showed unique patterns of relationships for males versus females. For both sexes, stress and social support showed similar relationship to adjustment. For females however, social support was related only to coping behaviors. Overall, social support seemed to be a more important variable for female adjustment while coping behaviors appear to be more pertinent to male adjustment (Asberg, et al., 2008).

Models of Coping Strategies by Academic Program

Examining the relationship between coping strategies and psychological well-being among a sample of 98 undergraduate teacher education students was the study of Gustems-Carnicer and Calderon (2012). The results showed that a relationship exists between coping style and psychological well-being. The study also pointed out that approach coping strategies as problem solving in teacher education students had a beneficial effect on symptoms of depression, phobic anxiety and overall level of psychological stress. On the one hand, cognitive avoidance coping were associated with greater presence of psychological symptoms indicating distress while behavioral avoidance strategies were associated with negative psychological well-being. Coping strategies thus may help reduce psychological distress in university students.

In the medical field, it is said that students of clinical psychology and medicine experience high level of mental distress and low levels of life satisfaction. The researchers then, Halland, et al. (2013) thought of investigating the effect of mindfulness training on the use of engagement and disengagement coping strategies, particularly on the measures of problem-focused coping, avoidance-focused coping

and the seeking social support. After a 7-week mindfulness-based stress reduction program, students who underwent the training increased their use of problem-focused coping compared to the control group. The study concluded that mindfulness training may help to improve adaptive coping in students, though there may be some limitations to students with high emotional reactivity.

For non-clinical population, Holen et al. (2012) explored the structure of coping with everyday stressors and examined the relationship between coping and mental health. Latent-variable regression analysis indicated that coping categories including both active and emotional strategies were associated with fewer mental health problems, while withdrawal and oppositional coping strategies were associated with greater mental health problems. The need for new, more comprehensive assessments was thus highlighted since the results replicated previous studies.

For social work students, a first of its kind study was conducted to explore stress and coping strategies of students in graduate social work education. Through concept mapping, five major clusters of stressors were presented: academic problems, financial difficulties, cultural barriers, psychological problems, and family concerns. Five major coping strategies also emerged as well: psychological coping, physical coping, problem solving, social support and entertainment. From the results, it was suggested that social work schools and departments should demonstrate cultural competence with the population by providing support services to help these students cope successfully (Chun and Poole, 2009).

All of these literature reviews talked about models, as interventions that can enhance the learning of students and as pictures or representations that exist in a structure or system. To arrive at a picture is known as model building and this requires

a rigorous process with utmost effort to arrive at a theory or concept. From the theory established comes the development of interventions called models which will be tested for its applicability in the locale where it was formulated.

The present study looks familiar in that the variables are presented showing how they are associated or represented with one another that may exist in a given system structure. What deviates this study from other researches is the stage on validation of the established associations or relationships, whether, they are present in another system structure or not.

Hence, this study aims to present different pictures or models showing how a diversified group of college freshmen with difficulties in mathematics problem solving cope with them. The developed models will serve as guides in the development of models used as interventions inside the classroom setting.

Process of Modeling

First Phase (Preliminary Investigation). This phase dealt with the review of related studies and literature that provided the researcher enlightenment on contributions of theorists and researchers to knowledge on difficulties in mathematics problem solving, coping strategies and the different models of learning. This phase included the identification of the common problem solving difficulties and the students' ways of overcoming them. These were done through a problem solving test that required solutions illustrating the four phases of problem solving and a coping strategy questionnaire that detailed the strategies of the students in addressing their problem solving difficulties.

Development Phase. This phase included the analysis using quantitative and qualitative method. Personal profile of the respondents such as sex and courses were described along with their mathematics problem solving difficulties as classified by Polya (1945) and the varied coping strategies the students utilized in coping with these difficulties. A student may experience difficulties in one or more of the phases of problem solving and may utilize several coping strategies. With such a scenario, several associations thereby a number of representations/models can be formed giving accounts to the different factors such as the problem solving difficulty phase, sex and academic program of the students.

Implementation/Validation Phase. This phase involved putting the plan into action where the model/s developed were tested to other groups of sudents. In short, this phase tested whether the developed models fit other groups of students and were able to address the problem solving difficulties of the studients through their coping strategies. Students involved in this implementation/validation phase having the same atrributes like coping strategies, sex and academic program as those students in the preliminary investigation were compared whether they applied the same coping strategies or not. The elicited coping strategies of students in this phase through a questionnaire were validated through observation and interview with the concerned students and with their respective teachers by the researcher.

Evaluation Phase. This phase confirmed the applicability of developed models with other group of students which provided conclusions regarding the study.

Model Building Framework

This research rests on three frameworks namely: the ADDIE Model, Lazarus and Folkman's Theory of Cognitive Appraisal, and Plomps' 3-stages of a design-based research that led to the development of the Model Building Framework used in this study (please see Figure 2).

People encounter as much difficulties and pressures in their everyday routines such as students struggling with mathematics problem solving. As problem solving involves the four phases namely: understanding the problem (UP), devising a plan (DP), carrying out the plan (CP) and looking back (LB), the life of a student becomes complicated since in each phase are possible difficulties that can be encountered. These difficulties coupled with anxiety inside the mathematics classroom are the stressors of the students which consequently, may lead to low achievement in mathematics (Tambychick and Meerah, 2010; Siniguian 2017). These difficulties as well as the probable causes of why the students encounter them were presented through a need and context analysis. The analysis included a review of the extant literature, which consequently had facilitated the development of a model building framework for the study.

While students struggled with their difficulties, they also tried their best to cope with such difficulties. This is one of the assumptions of the study. On the other hand, the student, while in a state of struggle, tried his best to cope with his difficulties. Ways of coping with their difficulties varied from each student. Some dealt with their difficulty in an objective manner while others by avoiding negative emotions related to stress. These types of strategies are generally classified into two namely: the problem-focused coping strategies and emotion-focused coping strategies (Lazarus and

Folkman, 1985; Carver, 1989). Seeking assistance from friends or teachers or tutors to be enlightened on the processes of problem solving is an example of a problem-focused coping strategy. This was highly utilized in the computational process of the problem solving. Ignoring the situation and talking and praying are examples of emotion-focused coping strategies which were utilized by a few of the respondents.

Associating these coping strategies and the problem solving difficulties was a gap which the researcher considered in conducting the study. Development of models was the study's primary aim which were eventually validated to determine whether they were able to address the problem solving difficulties of the students through their coping strategies.

The model building framework (please see Fig. 2) patterned after Plomp's 3-stages of a design-based research study, ADDIE Model and Lazarus and Folkman's Theory of Cognitive Appraisal served as the guide of the researcher in the development of the models.

Taken as a whole, the framework followed the 5-steps of ADDIE's model though it is intended for instructional materials development. Its 5-steps have a corresponding counterpart step in Plomp' 3-stages of a design-based research. Within the process flow is the interaction or association of stressors (mathematics problem solving difficulties) commonly encountered by the students and the stress alleviators (coping strategies) which is the idea behind Lazarus and Folkman's Theory of Cognitive Appraisal. The components of the model building framework developed in this study based on the aforementioned frameworks and theories are described in the succeeding sections.

Analysis Stage. This stage dealt with the analysis of the mathematics problem solving difficulties of the students through a problem solving test. Likewise, coping strategies were elicited through a Coping Strategy Questionnaire.

Model Development Stage. From the results of the problem solving test and coping strategy survey, two models associating the mathematics problem solving difficulties and coping strategies of the students were generated and developed namely: the coping strategies by sex by phase model and the coping strategies by academic program by phase model.

Model Implementation. This stage validated the models developed by engaging the students (validation group) through the administration of a similar problem solving test.

Model Evaluation Stage. This stage concluded the validation of the models. In particular, it assessed and determined whether the problem solving difficulties of the students were addressed or not through the coping strategies as modelled.

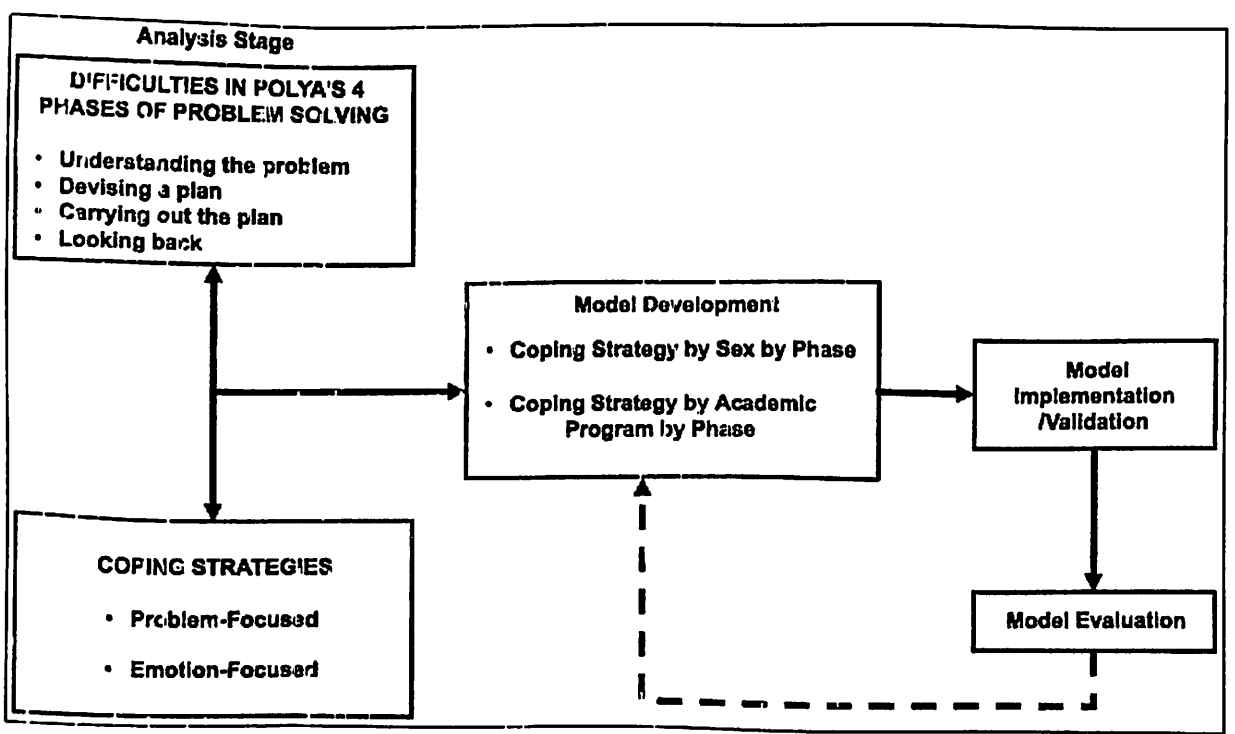


Figure 2. The Model Building Framework of the Study

Hypothesis:

Guided by the review of literature and model building framework (Figure 2), a hypothesis was formulated: All of the developed models fit or were applicable to other sets or groups of students.

Definition of terms

For clarity and better understanding of the study, the following terms are operationally defined.

Academic Program. It is referred to as the degree which a student wants to pursue. for example, the degree of BS in Mathematics, etc.

Mathematics Problem Solving. This refers to the process when students solve routine problems that require solutions illustrating the 4 phases of problem solving described by Polya (1945) in their solutions.

Mathematics Problem Solving Difficulty. This refers to the situation when a student feels stressed or challenged while solving a word problem. This is brought about by his difficulty in one of the following phases: understanding the problem, devising a plan/strategy, carrying out the plan, and looking back. This is determined using a problem solving test.

Coping strategy. It refers to a solution or mechanism used by the student in overcoming his/her identified mathematics problem solving difficulty/ies. This is determined using a Coping Strategy questionnaire.

Problem-focused coping strategy. It is a type of a coping strategy that is usually of the positive outlook as it involves actively planning or engaging in a specific behavior to overcome the problem causing distress (Folkman and Lazarus, 1985). In this type of coping, the student engages with the problems, involves himself or

participates in the classroom discussion through recitations and at other times, seeks guidance or assistance from his friends, families, supervisors and mentors to overcome his/her difficulties.

Emotion-focused coping strategy. This is a coping strategy that attempts to regulate the emotions evoked by the occurrence of a stressful event and can be considered active or avoidant (Holahan & Moos, 1987). The student makes ways to alleviate his/her feelings caused by his mathematics problem solving difficulty/ies by hanging out with friends, relaxing or watching movies.

Model. It is a representation showing the relation/association of mathematics problem solving difficulties and coping strategies of the students. This model will in turn allow for investigation of such association/relation to other systems (group of students).

Model Building. It refers to the process of coming up with a representation/picture showing the association/relation of mathematics problem solving difficulties and coping strategies of the students. It involves phases which commences with a preliminary investigation that identifies the mathematics problem solving difficulties and how students deal with them. Sex and course of students are likewise taken into account, from which different models were developed (development phase). The second phase includes implementation/validation where the different models will be tested for its applicability to other group of students. The last phase is evaluation where conclusion or confirmations regarding the applicability of the different models will be formulated.

MMW (Mathematics in the Modern World). This is a new General Education Core Course/subject prescribed by CHED under the K-12 curriculum taken by all college freshmen for the school year 2018-2019. It is not a traditional mathematics course nor is it a purely mathematics appreciation course. It is not a repetition of topics and concepts learned in high school algebra, but rather an exploration of the nature of mathematics and how the world can be viewed and understood using a mathematical lens.

Non-STEM-related academic programs. These are programs not belonging to any of the science, technology, engineering or mathematics which include BA in Communication, BS in Economics, BS in nursing and BS in Sociology,

Sex. It is an attribute that distinguishes the respondents from one another on the basis of their reproductive organs. The two general classifications of sex are Males (M) and Females (F).

STEM-related academic programs. These are programs that belong to any of the science, technology, engineering or mathematics which include BS in Agricultural and Biosystems Engineering, BS in Civil Engineering, BS in Chemical Engineering, BS in Mathematics and BS in Meteorology.

Instances. These refer to the number of times (frequency) or occurrences a particular problem solving difficulty was encountered by the respondents.

For example: Given that the problem solving test consisted of 20 problems, Student A can experience a certain difficulty 20 instances in each of the four phases, hence, Student A has a total of 80 possible instances. Since there were 297 students in all, then approximately 24,000 instances can be recorded for the whole study.

CHAPTER III

METHODOLOGY

This chapter presents a comprehensive discussion of the method by which this research was conducted The research design, instruments used, data gathering procedure and statistical treatment of data are herein discussed.

RESEARCH DESIGN

The study adopted the design research approach, which had three components namely; development, implementation and validation. Development of models has for its purpose to address the mathematics problem solving difficulties of students. This was achieved by looking at the coping strategies of students in dealing with these difficulties. Models/representations were then developed from the relations/association of variables coming from the freshmen respondents. These model/s were tested or implemented and later on validated, in another set of students, in a case study mode.

The case study was done to test whether students with problem solving difficulties in "understanding the problem" phase applied the same coping strategies as those students in the development phase. In general, given that the students in the implementation/validation experienced the same problem solving phase difficulty as those in the development phase, the case study tested or confirmed whether both groups of students utilized the same coping strategies or not.

Sample

Participants of the study involved 425 students from 13 intact classes of college freshmen students enrolled in Mathematics in the Modern World (c oded as Math 01) offered in a university in Ilocos Norte during the first semester of SY 2018-2019 (please see Table 1).

The participants belonged to the same year level, belonging to 18-19 age bracket and were the first graduates of the K-12 curriculum.

Table 1

Distribution of Respondents By Sex and Academic Program

Course	Number of Classes	Number of Males	Number of Females	Total
STEM-related academic programs				
BS-Agricultural and Biosystems Engineering	2	28	43	**71**
BS-Chemical Engineering	1	10	12	**22**
BS-Civil Engineering	3	67	46	**113**
BS-Mathematics	1	5	21	**26**
BS-Meteorology	1	9	8	**17**
Subtotals		***119***	***130***	***249***
Non-STEM-Related academic programs				
BA-Communication	1	8	24	**32**
BS-Economics	1	11	25	**36**
BS-Nursing	2	15	62	**77**
BS-Sociology	1	8	23	**31**
Subtotals		***42***	***134***	***176***

Thirteen intact classes were classified into two: *STEM-related and non-STEM-related academic programs.* For the STEM-related academic programs, the two classes of the BS in Agricultural and Biosystems Engineering had distributions of 34 and 37 students, respectively. The BS in Civil Engineering which consisted of three classes, had student distributions of 38, 39 and 36, respectively.

For the non-STEM related courses, there were 42 and 35 students, respectively in the two classes of the BS in Nursing. The other classes had the student distributions as shown above.

As the study needed two independent groups; one group for the development of the model, and the other group for the implementation/ validation stage, the researcher applied the 70 – 30 scheme of partitioning the students. The scheme according to Pete (2017) is arbitrary. However, the more respondents that are included in the development stage (70%), the better the developed model/s is/are. There were 425 students in totality. Two hundred ninety-seven (297) respondents represented the 70 percent and were included in the model development with the distribution found in Table 2. This sum was identified through random sampling particularly done through a table of random numbers generated by stattrek.com. The selected samples however, had their final say in their participation in the study.

Meanwhile, the developed models were validated by the remaining 30 percent of the total respondents which involved 128 respondents as distributed in Table 3. Their participation was primarily to test whether the models developed fit them and eventually can address the problem solving difficulties of the students in a case samples . Factors such as having the same coping strategies by sex and by academic programs of students as those in the development phase were taken into consideration in selecting the case samples.

Table 2

Distribution of Respondents By Sex and Academic Program in the Model Development Stage

Course	Male	Female	Total
STEM-Related academic programs			
BS-Agricultural and Biosystems Engineering	22	28	**50**
BS-Chemical Engineering	8	7	**15**
BS-Civil Engineering	48	31	**79**
BS-Mathematics	3	15	**18**
BS-Meteorology	8	4	**12**
Subtotals	***89***	***85***	***174***
Non-STEM-related academic programs			
BA-Communication	5	17	**22**
BS-Economics	9	16	**25**
BS-Nursing	11	43	**54**
BS-Sociology	4	18	**22**
Subtotals	***29***	***94***	***123***
TOTALS	**118**	**179**	**297**

Table 3

Distribution of Respondents By Sex and Academic Program in the Model Validation Stage

Course	Male	Female	Total
STEM-Related academic programs			
BS-Agricultural and Biosystems Engineering	8	13	**21**
BS-Chemical Engineering	3	4	**7**
BS-Civil Engineering	20	14	**34**
BS-Mathematics	2	6	**8**
BS-Meteorology	3	2	**5**
Subtotals	**36**	**39**	**75**
Non-STEM-related academic programs			
BA-Communication	3	7	**10**
BS-Economics	3	8	**11**
BS-Nursing	4	19	**23**
BS-Sociology	2	7	**9**
Subtotals	**12**	**41**	**53**
TOTALS	**48**	**80**	**128**

Instruments

The study made use of two instruments: a **Problem Solving Test** and a **Coping Strategy Questionnaire.** These instruments were subjected to face and content validation.

Problem Solving Test

The test was a researcher-made where applications on linear equations were evenly distributed according to the type of problem as provided below in the table of specifications (Table 4). This test was administered to the identified respondents in order for the researcher to provide answers to the first objective of the study, that is; to identify the common difficulties of students in solving mathematical problems classified according to the different phases of Polya's (1945) problem solving.

The prelirninary draft of the problem solving test consisted of 24 problems, which were a combination of different types of problems, each requiring answers illustrating the four phases of Polya's (1945) problem solving. These types were discussed and illustrated on the topic of devising a plan, with the strategy of simplifying an equation. The discussion of the different types of problems was allotted a total of three hours (180 minutes) which is equivalent to one week (please see Table 4). Several materials were referred to in the construction of the problem solving test namely; Feliciano and Uy (1991), Ymas, et. al (2005), Petilos (2002), online resources and other mathematics test items compiled in the Mathematics Department of the university.

Table 4

Table of Specifications on Problem Type (Initial Draft)

Type of Problem	No. of Minutes	No. of Items	Item No.
Age	20	3	1, 16, 20
Money/Coin	20	3	2, 15, 23
Geometry/Dimensions	20	3	3, 9, 18
Motion/Distance	25	3	4, 13, 21
Work	25	3	5, 10, 17
Investment/Interest	25	3	6, 12, 19
Mixture	25	3	7, 11, 24
Number Relations	20	3	8, 14, 22
Total	180	24	

Questions included in the test can be found in Appendix H.

After the presentation of the initial draft of the problem solving test to the three members of the comrnittee whose area of specialization is mathematics education, the researcher revised the instrument based on their suggestions. Upon their unanimous approval, the test was validated by three professors in the locale of the study. They were asked to evaluate the problem solving test as a whole using a researcher-made validation instrument. The panel of experts validated the instrument according to test specification, test format, and directions and test items. The test obtained a unanimous rating of 4.0 (4 - highest, 1 - lowest) which signified a high inter-rater reliability.

Meanwhile, scoring rubric was also presented which was utilized in scoring the solutions of the students. A copy of the rubric is presented in Appendix N.

The 24-item problem test was pilot tested to college sophomore students of the following degree programs: BS in Tourism Management, BS in Computer Engineering, and AB in English Language, with 87 students in total, since they had exposure to the topics and concepts measured by the test. The try-out was conducted

in three different schedules that matched the available time of the identified students which commenced last October 4, 2018.

The test questions were distributed first together with the answer sheets. The teacher explained the directions well before the students started to answer the items. Students were given time to ask questions or make some clarifications about the directions. Furthermore, the students were given at most two hours to finish the test.

To test the reliability of the problem solving instrument, Cronbach's alpha reliability was used with a coefficient of 0.79 which according to Nunnaly (1978, as cited in Santos, 1999) was acceptable. This coefficient facilitated the revision of some items of the initial draft of the problem solving test. This is because some of the test items were out of the range of the difficulty index (20% to 80%) and range of the discrimination index (30% to 80%), hence coming up with a new table of specification presented below. The final form of the Problem Solving Test was composed of 20 items (please see Table 5).

Table 5

Table of Specifications on Problem Type (Final Draft)

Type of Problem	No. of Minutes	No. of Items	Item No.
Age	20	2	1, 14
Money/Coin	20	3	2, 13, 16
Geometry/Dimensions	20	2	3, 20
Work	25	1	4
Mixture	25	3	5, 12, 15
Investment/Interest	25	2	6, 18
Motion/Distance	25	3	7, 11, 17
Number Relations	20	4	8, 9, 10, 19
TOTAL	180	20	

The revised or the final form of the problem solving test was then presented once more to the panel and everyone favored and advised the researcher to proceed with

the administration of the final form of the problem solving test and start the preliminary investigation.

Coping Strategy Questionnaire

The questionnaire was a form of an indirect interview where students were asked to share their past experiences particularly in problem solving situations. They were asked how they managed their difficulties known as coping strategies in the problem solving test. Data collected provided answers to the second objective of the study; that is, to identify the common coping strategies of the students in solving mathematical problems. Students may have their own coping strategies, thus, the questionnaire was open to any form of strategy.

Data Collection Procedure

Prior to the Development of the Model

Firstly, the researcher requested permission from the university president and the respective deans of all the participants for the conduct of the study from the try-out of the problem solving test up to the validation/implementation of the developed model/s. Informed consent forms were also given to the participants as prescribed by the University Reseach Ethics Review Board (URERB). When permission was granted, the final draft of the problem solving test was administered personally by the researcher.

Development of the Model

The administration of the final form of the problem solving test with an appended coping strategy questionnaire initiated the development of the models. The test was administered to all freshmen (425) after the topic on Problem Solving and Reasoning of the Mathematics in the Modern World (Math 01) had been discussed by the respective teachers of the identified students. It was first administered to the BS in Nursing students last November 5, 2018 until December 14, 2018. After all the respondents had taken the test, 70 percent of them (297) were randomly selected by the researcher and helped in the development of the models.

The test gave emphasis on the identification of student's mathematics problem solving difficulties on the four phases of Polya's problem solving (1945). Coping strategies were likewise elicited in each of the phases of problem solving, thereby coming up with varied models. These models showed how students coped with their problem solving difficulties through varied strategies. Solutions/responses to the problem solving test and questionnaire were then checked/tabulated by the researcher. To triangulate the responses of these students, informal conversation with unstructured interview questions was done to a selected number of students and to a few teachers who handled the identified respondents.

The results were presented to the three experts who earlier validated the problem solving test and signified their approval with how the solutions/responses were handled.

Model Implementation and Validation

After the models were developed, the researcher explained and discussed the different coping strategies that can be utilized in dealing with problem solving difficulties to the validation group which represented the 30 percent of the total respondents. The researcher did purposive sampling from the 30 percent respondents and interviewed a few if their coping strategies matched those in the models. The samples whose coping strategies matched those in the developed models were given a similar problem solving test as in the preliminary investigation phase. The administration of the test took place after the final examinations of the second semester of SY 2018-2019.

Validating the models involved comparing the difficulties of the case samples before the models were developed and after utilizing the coping strategies found in the models. The aim of this stage of the study as a whole was to determine whether the developed models were applicable to other group of students which is the last objective of the study, and consequently, was able to conclude that the models were able to address the problem solving difficulties of the students through their coping strategies.

Data Analysis Procedure

Descriptive statistical measures such as frequency and percentages were used to describe data trends. Frequency count for both problem solving difficulties and coping strategies per sex and academic programas was computed. On the other hand, the student's identified coping strategies were listed hand and counted per sex and academic program.

In the development phase, associations of the students' problem solving phase difficulties and coping strategies were presented through models like tables and graphs using MS-Excel. The interviews done to verify the students' performance in their matthematics subject were used to enrich the discussion of the results on coping strategy.

Applicability of the developed models was determined through a checklist, where the phase difficulties of the students were compared with the phase difficulties before the development, that is, if there was a decrease in the occurence of the difficulty or it has persisted after the coping strategies in the models have been utilized

.

Inclusion/Exclusion/Withdrawal Criteria

All first year college students enrolled during the first semester of S.Y. 2018-2019 were eligible for the study. However, only those available during the adrninistration of the problem solving test and coping strategy questionnaire were included and served as the respondents of the study. Those who were not around were no longer included.

Ethical Consideration

Approval to conduct this study was obtained from the members of the Dissertation Advisory committee of the UP-Open University, concerned colleges of the research locale and the University Research Ethics and Review Board (URERB) which ensured that the research study satisfactorily complied with the key ethical considerations in conducting a research.

This study had no conflict of interest with the UP-Open University and the result of the study was treated only for the purposes of the study. Prior to the handling of problem solving test and coping strategy questionnaires to the respondents, the researcher discussed with them the purpose of the study and explained some confidentiality issues. Once they agreed to participate, an informed consent was obtained from them. The informed consent form stated the voluntary participation of the respondents to become informants of the study, including their awareness of the purposes of the study, data collection method, duration, and utilization of participation.

The respondents were informed of the voluntary nature of their participation and were advised to stop answering the test and questionnaire at any point they deemed necessary for them. Data were captured from the respondents without any identification details, and all personal details were processed in an anonymous manner to ensure confidentiality.

The problem solving test was done during the free time of the selected participants. All materials needed for the test were provided. The problem solving test and coping strategy questionnaire required at most two hours.

After the analysis of the data gathered, the solutions to the problem solving test and accomplished questionnaires were deposited in a sealed envelope at the Faculty room of the Department of Mathematics in the College of Arts and Sciences of the University.

CHAPTER IV

RESULTS AND DISCUSSIONS

Discussion in this chapter focuses on the identification of both the students' problem solving difficulties in the different phases of Polya's (1945) problem solving and the strategies they apply in dealing with their difficulties as gleaned from their solutions to the test.

Students' Difficulties in Mathematics Problem Solving

After the administration of the problem solving test was the checking of the papers. A summary of the difficulties met by the students is presented in Table 6. There were two difficulties observed in each phase.

In understanding the problem (UP) phase, the difficulties observed were the inability to distinguish the known from the unknown information and the inability to identify the type of problem and recall basic facts. The former had two forms: either the student was only able to write the given or only what is required of the problem. The inability to identify the type of problem and recall basic facts has led the student to leave the space provided blank. There were 344 (5.51%) instances whereby this difficulty was experienced by the respondents, slightly lower than the instances of experiencing the inability to distinguish the known or unknown information (385 or 6.17 %).

In devising a plan (DP) phase, the inability to transform a problem into a mathematical equation and the inability to draw table/charts out of the information and organize information and connect to a concept were the difficulties observed. The

former difficulty had two forms: either the mathematical equation was incomplete or it was incorrect. While, the other difficulty, because of the student's difficulty to organize information, nas led him/her to leave the space provided blank. There were more instances (1001 or 16.03%) where the respondents experienced the inability to transform a problem into a mathematical equation than the inabiility to draw table/chart and organize information and connect to a concept (817 or 13.09%).

In the carrying out the plan, two difficulties were observed: inability to completely perform the working procedure systematically and accurately and the inability to start with the computational process. The first difficulty came in two forms: either the working procedure was incomplete or non-systematic. The second difficulty, because of the student's inablility to start/initiate the computation, s/he was not able to write anthing on the space provided, hence it was left blank. There were more instances (960 or 15.37 %) where the students had incomplete or non-systematic working procedure than the inability to start/initiate the computational process (774 or 12.40 %).

In the looking back phase, the inability to complete the checking procedure and the inability to start the evaluation of the correctness of the obtained solution were observed. The former difficulty had two forms: inability to complete the checking procedure and the inability to start the evaluation of the correctness of the obtained solution.There were more instances (1421 or 22.76%) where the students were unable to start the evaluation of the correctness of the obtained solution leaving the space provided blank than the inability to complete the checking procedure.

Table 6

Frequency of Observed Problem Solving Difficulties of the Students

Phases	Observed Responses/Difficulties	Instances/Frequencies	
Understanding the Problem (UP) Phase	Inability to distinguish the known from the unknown information	385	(6.17)
	Inability to identify the type of problem and recall basic facts	344	(5.51)
	Subtotal	***729***	***(11.68)***
Devising a Plan (DP) Phase	Inability to transform a problem into a mathematical equation	1001	(16.03)
	Inability to draw table/charts out of the information and organize information and connect to a concept	817	(13.09)
	Subtotal	***1818***	***(29.12)***
Carrying out the Plan (CP) Phase	Inability to completely perform the working procedure systematically and accurately	960	(15.37)
	Inability to start with the computational process	774	(12.40)
	Subtotal	***1734***	***(27.78)***
Looking back (LB) Phase	Inability to complete the checking procedure	541	(8.67)
	Inability to start the evaluation of the correctness of the obtained solution	1421	(22.76)
	Subtotal	***1962***	***(31.43)***
OVERALL TOTAL		**6243**	

Note: Figures in parenthesis are percentage values

A few of the respondents' solutions are presented below as exhibits with their encountered difficulties.

Understanding the Problem

Solutions showing the inability to distinguish the known from the unknown information

In Exhibit #1, the solution shows that the student was unable to distinguish the known from the unknown information. He merely lifted the words/phrases as stated in the problem.

Exhibit #1(BS-ABE-B5)

1. *Deewys is twice as old as Jean. Three years ago, the sum of their ages is 39. How old are they?*

Understanding the problem

- Because is twice as old as Jean
- Three years ago, the sum of their ages is 39

Devising a plan.

Let x = age

x-3 = their age 3 years ago

Exhibit #2 shows the student's inability to distinguish the unknown information in the problem and just lifted the exact words used in the problem.

Such difficulty was experienced by 144 (48.48 %)respondents ((please see Table 7).

Exhibit #2 (BSCE-B1)

2. *In consecutive turns of a Monopoly game, Stacy first paid P8,000.00 for a hotel. She then lost half her money when she landed on Boardwalk. Next, she collected P2,000.00 for passing GO. She then lost half her remaining money when she landed on Illinois Avenue. Stacy now has P25,000.00. How much did she have just before she purchased the hotel? (Aufmann, 2013)*

Known: P8,000 first paid
- ½ of money when she landed in boardwalk
- she collected 2000 for passing GO
- lost ½ of her remaining money
- 25 000 final money

devising the plan

x = 8000 = hotel

$\frac{x - 8000}{2}$ = lot

$\frac{x - 8000}{2} + 2000$ = passing GO

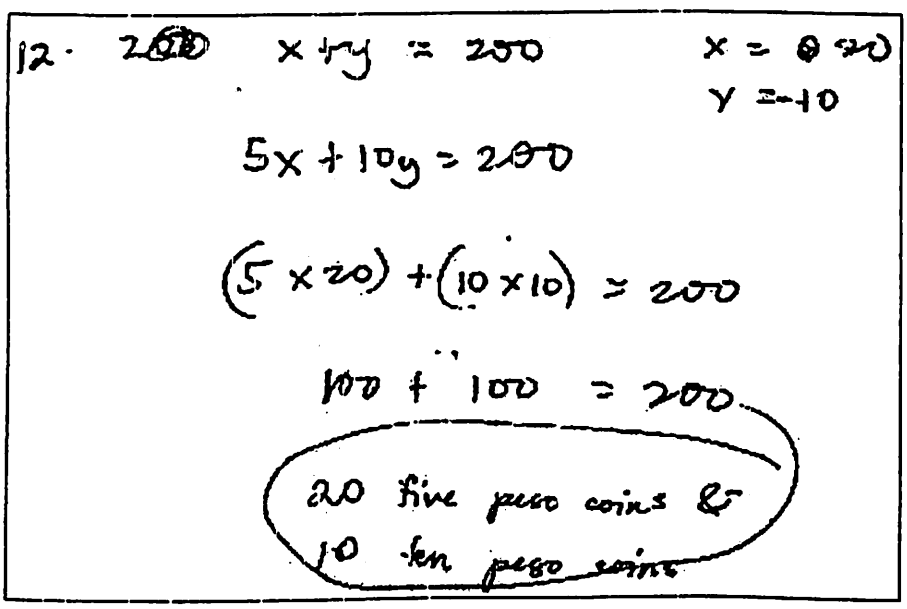
$\frac{x-8000}{2} + 2000 = 25000$

Solution showing the inability to identify the type of problem and recall basic concepts

Looking at Exhibit #3, one can observe that the student immediately proceeded in manipulating his working equation without trying to distinguish the given/known and unknown information of the problem. S/he was not able to identify the type of problem and recall basic concepts, thus, left the space provided blank.

Exhibit #3 (BA-COMM-1)

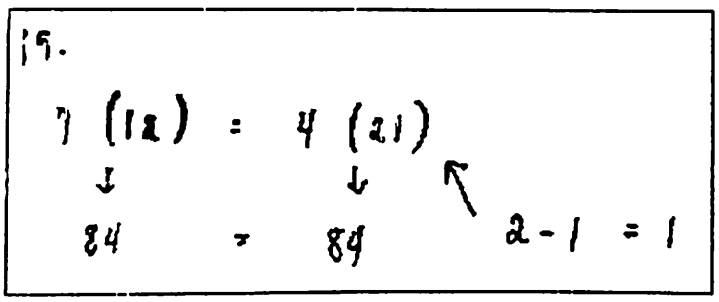
12. Ellah has exactly P200 in P5 coins and P10 bills. He has twice as many P10 as P5. How many of each does he have? (Petilos, 2002)



Looking at the solution of Exhibit #4, the respondent totally left the space provided for understanding the problem phase. The student did not write anything about the problem's given and unknown information because s/he was not familiar with the type of problem and cannot recall basic facts. One hundred thirteen (38.05%) respondents experienced this type of difficulty (please see Table 7).

Exhibit #4 (BSN-A2)

19. Seven times a 2-digit number is equal to 4 times the number obtained by reversing the digits. The difference between the digits is 1. Find the number.



Understanding the problem is really a difficulty to the students. This observation supported the result of Ferguson (1980), which believed that reading, which is a part of understanding the problem phase, where symbols and abstractions are concerned, is one of the greatest problems in learning mathematics. This difficulty of understanding the problem was further strengthened by the study of Pearce, et. al (2013). This is also supported by the study of Didis & Erbas (2015) where they found out that students struggle in comprehending the text.

Devising a Plan/Strategy

Solutions showing Inability to transform problems into mathematical equations

One can easily check that the mathematical equation formed is incorrect in Exhibit #5.

Exhibit #5 (BS-ECON-A16)

3. *A 12 cm by 16 cm rectangular piece of cardboard has a 2cm by 2 cm square cut out of each corner. Then the sides are folded up to make an open box. What is the volume of the box?*

UNDERSTANDING THE PROBLEM
known: → 12 cm by 16 cm rectangular piece of cardboard
→ 2cm by 2cm square cut out of each corner
unknown: → volume of the box

• Devising a plan:
Let $12x + 16 \times x$ = rectangular
2^2 = square cut
$4x$ = side of squ

Working equation
$12x + 16 \times x(2)^2 = 4x$

DO-UP

Exhibit #6 shows a solution of the student who incompletely formed the mathematical equation for the stated problem. Incomplete in a way that s/he missed an expression to make the mathematical equation feasible.

Exhibit #6

START HERE. ***Solve each problem nea illustrate each of the four phases of pro***

1. *Deewye is twice as old as Jean. How old are they?*

Understanding the Problem
- Deewye is twice as old as Jean
- 3 yrs ago, the sum of their age is 30

Devising a Plan
x = Jean
$2x$ = Deewye

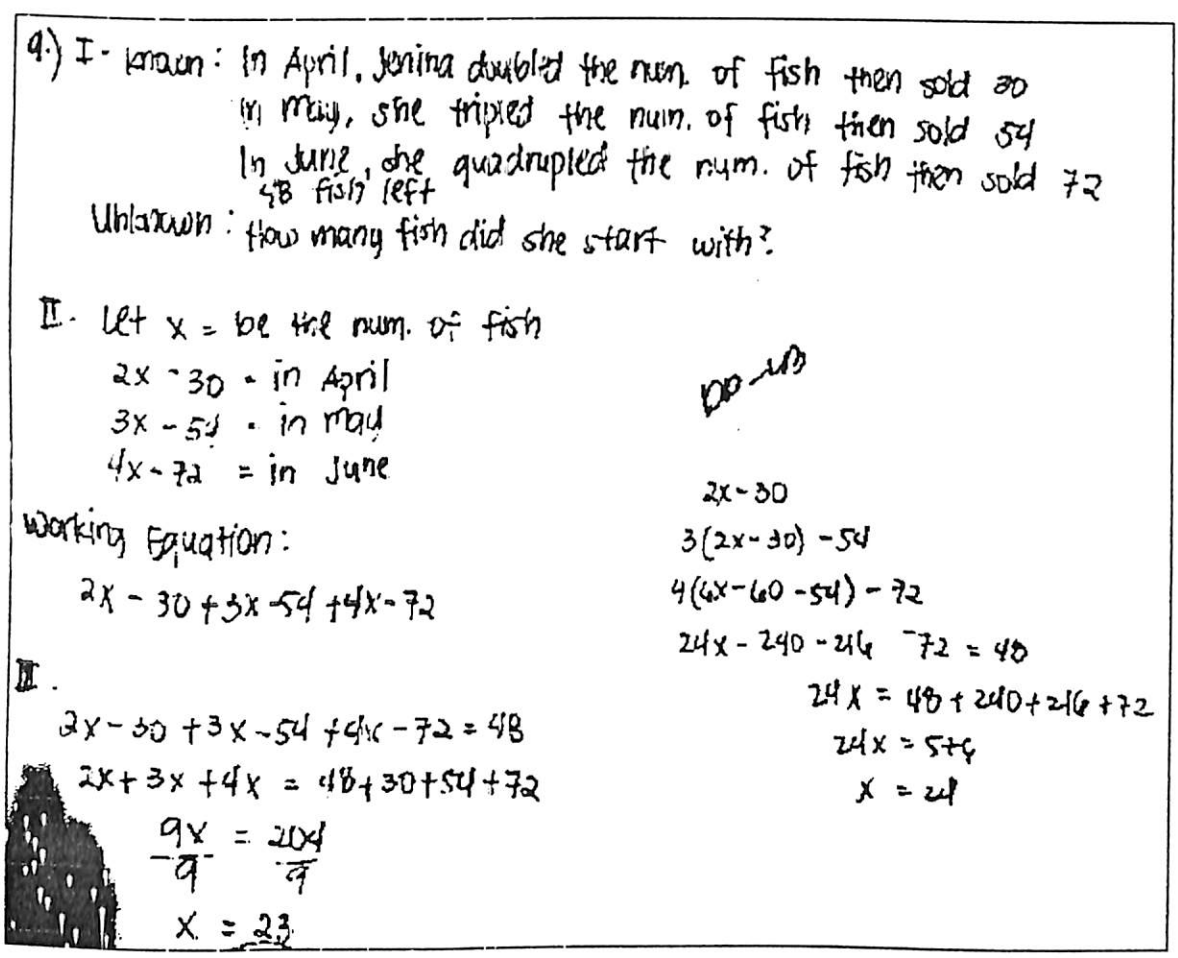
$2x + x - 3 = 39$

From the solution of the student (Exhibit #7), s/he was able to distinguish the unknown from the known information, however, s/he was unlucky to formulate the

working equation. These types of difficulties were experienced by 270 respondents (90.91 %) (please see Table 7).

Exhibit #7 (BS-CHEM E14)

9. *Jenina owns a pet shop that specializes in tropical fishes. In April, Jenina doubled the number of fish she had on hand and then sold 30 of them. In May, she tripled the number of fish she had on hand, and then sold 54 of them, In June, she quadrupled the number of fish she had, and then sold 72 of them. She now had 48 fish left. How many fish did she start with? (Petilos, 2002)*

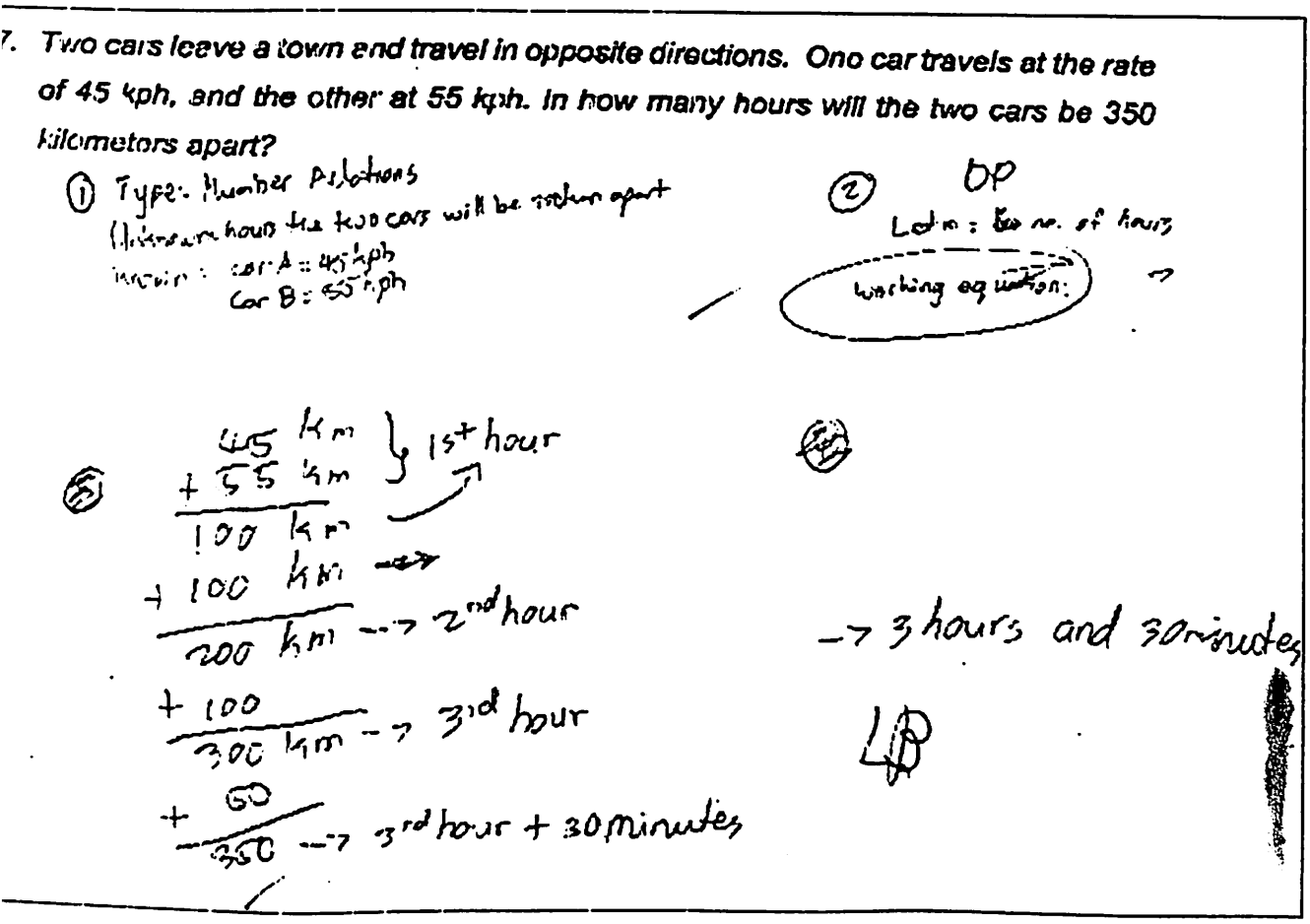


Solution showing the inability to draw tables/charts out of the information and organize information and connect to a concept

This student (Exhibit #8) proceeded with a strategy that worked well for the given situation, however, s/he was not able to form the mathematical equation that

applied to distance/motion problem. Two-hundred forty-three (81.81 %) respondents experienced this type of difficulty (please see Table 7).

Exhibit #8 (BS-METEO-1)



The above exhibits show that devising a plan to solve a mathematical problem is likewise difficult to the students. This result supported the findings of Reddy and Panacheroensawad's (2017), where their respondents also showed their inability to remember related equations. The inability to translate problems into mathematics equations as revealed in Siniguian's (2017) was also apparent in this study. Moreover, the present study confirmed the findings of Nurreberg and Pickering (1987) and Sawrey (1990) where the respondents of the latter studies showed their ability to solve stoichiometry problems but were unable to represent the required reaction in

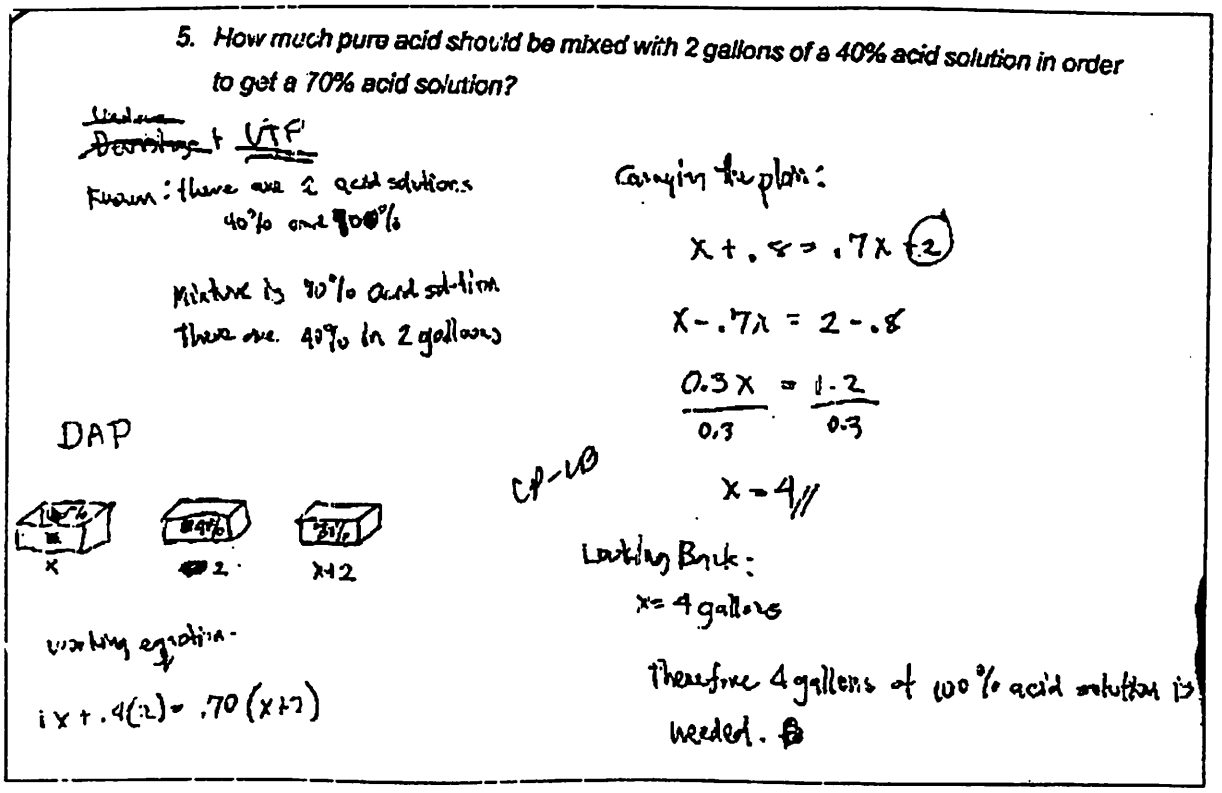
the stoichiometry problem with an illustration, which is one of Polya's (1945) charateristics of the difficulty of devising a plan.

Carrying out the plan/strategy

Solution with an inability to completely perform the working procedure systematically and accurately

In Exhibit #9, one can observe that the mathematical equation formed is correct, however, the respondent had an error in applying the distributive property, which resulted to an incorrect computation. Two-hundred sixty-five (89.23 %) respondents encountered this type of difficulty (please see Table 7).

Exhibit #9 BSCE-A2

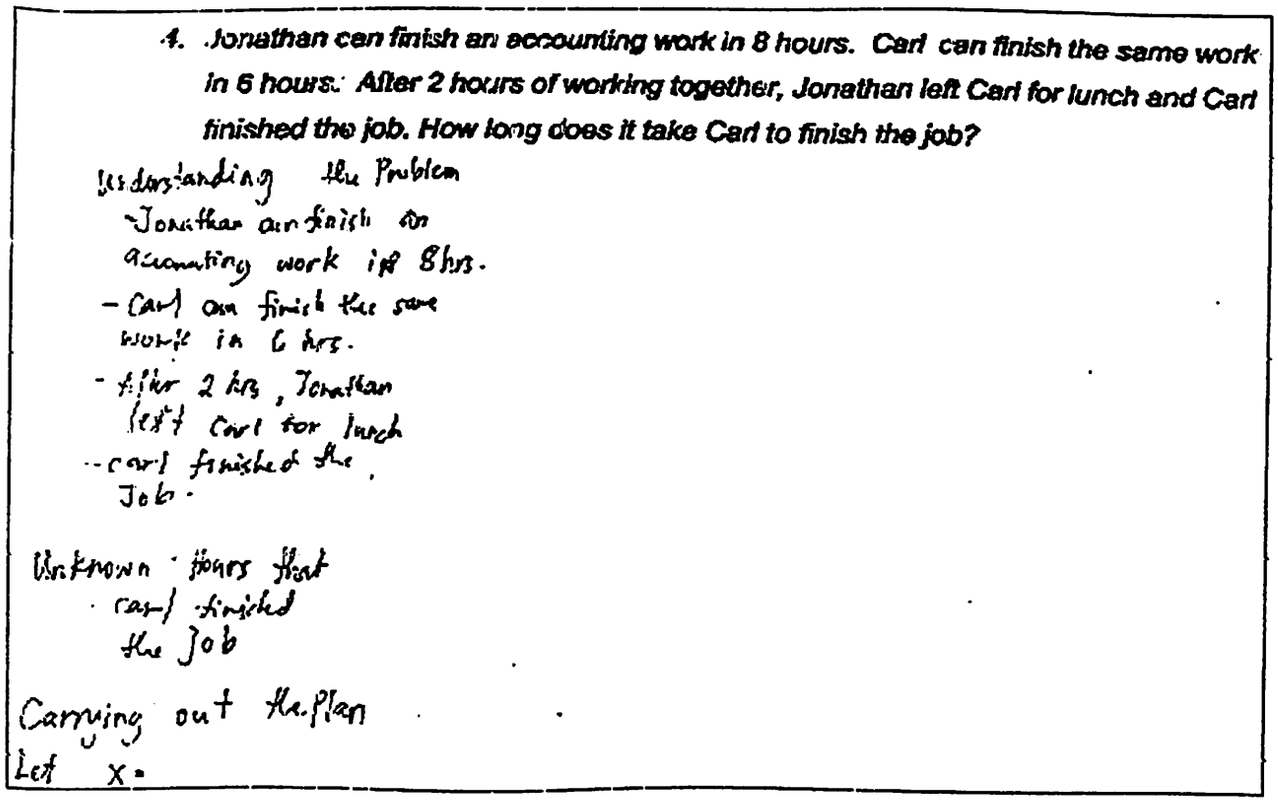


Solution showing inability to start with the computational process

It can be observed that the student (Exhibit #10) was unable to start with the computational process because s/he was not able to form the mathematical equation. There were 237 (79.80 %) respondents who experienced this type of difficulty.

The difficulty of performing the computational process coincides with the findings of the study of Siniguian (2017) and Dela Cruz and Lapinid (2014) where he investigated the difficulties experienced by the third year college students in solving Mathematics problem. The study revealed that the difficulties are on the inability to translate into mathematical formula (DP) which consequently affected the student's computational process (CP) and the inabiility to use correct mathematics (CP).

Exhibit #10 (BS-ABE-B23)



4. *Jonathan can finish an accounting work in 8 hours. Carl can finish the same work in 6 hours. After 2 hours of working together, Jonathan left Carl for lunch and Carl finished the job. How long does it take Carl to finish the job?*

Understanding the Problem
- Jonathan can finish an accounting work in 8 hrs.
- Carl can finish the same work in 6 hrs.
- After 2 hrs, Jonathan left Carl for lunch
- Carl finished the Job.

Unknown - hours that Carl finished the Job

Carrying out the Plan
Let x =

Looking back

Solution showing the student's inability to complete the checking procedure

In Exhibit #11, one can observe that the student has the knowledge of checking his/her work but his/her working procedure was wrong.

Exhibit #11 (BSCE-C25)

2. *In consecutive turns of a Monopoly game, Stacy first paid P8,000.00 for a hotel. She then lost half her money when she landed on Boardwalk. Next, she collected P2,000.00 for passing GO. She then lost half her remaining money when she landed on Illinois Avenue. Stacy now has P25,000.00. How much did she have just before she purchased the hotel? (Aufmann, 2013)*

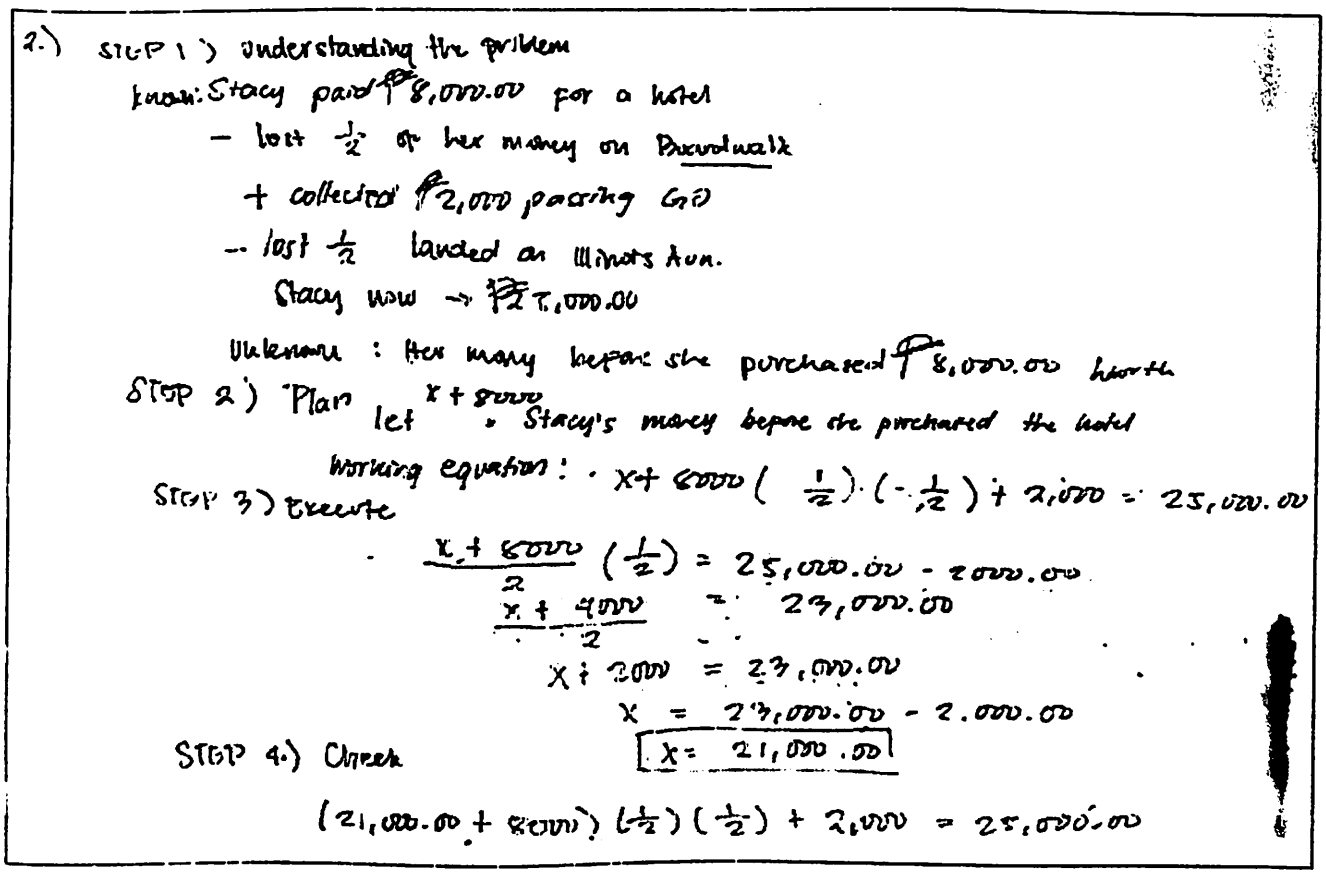
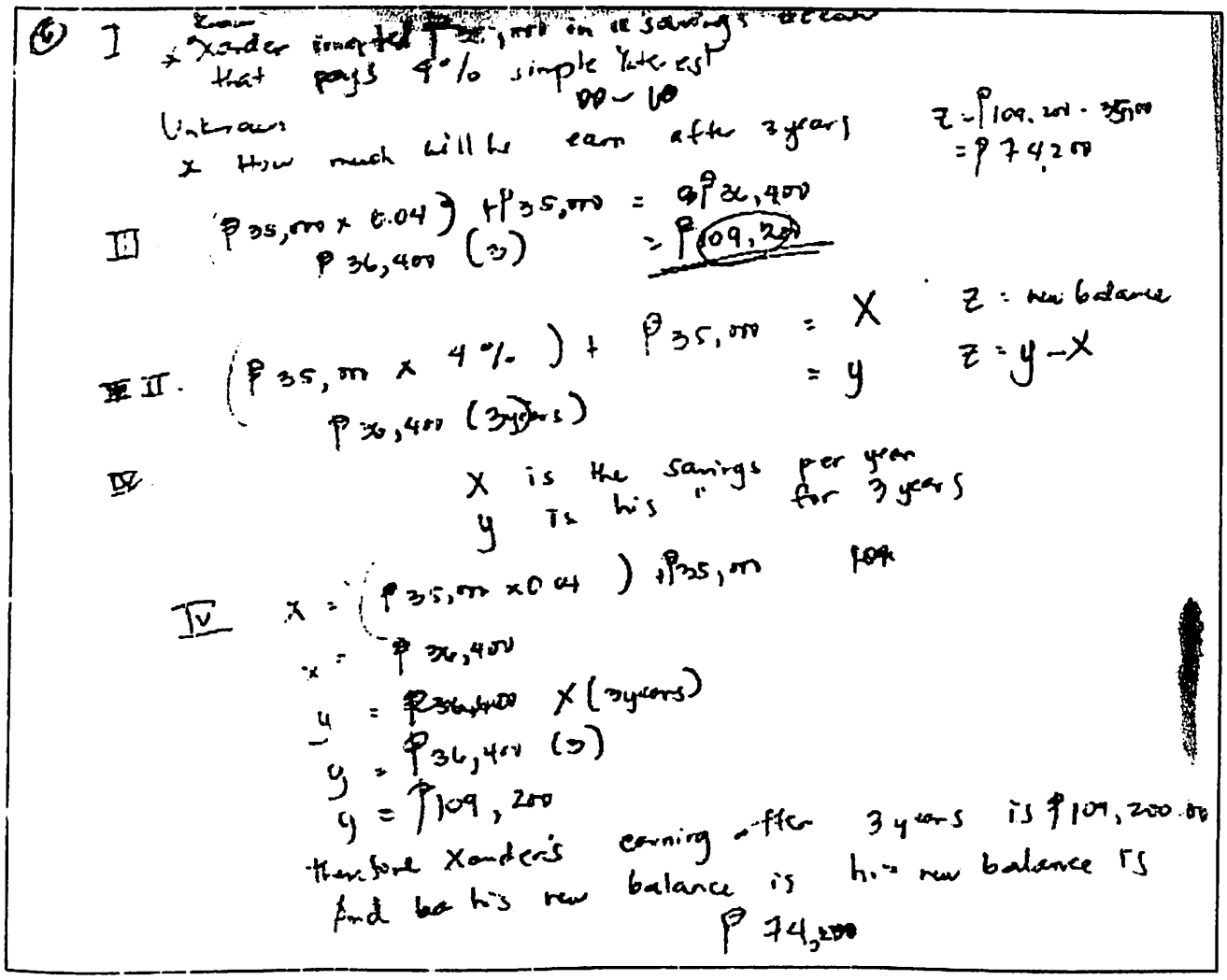


Exhibit #12 was able to recheck/re-evaluate the derived value but was not consistent with the the facts of the problem. Two hundred eighteen (73.40 %) of the

respondents showed these types of difficulties as experienced by Exhibits #11 and #12.

Exhibit #12 (BS-ABE-A6)

6. *Xander invested P35,000.00 in a savings account that pays 4% simple interest. How much will he earn after 3 years? What will the new balance be?*



Solutions Showing an inability completely perform the working procedure systematically accurately

Both exhibits #13 and #14 showed that their procedures went well as seen from the solutions however, they were not able to check whether they satisfied the conditions given in the problem or not. One hundred thirty respondents (experienced this type of difficulty (please see Table 7).

Exhibit #13 (BSN-A1)

8. *The first of three numbers exceeds twice the second number by 4, while the third number is twice the first. If the sum of the three number is 54, find the numbers.*

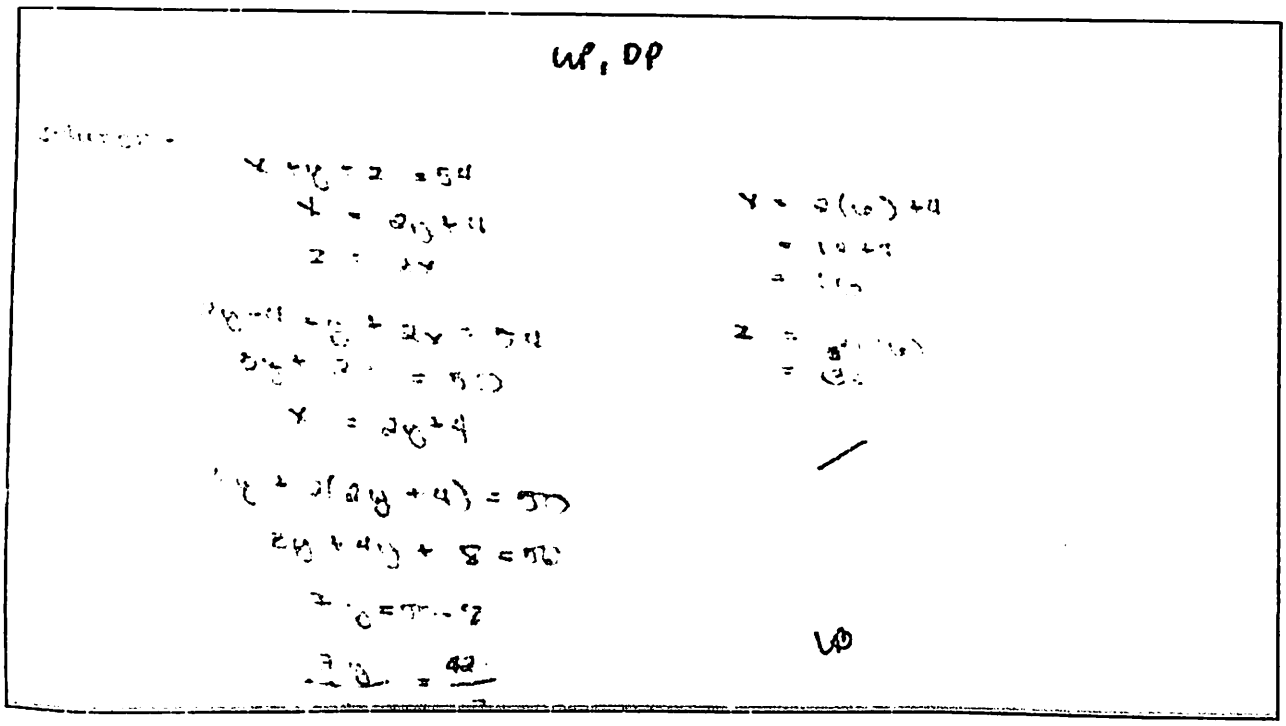


Exhibit #14 (BS-ECON-15)

5. *Xander invested P35,000.00 in a savings account that pays 4% simple interest. How much will he earn after 3 years? What will the new balance be?*

Known : Xander invested ₱35,000 in a savings account that pays 4% simple interest.

Unknown : earn after 3 years.

Investment = ₱35,000
Rate = 4 %
Time = 3 yrs.

Let x be the new balance after 3 years.

$x = ₱35,000 + ₱35,000(0.4)(3)$
$x = ₱35,000 + ₱35,000(.12)$
$x = ₱35,000 + ₱4,2000$
$x = ₱37,200$

The scenario of the inability to start the evaluation of the correctness of the obtained solution represented the instance when the space intended for checking the students' solutions was left blank. Two hundred eighty four (95.62 %) respondents encountered this difficulty (please see Table 7).

Above all, these findings are usually the common encountered difficulties in the looking back phase (Polya, 1945), namely, the inability to complete the checking procedure. Such phase difficulty was also revealed by Siniguian (2017), where he characterized the difficulty of looking back as the inability to use correct mathematics.

The study, after scrutinizing the respondents' solutions revealed that the most encountered difficulty was in the phase of looking back with 1,962 (31.43 %) instances. This quantity represented two possible scenarios namely; the number of times that the respondents were unable to complete the checking procedure (541 or 8.67 %) and the number of times that the respondents were unable to start the evaluation of the correctness of the obtained solution (1421 or 22.76 %). The checking of procedure was incomplete when the respondents were not able to ensure the accuracy and facts of the problem (the given conditions were not completely checked) while incorrect checking/evaluation happened when the respondents proceeded with incorrect mathematical equation in checking/evaluating the accuracy and facts of the problem. Inability to start the evaluation of the correctness of the obtained solution led them to leave the space for the checking of solution's part. The higher number of this difficulty might be due to students' forgetting to re-check their answers, though the study assumes that when the space is left blank, it indicates students' inability to re-check his/her derived answer.

While, the least encountered difficulty was in the phase of understanding the problem with 729 (11.68 %) instances as seen in Table 6. These data imply that the students can get clues/hints from the stated problem alone, hence, they are able to distinguish at least some information about the known information (given) and the unknown information (what the problem asks for) in the understanding the problem (UP) phase.

In summary, in understanding the problem phase, two types of difficulties were observed; inability to distinguish the known from the unknown information, and the inability to identify the type of problem and recall basic facts. There were 385 (6.17%) instances where the inability to distinguish the known information were encountered by the respondents and 344 (5.51 %) instances where the respondents were unable to identify the type of problem and recall basic concepts that led them to leave the space provided for them blank (please see Table 6).

Planning to solve a plan consists of varied strategies. Drawing pictures, tables/charts, pattern searching, guess and check and transforming a situation into mathematical sentences are some of them. The inability to perform any of these strategies was considered a difficulty of the student in this study (Polya, 1945). A special attention, however, was given at the difficulty of the students in transforming a problem into a mathematical equation. This was encountered by the respondents for 1001 (16.03 %) times. Two possible forms of this difficulty included those equations that were incompletely formed and those equations that were incorrectly formed. The other difficulty was the inability to draw tables/charts out of the information and organize information and connect to a concept which was encountered by the respondents for 817 (13.09 %) times. This difficulty represented those students who

left the space provided for them blank.

There is a difficulty in carrying out the plan phase when there is an inability to completely perform the working procedure systematically and accurately. This came into two forms: a) having incomplete computation or incorrect computation, and b) the inability to start with the computational process which led them to leave the space blank. There was a total of 960 (15.37 %) instances where the students' inability to completely perform the working procedure systematically and accurately and a total of 774 (12.40 %) instances of encountering the difficulty of starting with the computational process (please see Table 6).

Two difficulties in the looking back phase were observed: a) inability to complete the checking procedure and 2) inability to start the evaluation of the correctness of the obtained solution. There were 541 (8.67 %) instances where the difficulty of completing the checking procedures were experienced by the students and 1421 (22.76 %) instances for the inability to start the evaluation of the correctness of the obtained solution.

In Table 6, one can observe that the difficulties in the looking back phase had the greatest number of instances as experienced by the students when compared with the rest of the phases of the problem solving. In this phase, are possibilities that a student experienced the inability to start the evaluation of the correctness of the obtained solution because s/he really had no idea on how to check a derived value or s/he had the confidence that her or his derived value was correct and satisfied the facts given in the problem or due to time constraint, s/he did not check the derived value anymore. As a consequence, the researcher, in her desire to know what caused the concerned respondents of leaving the space provided to them tried to

communicate with them through their mathematics teachers during their vacant time. Following are sample responses of the respondents who encountered difficulties in the looking back phase particularly those who were not able to check his/her derived but had the first three steps correctly performed. A full list of the sample responses can be found in Appendix O.

From personal interviews:

Teacher: In solving problems, the last step is to check whether you derived the correct value, right? Do you usually do this? If not, why?

Student 1: I usually don't do it coz i find it time consuming during the exams but I am sure of my solution and i guess this part is useful.)

Analysis: The response of Student 1 gave an assurance that s/he's correct in her/his derived value and does not really need to check her/his work. The researcher finds that Student 1does not have a difficulty in this phase.

Student 2: This would be easy but because I have a wrong working equation, therefore I cannot check my answer (*Inability to check/evaluate derived value ensuring the accuracy and facts of the problem).*

Analysis: Student 2 had the inability to start the evaluation of the correctness of the obtained solution because at first, s/he had a wrong working equation The researcher finds that Student 2 has a difficulty in starting the evaluation.

Student 3: How can I check it if I can't even evaluate the equations? (had no idea how to evaluate the derived value that ensured the accuracy and facts of the problem)

Analysis: Since Student 3 cannot evaluate the equations, then s/he cannot start the evaluation.

Student 4: Kung minsan po, ay hindi na, kasi alam ko naman na tama ang sagot ko Ma'am. *(not a difficulty)*

Analysis: Such a response ensured the researcher that the student knew how and what s/he needed to check. So that Student 4 finds no difficulty in this phase.

Student 5: Can't evaluate the correctness of the obtained solution. (had no idea how to evaluate the derived value that ensured the accuracy and facts of the problem)

Analysis: Student 5 cannot start the evaluation of the correctness of the obtained solution. This is a difficulty.

Student 6: It's so complicated and very confusing.

Analysis: Student 6 cannot start the evaluation because he is total confused because of the complexity. This is a difficulty.

After summarizing all the responses in the informal interview with the students, a summary on the distribution of respondents in their encounter with the difficutlies in each phase of problem solving is given in Table 7.

As a whole, there were 6,243 instances from where the difficulties were observed, from the understanding the problem phase up to the looking back phase (please see Table 6).

Students' Difficulties by Sex by Phase

Table 7 likewise shows the distribution of the respondents by sex as they encounter the above mentioned difficulties in the different phases of problem solving. As seen from Table 7, from the female respondents, 175 (97.76 %) were unable to start the evaluation of the correctness of the obtained solution while 164 (91.62%) were unable to transform problems into mathematical equations. In addition, 160 (89.39 %) were unable to completely perform the working procedure systematically and accurately. Such numbers show that the inability to start the evaluation of the correctness of the obtained solution in the looking back (LB) phase is the most encountered difficulty among the female respondents, followed by the inability to transform a problem into a mathematical equation in the devising a plan (DP) phase

and then the inability to completely perform the working procedure systematically and accurately in the carrying out the plan (CP) phase.

Table 7.

Frequency Distribution of the Students by Sex in their Encounter in the Different Phases of Problem Solving

Phases	Difficulties	Males	Females	TOTALS
Understanding the Problem (UP) Phase	Inability to distinguish the known from the unknown information	65 (55.08)[a] (21.89)[b]	79 (44.13)[c] (26.60)[d]	**144** **(48.48)[e]**
	Inability to identify the type of problem and recall basic facts	51 (49.00)[a] (16.50)[b]	62 (34.64)[c] (20.88)[d]	**113** **(38.04)[e]**
Devising a Plan (DP) Phase	Inability to transform a problem into a mathematical equation	106 (89.83)[a] (35.69)[b]	164 (91.62)[c] (55.21)[d]	**270** **(90.91)[e]**
	Inability to draw table/charts out of the information and connect to a concept	90 (76.27)[a] (30.30)[b]	153 (85.47)[c] (51.51)[d]	**243** **(81.81)[e]**
Carrying out the Plan (CP) Phase	Inability to completely perform the working procedure systematically and accurately	105 (88.98)[a] (35.35)[b]	160 (89.39)[c] (53.87)[d]	**265** **(89.23)[e]**
	Inability to start with the computational process	92 (77.96)[a] (30.98)[b]	145 (81.00)[c] (48.82)[d]	**237** **(79.80)[e]**
Looking back (LB) Phase	Inability to complete the checking procedure	81 (68.64)[a] (27.27)[b]	137 (76.54)[c] (46.13)[d]	**218** **(73.40)[e]**
	Inability to start the evaluation of the correctness of the obtained solution	109 (92.24)[a] (36.70)[b]	175 (97.76)[c] (58.92)[d]	**284** **(95.62)[e]**
OVERALL TOTAL		**118**	**179**	**297**

Note: Figures in parentheses are percentages values

Legend:

a – percentage of males encountering the difficulty to the total number of males
b – percentage of males encountering the difficulty to the total number of respondents
c – percentage of females encountering the difficulty to the total number of females
d – percentage of females encountering the difficulty to the total number of respondents
e – percentage of both males and females encountering the difficulty to the total number of respondents

While, among the male respondents, 106 (89.83%) were unable to transform problems into mathematical equations, 105 (88.98%) were unable to completely perform the working procedure systematically and accurately and 109 (92.24 %) had the inability to start the evaluation of the correctness of the obtained solution. These numbers reveal that the inability to start the evaluation of the correctness of the obtained solution (109 or 92.24 %) in the looking back (LB) phase is the most encountered difficulty among the male respondents, followed by the inability to transform a problem into a mathematical equation (106 or 89.83 %) in the devising a plan (DP) phase and then the inability to completely perform the working procedure systematically and accurately(105 or 88.98 %) in the carrying out the plan (CP) phase.

Between the two sexes, the percentages of students by their encounter with the difficulties of the students in the different phases of problem solving can be compared and better visualized in Figure 3. One can observe that there are more female respondents who encountered the difficulties in each phase of problem solving than the male respondents. This implies that the female respondents experienced more difficulties than the male counterparts which could be attributed to their low levels of confidence in their mathematics skills when compared with males. (Ganley, 2018).

In understanding the problem (UP) phase, both males and females had the smallest percentage who encountered the difficulties of distinguishing the known from the unknown information (Males = 21.89%, Females = 26.60%) and identifying the type of problem and recalling basic facts (Males = 16.50%, Females = 20.88%) (Table 7). Such observation, however, conflicts the belief of Ferguson (1980) and Pearce, et al. (2013) in their respective researches that reading and understanding the problem, which included the lack of vocabulary knowledge had the greatest

percentage, followed by devising a plan in solving the problem, and only a few had difficulties on computation. The same observation disagrees with the observation of Reddy and Panacheroensawad's (2017).They revealed that lack of understanding the problem which is a difficulty in the first phase (UP) and poor mathematical skills are the major obstacles in the domain of problem solving skills in Physics.

In carrying out the plan (CP) phase, Figure 3 and Table 7 presents the female students to be less systematic in working procedures. This further implies that females are less careful when it comes to computational procedures than the males which is in conflict with the finding of (Ganley & Lubienski, 2016). They found out that females are more likely to follow school-taught procedures as taught by the teachers.

In the looking back (LB) phase, the male respondents check/evaluate their derived value more often than the females as revealed in Figure 3 and Table 7. This implies that males want to make sure of their answers. As a consequence, males seem less worried about being wrong and more inclined to try new methods (Gould, 1996; Fennema & Carpenter, 1998; Gallagher et al., 2000; Bell & Norwood, 2007). Thus, mathematics teachers should emphasize giving activities and tasks pertaining to formulation of working equations. In addition, the findings support Siniguian's (2017) observation where he revealed that the students' inability to use correct mathematics, a difficulty of the looking back phase is one of the major difficulties in solving mathematical problems.

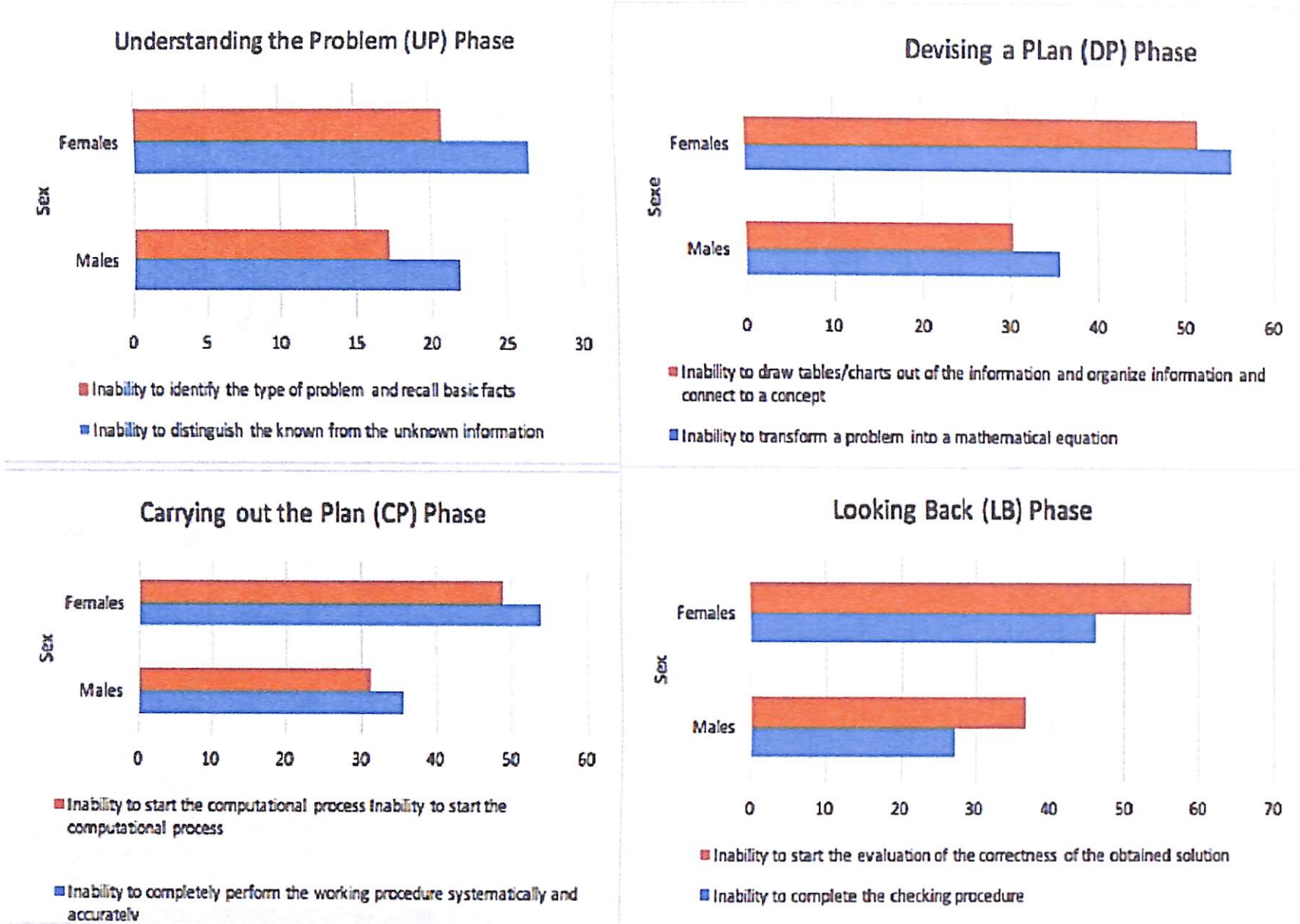


Figure 3. Distribution of Students in their Encounter with Difficulties in Each Phase of Problem Solving

Students' Difficulties by Academic Program by Phase

Table 8 likewise shows the distribution of the respondents by academic program as they encounter the above mentioned difficulties in the different phases of problem solving. As seen from the table, among the STEM-related academic programs, the BS in Meteorology got the highest percentage of respondents who experienced four of the eight mentioned difficulties. Among these diffculties include the inability to distinguish the known from the unknown information (58.33 %), inability to identify the type of problem and recall basic facts (66.67 %), inability to transform a problem into a mathematical equation (100.00 %), and inability to start the evaluation of the correctness of the obtained solution (100.00 %). The BS in Agricultural and Biosystems Engineering on the other hand had its highest percentage of respondents who are unable to draw tables/charts out of the information and organize information and connect to a concept (92.00 %) in the devising a plan (DP) phase, who are unable to start the computational process (92.00 %) in the carrying out plan (CP) phase, and who are unable to complete the checking procedure (86.00 %) in the looking back (LB) phase. While, the BS in Mathematics had its greatest percentage of respondents who are unable to start the computational process (94.44 %) in the carrying out the plan (CP) phase, and who are unable to start the evaluation of the correctness of the obtained solution (100.00 %) in the looking back (LB) phase. The respondents of the BS in Civil Engineering had the second highest percentage in the inability to transform problems into mathematical equations (94.94 %) and the inability to draw tables/charts out of the information and organize information and connect to a concept (81.01 %) in the devising a plan (DP) phase.

Table 8

Frequency Distribution of the Students by Academic Program (STEM-RELATED) in their Encounter in the Different Phases of Problem Solving

PHASES / STEM-RELATED ACADEMIC PROGRAM	Understanding the Problem (UP)		Devising a Plan (DP)		Carrying out the Plan (CP)		Looking Back (LB)		TOTAL NO. OF RESPONDENTS
	Inability to distinguish the known from the unknown information	Inability to identify the type of problem and recall basic facts	Inability to transform a problem into a mathematical equation	Inability to draw tables/charts out of the information and organize information and connect to a concept	Inability to completely perform the working procedure systematically and accurately	Inability to start the computational process	Inability to complete the checking procedure	Inability to start the evaluation of the correctness of the obtained solution	
BS-ABE	27 (54.00)[a] (15.51)[b]	11 (22.00)[a] (6.32) [b]	48 (56.00)[a] (27.59)[b]	46 (92.00)[a] (26.44)[b]	48 (96.00)[a] (27.59)[b]	46 (92.00)[a] (26.44)[b]	43 (86.00)[a] (24.71)[b]	49 (98.00) [a] (28.16) [b]	50
BS-CE	37 (46.83)[a] (21.26)[b]	32 (40.51)[a] (18.39)[b]	75 (94.94)[a] (43.10)[b]	64 (81.01)[a] (36.78)[b]	72 (91.14)[a] (41.38)[b]	66 (83.54)[a] (37.93)[b]	57 (72.15)[a] (32.75)[b]	76 (96.20) [a] (43.68) [b]	79
BS-CHEM E	5 (33.33)[a] (2.87) [b]	6 (40.00)[a] (3.45) [b]	11 (73.33)[a] (6.32) [b]	7 (46.67)[a] (4.02)[b]	11 (73.33)[a] (6.32) [b]	7 (46.67)[a] (4.02) [b]	9 (60.00)[a] (5.17) [b]	12 (80.00) [a] (6.90) [b]	15
BS-MATH	5 (27.78)[a] (2.87) [b]	8 (44.44)[a] (4.60) [b]	10 (55.56)[a] (5.75) [b]	14 (77.78)[a] (8.05)[b]	11 (61.11)[a] (6.32) [b]	17 (94.44)[a] (9.77)[b]	9 (50.00)[a] (5.17) [b]	18 (100.00)[a] (10.34) [b]	18
BS-METEO	7 (58.33)[a] (4.02) [b]	8 (66.67)[a] (4.60) [b]	12 (100.00) [a] (6.90) [b]	8 (66.67)[a] (4.60)[b]	11 (91.67)[a] (6.32) [b]	9 (75.00)[a] (9.77)[b]	10 (83.33)[a] (5.74) [b]	12 (100.00)[a] (6.90 [b]	12
OVER ALL TOTAL (STEM-related)	**81 (46.55)[c]**	**65 (37.36)[c]**	**156 (89.66)[c]**	**141 (81.03)[c]**	**153 (87.93)[c]**	**145 (83.33)[c]**	**128 (73.56)[c]**	**163 (93.68)[c]**	**174**

Note: Figures in parentheses are pecentage values

Legend:

a - percentage of the number of respondents encountering the difficulty to the total number of respondents per academic program

b - percentage of the number of respondents encountering the difficulty to the over all total number of respondents for STEM-related academic program

c - percentage of the total number of respondents encountering the difficulty to the over all total number of respondents for STEM-related academic program

In contrast, the BS in Agricultural and Biosystems Engineering got the least percentage of respondents who are unable to identify the type of problem and recall basic facts (22.00 %) in the understanding the problem (UP) phase. The BS in Chemical Engineering also got the least percentage of respondents who are unable to draw tables/charts out of the information and organize information and connect to a concept (46.67 %) in the devising a plan (DP) phase, who are unable to start the computational process (46.67 %) in the carrying out the plan (CP) phase, and who are unable to start the evaluation of the correctness of te obtained solution (80.00 %) in the locking back (LB) phase. While, the BS in Mathematics had the least percentage of respondents who experienced the inability to distinguish the known from the unknown information (27.78 %) in the understanding the plan (UP) phase, the inability to transform problems into mathematical equations (55.56 %) in the devising a plan (DP) phase, the inability to completely perform the working procedure systematically and accurately (61.11 %) in the carrying out the plan (CP) phase and the inability to complete the checking procedure (50.00 %) in the looking back (LB) phase.

A comparison on the percentages of respondents in the STEM-related academic programs who encountered the different difficulties in each of the phases of problem solving can be better visualized in Figure 4.

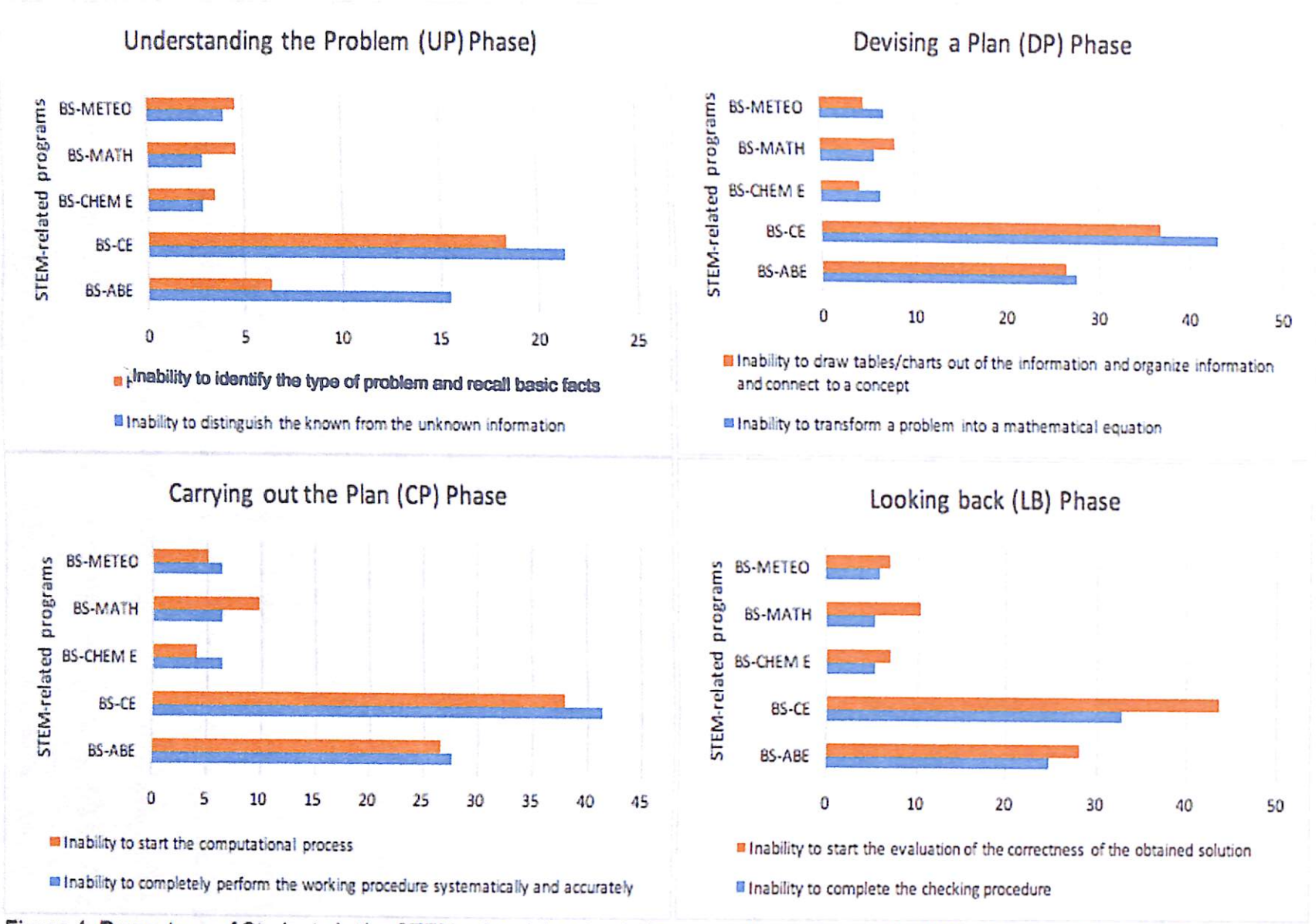


Figure 4. Percentage of Students in the STEM-related Academic Programs Encountering the Difficulties in each of the Phases of Problem Solving

For the STEM-related academic programs, one can check that the inability to identify the type of problem and recall basic facts (66.67 %) was encountered mostly by the respondents of the BS in Meteorology program, followed by the BS in Mathematics program (44.44 %) in understanding the problem (UP) phase (Table 8). While, the BS in Mathematics got the least percentage of respondents who were unable to distinguish the known from the unknown information (27.78 %) , followed by the respondents of the BS in Chemical Engineering program (33.33%). In the devising a plan (DP) phase, it is visible in the table that the BS in Meteorology got the highest percentage of respondents who were unable to transform problems into mathematical equations (100.00 %), followed by the BS in Civil Engineering program (94.94 %). While, the BS in Mathematics had the highest percentage of respondents who were unable to start the computational process (94.44 %) followed by the BS in Agricultural and Biosystems Engineering program (92.00 %) in carrying out the plan (CP) phase. The BS in Agricultural and Biosystems Engineering program got the highest percentage of respondents who were unable to completely perform the the working procedure systematically and accurately (96.00 %), followed by the BS in Meteorology program (91.67 %).

In the last phase (LB), both the BS in Meteorology and BS in Mathematics programs got the highest percentage of respondents who were unable to start the evaluation of the correctness of the obtained solution (100.00%) which was followed by the BS in Agricultural and Biosystems Engineering program (98.00 %). The inability to complete the checking procedure was seen to have its greatest encounter by the respondents of the BS in Agricultural and Biosystems Engineering program followed by the BS in Meteorology program.

Under the K-to12 curriculum, the mentioned academic programs all belong to the Science,Technology, Engineering, and Mathematics strand. Founded on the belief that a STEM student can help solve real-life problems and advance national development (https://www.edukasyon.ph, 2019) s/he must at least know the four basic phases of problem solving but results show otherwise. The respondents of the BS in Mathematics in particular, believed to be knowledgeable of the "hows" of problem solving were seen to be unable to draw tables/charts out of the information and organize information and connect to a concept which eventually led them to leave the space provided blank as compared to the other STEM-related academic programs. Fourteen out of the 18 respondents (77.78 %) experienced this difficulty. On the contrary, the BS in Mathematics respondents had the least percentage of respondents (55.56 %) who had difficulty in transforming a problem into a mathematical equation in comparison to the others. This however, contradicts the result of Sultan (2014) where translating word problems in mathematical phrases were revealed through solving word problems in Algebra.

These observations imply that mathematics teachers need to provide the students with activities and tasks that are real-life problems that require them to understand, compute and check their solutions. Through these activities, the students will be able to discover their own learning. As what Dewey (1915) says, learning becomes more permanent when the student performs by himself or herself. The observations likewise imply that implementation on the qualification for admission for enrollment was not strictly implemented for some of the academic programs. Looking at the profile of the BS in Mathematics respondents revealed that only a few of them enrolled in the STEM strand during their Senior High School (SHS).

On the other hand, among the non-STEM-related academic programs (please Table 9), the BS in Sociology got the highest percentage of respondents who experienced five out of the eight mentioned difficulties. Among these difficulties include the inability to distinguish the known from the unknown information (59.09 %) in understanding the problem (UP) phase, inability to transform problems into mathematical equations (100.00 %) and inability to draw tables/charts out of the information and organize information and connect to a concept (86.36 %) in the devising a plan (DP) phase, inability to completely perform the working procedure systematically and accurately (95.45 %) and inability to start the computational process in the carrying out the plan (CP) phase and inability to start the evaluation of the correctness of the obtained solution (100.00 %) in the looking back (LB) phase. The BS in Nursing, likewise, had the highest percentage of respondents who were unable to identify the type of problem and recall basic facts (55.56 %) in the understanding the problem (UP) phase and the inability to completely perform the working procedure systematically and accurately (96.30 %) in the carrying out plan (CP) phase. While, the BA in Communication had the greatest percentage of respondents who were unable to draw tables/charts out of the information and organize information and connect to a concept (86.36 %) in the devising a plan (DP) phase and the inability to complete the checking procedure (95.45 %) and who wre unable to start the evaluation of the correctness of the obtained solution (100.00 %) in the looking back (LB) phase.

Table 9

Frequency Distribution of the Students by Academic Program (non-STEM-RELATED) in their Encounter in the Different Phases of Problem Solving

PHASES / NON-STEM ACADEMIC PROGRAM	Understanding the Problem (UP)		Devising a Plan (DP)		Carrying out the Plan (CP)		Looking Back (LB)		TOTAL NO. OF RESPOND NETS
	Inability to distinguish the known from the unknown information	Inability to identify the type of problem and recall basic facts	Inability to transform a problem into a mathematical equation	Inability to draw tables/charts out of the information and organize information and connect to a concept	Inability to completely perform the working procedure systematically and accurately	Inability to start the computational process	Inability to complete the checking procedure	Inability to start the evaluation of the correctness of the obtained solution	
BA-COMM	11 (50.55) [a] (8.94) [b]	3 (13.64) [a] (2.44) [b]	21 (95.45) [a] (17.07) [b]	19 (86.36) [a] (15.45) [b]	20 (90.91) [a] (16.26) [b]	18 (81.82) [a] (14.63) [b]	21 (95.45) [a] (17.07) [b]	22 (100.00) [a] (17.89) [b]	22
BS-ECON	14 (56.00) [a] (11.38) [b]	8 (32.00) [a] (6.50) [b]	22 (88.00) [a] (17.89) [b]	20 (80.00) [a] (16.26) [b]	19 (76.00) [a] (15.45) [b]	18 (72.00) [a] (14.63) [b]	17 (68.00) [a] (13.82) [b]	21 (84.00) [a] (17.07) [b]	25
BS-NURSING	25 (46.30) [a] (20.33) [b]	30 (55.56) [a] (24.39) [b]	49 (90.74) [a] (39.84) [b]	44 (81.48) [a] (35.77) [b]	52 (96.30) [a] (42.28) [b]	36 (66.67) [a] (29.27) [b]	36 (66.67) [a] (29.27) [b]	52 (96.30) [a] (42.28) [b]	54
BS-SOCIO	13 (59.09) [a] (10.57) [b]	7 (31.82) [a] (5.69) [b]	22 (100.00) [a] (17.89) [b]	19 (86.36) [a] (15.45) [b]	21 (95.45) [a] (17.07) [b]	20 (90.91) [a] (16.26) [b]	16 (72.73) [a] (13.00) [b]	22 (100.00) [a] (17.89) [b]	22
TOTAL (NON-STEM related)	**63 (51.22) [c]**	**48 (39.02) [c]**	**114 (92.68) [c]**	**102 (82.93) [c]**	**112 (91.06) [c]**	**92 (74.80) [c]**	**90 (73.17) [c]**	**118 (95.93) [c]**	**123**

Note: Figures in parentheses are percentage values

Legend:

a - percentage of the number of respondents encountering the difficulty to the total number of respondents per academic program

b - percentage of the number of respondents encountering the difficulty to the over all total number of respondents for the non-STEM-related academic program

c - percentage of the total number of respondents encountering the difficulty to the over all total number of respondents for the non-STEM-related academic program

Analogously, the BS in Economics got the least percentage in four out of the eight difficulties mentioned. These include the inability to transform problems into mathematical equations (80.00 %) and the inability to draw tables/charts out of the information and organize information and connect to a concept (80.00 %) in the devising a plan (DP) phase, inability to completely perform the working procedure systematically and accurately (76.00 %) in the carrying out the plan (CP) phase and the inability to start the evaluation of the correctness of the obtained solution (84.00 %) in the looking back (LB) phase. The BA in Communication also got the least percentage of respondents who were unable to identify the type of problem and recall basic facts (13.64 %) in the understanding the problem (UP). Lastly, the BS in Nursing got the least percentage of respondents who experienced the inability to distinguish the known from the unknown information (46.30 %) in the understanding the plan (UP) phase and the inability to start the computational process (66.67 %) in the carrying out the plan (CP) phase.

A comparison on the percentages of respondents in the non- STEM-related academic programs who encountered the different difficulties in each of the phases of problem solving can be better visualized in Figure 5.

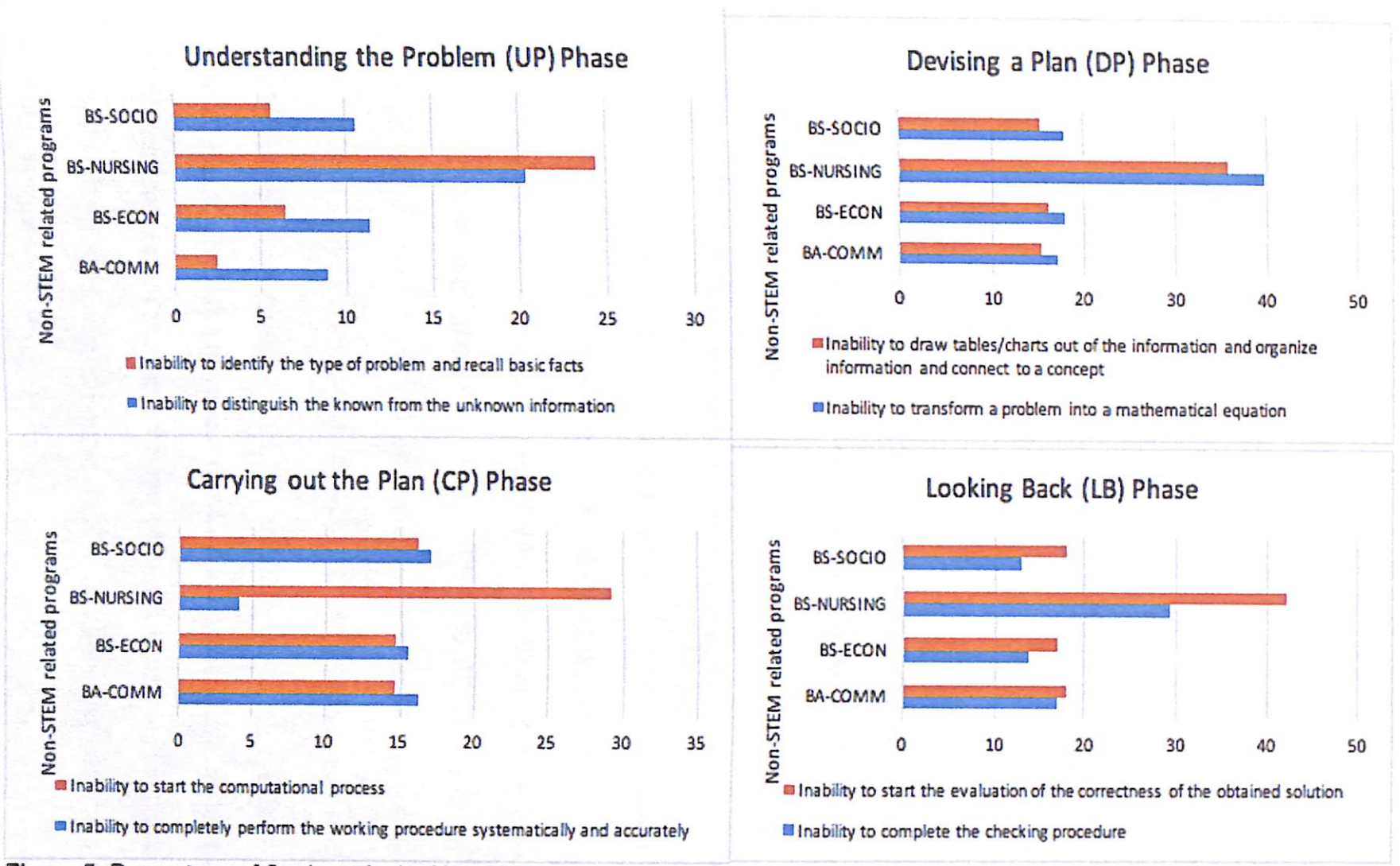


Figure 5. Percentage of Students in the Non-STEM related Academic Programs Encountering the Difficulties in Each of the Phases of Problem Solving

For the non-STEM-related academic programs, the inability to distinguish the known from the unknown information (59.09 %) was encountered mostly by the respondents of the BS in Sociology programs which was followed by the BS in Economics program in understanding the problem (UP) phase. While, more than 50 percent of the BS in Nursing respondents encountered the difficulty of identifying the type of problem and recalling basic facts (55.56 %), followed by the BS in Economics programs (32.00 %). In the devising a plan (DP) phase, it is visible in the table that all the respondents of the BS in Sociology program experienced the inability to transform problems into mathematical equations, followed by the respondents of the BA in Communication program (95.45 %) . While, the respondents of both the BA in Communication and BS in Sociology respondents encountered the difficulty of drawing tables/charts out of the information and organize information and connecting to a concept (86.36 %) followed by the respondents of the BS in Nursing program (81.48%). In carrying out the plan (CP) phase, 96.30 percent of the respondents of the BS in Nursing program encountered the inability to completely perform the working procedure systematically and accurately, followed by the BS in Sociology program (95.45 %). Conversely, 66.67 percent of the respondents of the BS in Nursing encountered the inability to start the computational process followed by the respondents of the BS in Economics program (72.00 %). In the last phase (LB), the inability to complete the checking procedure was encountered by the 95.45 percent of the respondents of the BS in Communication program which was followed by the respondents of the BS in Sociology program (72.73 %). While, the inability to start the evaluation of the correctness of the obtained solution was greatest in percentage for the respondents of both the BA in Communication (100.00 %) and BS in Sociology

(100.00 %) followed by the respondents of BS in Nursing (96.00 %).

The above observations imply that a non-STEM-student may have the skill of understanding what is/are given and required in a problem, but not on the skills of formulating the working equation, computations and checking the solutions. The finding however, is in conflict with the result of Apostol (2014), where she found out that majority of the students under her investigation made use of the heuristics on making a model or diagram, or using a formula in solving word problems. This implies that the students had less struggle in the devising a plan phase.

Thus, there is also a need for the mathematics teachers to give more exercises and other enrichment activities to these students giving emphasis on the last three phases of problem solving. Most particularly are the respondents of the BS in Sociology, all of them showed the difficulty of completely forming the working equation and in carrrying out the correct computation, though a few managed to have a correct manipulation but were unsuccessful in checking his/her solution. This observation is a bit acceptable in the actual system since Sociology students study the society including patterns of social relationships, social interaction and culture (Dictionary of the Social Sciences, 2002). An interesting observation however goes to the BS in Nursing students. Of the 54 respondents, nearly half of them were able to understand the problem, a few managed to form and manipulate the working equation, though they were not able to check their solution whether they satisfied the given conditions or not stated in the original problem. This scenario may be brought about by time constraint, that is, they were in a hurry to finish the test, or that they really had limited knowledge on the basic skills of problem solving. These reasons are listed in Appendix O, where they were informally interviewed by the researcher during their

vacant time.

In summary, the observations imply that teachers need to address the difficulties of the students in problem solving which is in response to the twin goals of mathematics of the K-12 curriculum namely: problem solving and critical thinking. One way of addressing these difficulties is by giving more real-life problems to the students in the form of hands-on activities and tasks and guidance in solving the problems. Teachers can also present the strategy of trial and improvement as a mean of deriving the solutions to facilitate the learning of the students. This is in response to Dewey's (1915) learning by doing.

Students' Coping Strategies

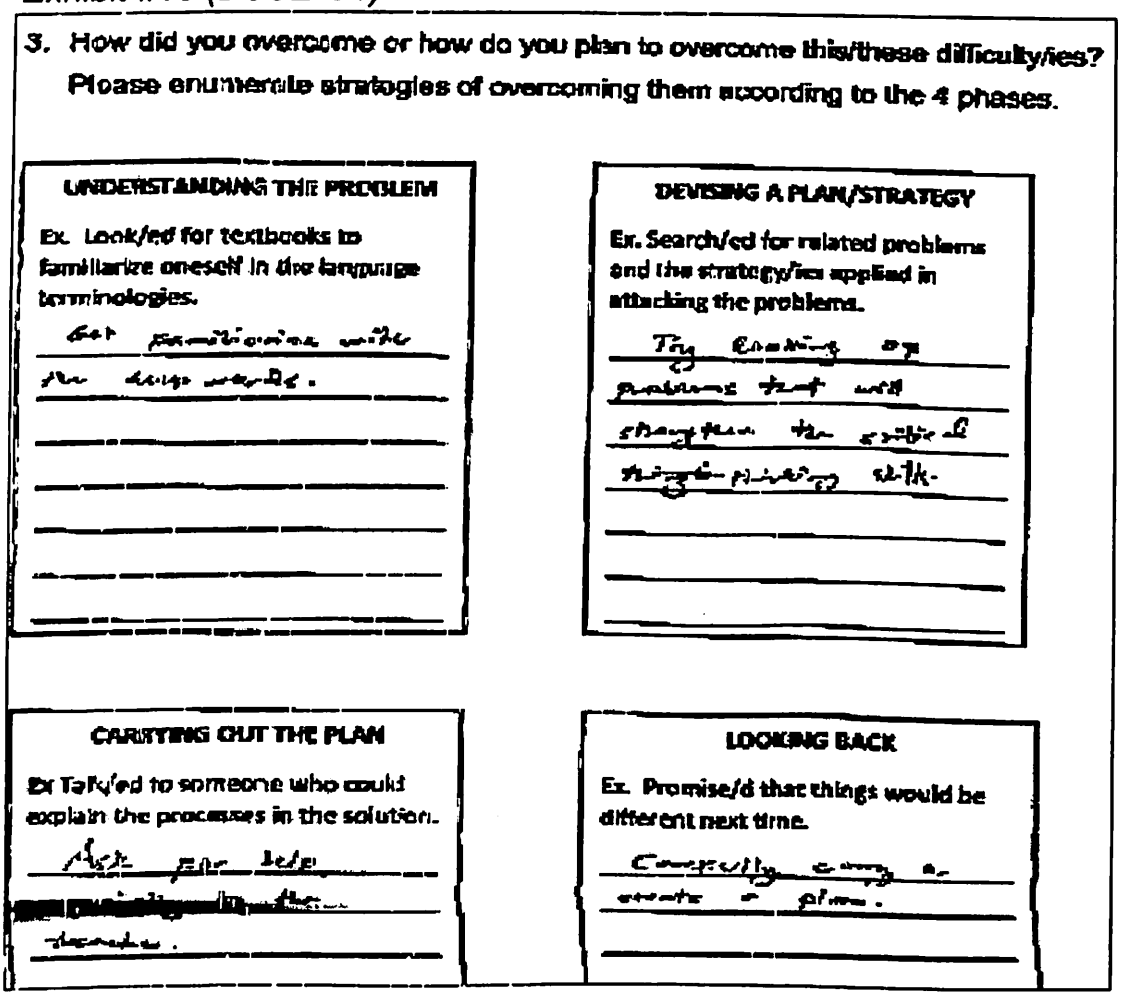
Coping strategies or sometimes called mechanisms are ways that people particularly the students use in facing their stressful or difficult situations. The difficult situation which this study describes is when the students are faced with solving varied types of problems.

After the administration of the problem solving test, the researcher distributed a simple coping strategy questionnaire where the students' responses were elicited. A few of the students' responses are presented below. It is to be noted that students were free to write their most utilized coping strategies in dealing with their difficulties in each of the different phases of problem solving.

Students' Elicited Responses

Coping strategies stated by the student included: " get familiarize with the deep words (UP)", "try looking for problems that will strengthen the critical thinking skills (DP)", "ask for help especially from the teacher (CP)," and "carefully carry or create a plan (LB)' (Exhibit #15).

Exhibit #15 (BSCE-C1)


3. How did you overcome or how do you plan to overcome this/these difficulty/ies? Please enumerate strategies of overcoming them according to the 4 phases.

UNDERSTANDING THE PROBLEM

Ex. Look/ed for textbooks to familiarize oneself in the language terminologies.

DEVISING A PLAN/STRATEGY

Ex. Search/ed for related problems and the strategy/ies applied in attacking the problems.

CARRYING OUT THE PLAN

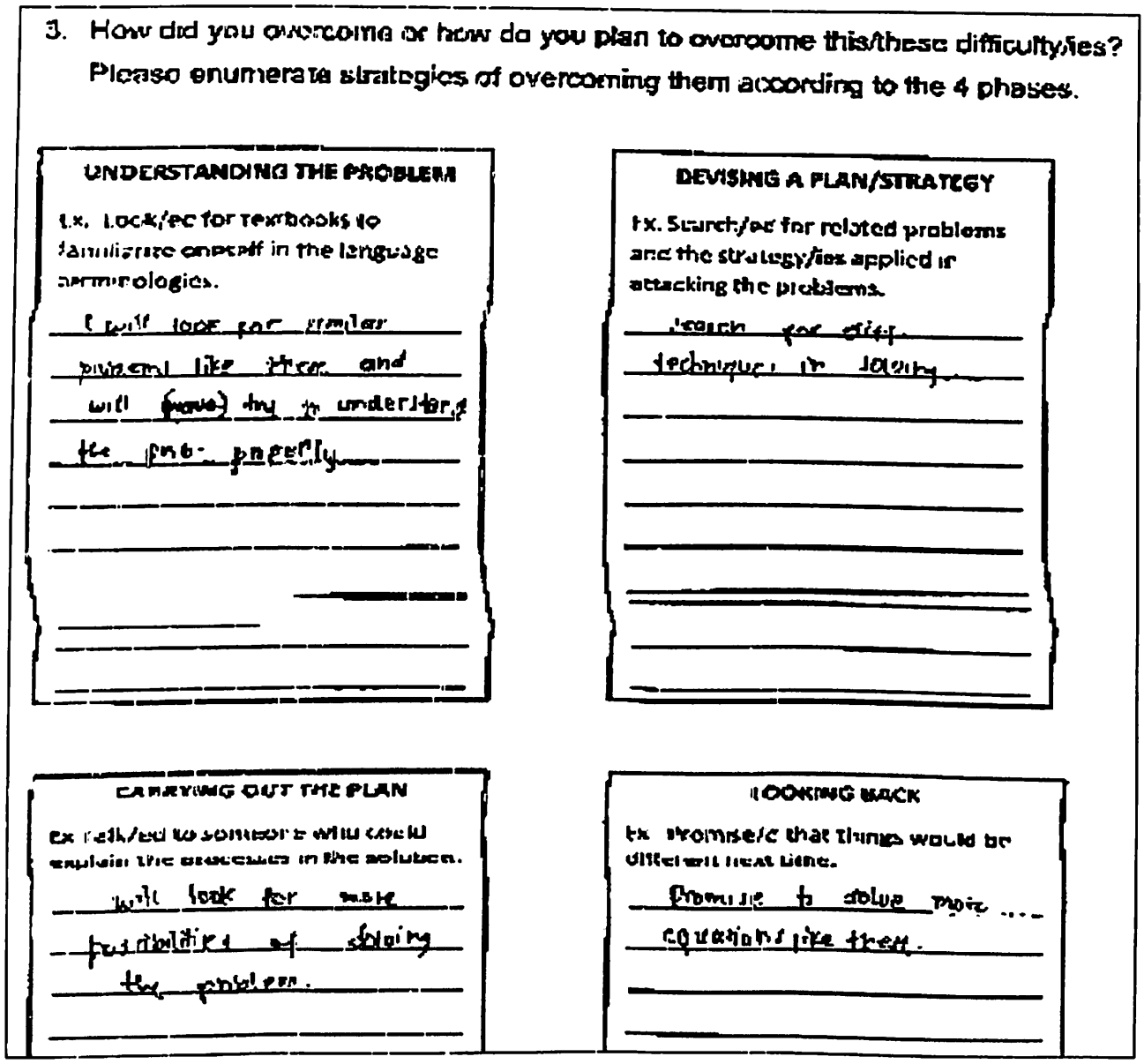
Ex Talk/ed to someone who could explain the processes in the solution.

LOOKING BACK

Ex. Promise/d that things would be different next time.

Other responses were (Exhibit #16): "look for similar problems like these and will try to understand the problem properly (UP)", "search for different techniques of solving (DP)", "will look for more possibilities of solving the problem (CP)", and "promise to solve more equations like these (LB)".

Exhibit #16 (BS-Chem Eng-16)



3. How did you overcome or how do you plan to overcome this/these difficulty/ies? Please enumerate strategies of overcoming them according to the 4 phases.

UNDERSTANDING THE PROBLEM

Ex. Look/ec for textbooks to familiarize oneself in the language terminologies.

I will look for similar problems like these and will (have) try to understand the problem properly.

DEVISING A PLAN/STRATEGY

Ex. Search/ec for related problems and the strategy/ies applied in attacking the problems.

search for other techniques in solving.

CARRYING OUT THE PLAN

Ex. Ask/ed to someone who could explain the processes in the solution.

will look for some possibilities of solving the problem.

LOOKING BACK

Ex. Promise/e that things would be different next time.

Promise to solve more ... equations like them.

Coping strategies included in this questionnaire are: " by re-reading the given problem and understanding the clues (UP)", "by creating a lot of formula until I come up with the right one (DP)", "having a trial and error in the gathered/created formula (CP)", and "going back to the problem and checking it step by step (LB)" (Exhibit #17).

Exhibit #17 (BS-Comm-14)

3. How did you overcome or how do you plan to overcome this/these difficulty/ies? Please enumerate strategies of overcoming them according to the 4 phases.

UNDERSTANDING THE PROBLEM

Ex. Look/ed for textbooks to familiarize oneself in the language terminologies.

By re-reading the given problem and underlining the clues

DEVISING A PLAN/STRATEGY

Ex. Search/ed for related problems and the strategy/ies applied in attacking the problems.

By creating a list of formula until you can find the with the right one.

CARRYING OUT THE PLAN

Ex. Talk/ed to someone who could explain the processes in the solution.

Having a brief conference with my groupmates

LOOKING BACK

Ex. Promise/d that things would be different next time.

Going back to the problem and checking it step by step

After a thorough analysis of the students' papers on the Coping Strategy Questionnaire, the following coping strategies were recorded according to the problem solving phase difficulties as seen in Table 9. It was found out that of the 297 respondents in the model development stage, 43 strategies emerged as seen in

Tables 9 to 12 from where, as described by Carver, et al. (1998) two major classifications in each of the four phases of problem solving arose namely: the Problem-Focused Strategies and the Emotion-Focused Strategies. The themes for each phases were formed based on the items listed by a priori scale assignment of Carver's, et al. (1989) multidimensional coping inventory in assessing the different ways by which people respond to (please find Appendix P). The coping inventory was divided into two: the problem-focused coping and the emotion-focused coping. From the tables below, it is apparent that generally, the respondents applied the Problem-Focused Coping Strategies which is in conflict with the conclusion of Brougham, et. al. (2009) where they found out that emotion-focused coping strategies dominate the problem-focused coping strategies both for men and women. These are the strategies that deal with the problem in order to reduce the stress. The coping strategies were grouped according to the degree of relatedness just like what Carver, et al. (1989) did in their study. Groupings were as follows: active coping, planning, and seeking social support for the problem-focused coping strategies. Codes were then introduced by the researcher indicative of the problem solving phase. On the other hand, emotion-focused strategies are those that handle the feeling of distress resulting from the problem situation.

To get alleviated with difficulties in understanding the problem (UP) phase that include the inability to distinguish the known from the unknown information and Inability to identify the type of problem and recall basic concepts, the students were able to list 10 strategies, one of which was classified as emotion-focused strategy (please see Table 10), that is, the strategy of ignoring the situation on hand, a form of avoidance coping (Billings and Moos, 1984; Rapson, 1990).

Table 10

Students' Strategies in Coping with Difficulties in Understanding the Problem (UP) Phase

PHASES OF PROBLEM SOLVING	DIFFICULTIES	COPING STRATEGIES	
		Problem-Focused Coping Strategies	
Understanding the Problem (UP) Phase	Inability to distinguish the known from the unknown information Inability to identify the type of problem and recall basic concepts	UP1	recalled and/or applied basic facts/principles/stock knowledge
		UP2	understood fully, analyzed and listed/enumerated all the given information and/or thought critically/logically giving focus on the problem/needed focus
		UP3	familiarization of terminologies using online references and/or non-online references
		UP5	re-read/re-write the problem and identified clues
		UP6	rephrase/translated the sentence in own words/grammar construction
		UP7	asked seatmates/friends/teacher/tutor to help explain/solve (assistance)
		UP8	looked for more exercises in books and read books related to the problem at hand/more exposure
		UP9	reviewed old notes/lectures taught by the teacher
		UP10	listened attentively to the teacher
		Emotion- Focused Coping Strategies	
		UP4	Ignored

In the phase of devising a plan, inability to transform problems into mathematical equations and Inability to draw tables/charts out of the information and organize information and connect to a concept were the common difficulties. These were coped by 10 strategies that included one emotion focused strategy, that is, the student's belief that s/he did his/her best to advance the study. (please see Table 11).

This strategy is one of the findings that Tamres, et al. (2002) were able to reveal in their study in examining the sex-difference in coping, that is, reflecting about the problem and the use of positive self-talk.

Table 11

Students' Strategies in Coping with Difficulties in the Devising the Plan (DP) Phase

PHASES OF PROBLEM SOLVING	DIFFICULTIES	COPING STRATEGGIES	
		Problem-Focused Coping Strategies	
Devising a Plan (DP) Phase	Inability to transform a problem into a mathematical equation	DP1	recalled and/or applied related strategies/concepts previously studied/stock knowledge to real-life situations
		DP2	understood fully, analyzed/thought critically and pondered on what the formula would be
		DP3	searched online for some strategies/related problems
		DP4	proceeded in creating own strategy/plan/formulas
		DP5	performed trial and error with plans
	Inability to draw tables/charts out of the information and organize information and connect to a concept	DP6	organized information expressing the variables and the other numbers connecting them to a concept
		DP7	asked friends/teacher/tutor to help explain/solve (assistance)
		DP8	looked for more exercises in books and read books related to the problem at hand/more exposure/needed more problem solving exercises
		DP9	needed computing gadgets
		Emotion-Focused Coping Strategies	
		DP10	did best to advance study

As what students fondly say that mathematics is full of computation, this study also reveals a wide list of coping strategies consisting of 12 coping strategies as seen in Table 11. All of them were utilized to help one get alleviated with the inability to perform the systematic working procedure and Inability to start with the computational

process. Seven strategies were problem-focused, while, five strategies were emotion-focused (please see Table 12).

Table 12

Students' Strategies in Coping with Difficulties in Carrying out the Plan (CP) Phase

PHASES OF PROBLEM SOLVING	DIFFICULTIES	COPING STRATEGIES	
		Problem-Focused Coping Strategies	
Carrying out the Plan (CP) Phase	Inability to completely perform the working procedure systematically and accurately	CP1	understood fully, analyzed/thought critically and solved the problem carefully/self-study ; applied plan to answer the problem by oneself
		CP2	With the formulas as guides, was able to make substitutions/computations; needed computing gadgets
		CP3	watched YouTube/online applications /tutorials on the process of computations
		CP4	learned/reviewed the process/computations
		CP6	performed trial and errors
		CP7	asked friends/teacher/tutor to help explain further the process/computation/copied from seatmate
	Inability to start with the computational process	CP8	needed to read more books/references and lots of problem solving exercises/more practice/ more exposure
		Emotion-Focused Coping Strategies	
		CP5	questioned oneself how to solve it
		CP9	just overcame through positivity
		CP10	shared feelings with someone
		CP11	Ignored
		CP12	Talk and pray

In the last phase of problem solving, the two common problem solving difficulties namely: 1) Inability to complete the checking procedure, and 2) Inability to start the evaluation of the correctness of the obtained solution were coped with any of

the 11 strategies above, with seven problem-focused strategies and four emotion-focused related strategies (please see Table 13).

Table 13

Students' Strategies in Coping With Difficulties in the Looking Back (LB) Phase

PHASES OF PROBLEM SOLVING	DIFFICULTIES	COPING STRATEGIES	
		Problem-Focused Coping Strategies	
Looking back (LB) Phase	Inability to complete the checking procedure	LB1	rechecked/re-evaluated whether the answer was correct
		LB2	understood/analyzed the problem more/self-study
		LB8	looked for more exercises in books and read books related to the problem at hand/more exposure
		LB4	be objective in formulating the equations
		LB5	performed trial and error
	Inability to start the evaluation of the correctness of the obtained solution	LB6	needed English language skills
		LB7	asked friends/teacher/tutor to help explain the whole process/sought assistance from others
		Emotion-Focused Coping Strategies	
		LB3	thought that things will get better; thought that one will get matured enough to handle problems next time and not get confused with questions that have easy solutions
		LB9	believing in one's self/confidence
		LB10	concluded briefly
		LB11	Ignored

Students' Coping Strategies by Sex by Phase

Both sexes utilized almost all of the coping strategies listed in Table 14.

In understanding the problem (UP) phase, the males utilized nine coping strategies; eight problem-focused and one emotion-focused while the females utilized eight coping strategies, all of which were problem-focused coping strategies. This

result supported the finding of Stone and Neale (1984, as cited by Rapson, 1990). This meant that the male respondents, in their quest for distinguishing the known and unknown information, had to utilize the mentioned coping strategies, which in general were all direct-action in nature. One male utilized the strategy of ignoring the problem at hand (UP4), an emotion-focused coping strategy which can be considered as an avoidance coping. Two males utilized the strategy of reviewing old notes/lectures taught by the teacher (UP9) while the females did not utilize any of these. The avoidance coping revealed in this study, however, is in conflict with the findings of Billings and Moos (1984, as cited in Rapson (1990)). One female utilized the strategy of listening to the teacher attentively (UP10) while not one of the males did. Coping strategies that were commonly used by both sexes included recalling and/or applying basic facts/principles/stock knowledge (UP1), understanding fully, analyzed and listed/enumerated all the given information and/or thought critically/logically giving focus on the problem (UP2), familiarization of terminologies using online references and/or non-online references (UP3), re-reading/re-writing the problem and identified clues (UP5), rephrasing/translating the sentence in own words/grammar construction (UP6), asking seatmates/friends/teacher/tutor to help explain/solve the problem (UP7) and looking for more exercises in books and read books related to the problem at hand (UP8). Majority of the respondents utilized the strategy of understanding fully, analyzing and listing/enumerating all the given information and/or thinking critically/logically giving focus on the problem at hand (UP2) followed by the strategy of familiarizing with terminologies using online references and/or non-online references (UP3). The coping strategies that were elicited through the Coping Strategy Questionnaire were validated through informal interviews by the researcher.

Table 14

Common Coping Strategies Utilized by the Respondents (By Sex) in Understanding the Problem Phase (UP)

SEX	COPING STRATEGIES										# of Problem-Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	UP1	UP2	UP3	UP4	UP5	UP6	UP7	UP8	UP9	UP10		
Males	2	39	20	1	11	2	5	18	2	0	8	1
Females	5	58	34	0	24	1	8	24	0	1	8	0
Both	√	√	√		√	√	√	√				

Note: A respondent can have multiple responses

In the devising a plan (DP) phase, both sexes applied the same set of coping strategies (please see Table 15). Majority of the respondents utilized the strategy of looking for more exercises in books and read books related to the problem at hand/more exposure/needed more problem solving exercises (DP8) followed by the strategy of searching online for some strategies/related problems (DP3). In addition, two respondents, a male and a female utilized the strategy of telling themselves that they did their best to advance their studies (DP10). The strategy of using positive self-talk by telling oneself that he did his best to reflect about a particular problem was revealed in the study of Tamres, et al. (2002).

Table 15

Common Coping Strategies Utilized by the Respondents (By Sex) in Devising a Plan Phase (DP)

SEX	COPING STRATEGIES										# of Problem-Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8	DP9	DP10		
Males	6	7	13	16	12	3	11	22	2	1	9	1
Females	12	19	22	16	9	5	18	48	2	1	9	1
Both	√	√	√	√	√	√	√	√	√	√		

Note: A respondent can have multiple responses

In carrying out the plan (CP) phase, it can be observed that both sexes utilized the same number of coping strategies. The males did not utilize the strategy of questioning himself how to manipulate/compute the working equation (CP5) while a lone female respondent did (please see Table 16). Meanwhile, two male respondents applied the strategy of ignoring the problem at hand (CP11) while no one from the females did. Coping strategies that were commonly used by both sexes included CP1, CP2, CP3, CP4, CP6, CP7, CP8, CP9, CP10 and CP12. Majority of the respondents utilized the strategy of asking friends/teacher/tutor to help explain further the process/computation/copied from seatmate (CP7) followed by the strategy of understanding fully, analyzing/thinking critically and solved the problem carefully/self-study and applied plan to answer the problem by oneself (CP1).

Table 15

Common Coping Strategies Utilized by the Respondents (By Sex) In Carrying out the Plan Phase (CP)

SEX	COPING STRATEGIES												# of Problem - Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11	CP12		
Males	11	5	9	6	0	7	34	10	3	2	2	1	7	4
Females	24	12	11	6	1	7	76	5	4	1	0	2	7	4
Both	√	√	√	√		√	√	√	√	√		√		

Note: A respondent can have multiple responses

In the looking back (LB) phase, the females utilized all the listed 11 coping strategies, four of which were emotion-focused and seven were problem-focused while the males utilized only nine of them, two of which were emotion-focused and seven problem-focused coping strategies (please see Table 17). The strategies of concluding briefly (LB10) and ignoring the problem at hand (LB11) were utilized by a few of the female respondents. Strategies that were commonly used by both sexes included LB1, LB2, LB3, LB4, LB5, LB6, LB7, LB8, and LB9. Majority of the respondents utilized the strategy of rechecking/re-evaluating whether the answer was correct (LB1) followed by the strategy of thinking that things will get better/thinking that one will get matured enough to handle problems next time (LB3).

Table 17

Common Coping Strategies Utilized by the Respondents (By Sex) in Looking Back Phase (LB))

SEX	COPING STRATEGIES											# of Problem-Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	LB 1	LB2	LB3	LB4	LB5	LB6	LB7	LB 8	LB9	LB10	LB11		
Males	23	7	27	1	7	2	8	2	12	0	0	7	2
Females	37	13	30	8	8	1	9	8	12	2	3	7	4
Both	√	√	√	√	√	√	√	√	√				

Note: A respondent can have multiple responses

In the four phases of problem solving, it can be observed that problem-focused coping strategies were the most utilized strategies of both males and females. This finding supports the study of Stone and Neale (1984, as cited by Rapson (1990)) and partly that of the study of Rapson (1990). With this, it is hoped that students will have higher scores in their school activities' assessments, not only for females as the study of Rodriguez, et al. (2012) revealed, but also for the males. The observations imply that activities and tasks given by the mathematics teachers should be performed incorporating the coping strategies mostly utilized by the students in each phase of problem solving. Doing so may help improve the achievement of the students in mathematics (Ader and Erktin, 2012; Chinaveh, 2012)

Students' Coping Strategies by Academic Program by Phase

It is apparent from the results that every academic program utilized almost the same coping strategies in each of the phases of problem solving.

A total of 97 respondents utilized the strategy of understanding fully, analyzing and listing all the information or thinking logically giving focus on the problem (UP2) to overcome their difficulty in understanding the problem phase (UP) (please see Table 18). Other coping strategies utilized by the majority of the respondents were UP3, UP8, UP5 and UP7 which were: familiarization of terminologies using online references and/or non-online references, looking for more exercises in books and reading books related to the problem at hand/more exposure, re-reading/re-writing the problem and identified clues and asking seatmates/friends/teacher/tutor to help explain/solve (assistance) respectively. The least utilized coping strategies which were evident in the BS in Sociology, a NON-STEM related academic program and BS in Mathematics, a STEM-related academic program were UP4 and UP10 namely:

ignoring the problem at hand which is an emotion-focused coping strategy and listening attentively to the teacher which is a problem-focused coping strategy respectively. Meanwhile, seeking assistance and support from seatmates/friends/teacher/tutor to help explain/solve the problem at hand (UP7) was utilized by a few number of respondents of the BS in Nursing. This number of respondents of the BS in Nursing, however, was the greatest as compared with the other courses like BA in Communication, BS in Agricultural and Biosystems Engineering, BS in Civil Engineering and BS in Mathematics.

The STEM-related academic programs namely, the BS in Civil Engineering and BS in Mathematics, had few respondents who utilized the strategy of familiarizing terminologies using online references and/or non-online references (UP3) while the majority of the total respondents predominantly applied the strategy of understanding fully, analyzing and listing all the information or thinking logically giving focus on the problem (UP2).

The Information presented imply that students enrolled in the STEM programs do not rely so much from online resources, instead they give full attention to the problem they are into and give their best to understanda and analyze the situation.

Table 18

Common Coping Strategies Utilized by the Respondents (By Academic Program) in Understanding the Problem Phase (UP)

ACADEMIC PROGRAMS	COPING STRATEGIES										# of Problem-Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	UP1	UP2	UP3	UP4	UP5	UP6	UP7	UP8	UP9	UP10		
STEM-related												
BS-ABE		22	3		4	2	3	8			6	0
BS-CE		22	26		7		1	12	2		6	0
BS-CHEM E	2	4	3		2			3			5	0
BS-MATH		4	6		2	1	1	3		1	7	0
BS-METEO	1	3						3			3	0
NON-STEM related												
BA-COMM	2	10	1		5		1				5	0
BS-ECON		9	4		4			5			4	0
BS-NURSING	1	15	4		9		7	5			6	0
BS-SOCIO	1	8	7	1	2			3			5	1
TOTAL	7	97	54	1	35	3	13	42	2	1		

Note: A respondent can have multiple responses

Seventy respondents utilized the strategy of looking for more exercises in books and read books related to the problem at hand (DP8) to overcome their difficulty in devising a plan phase (DP) (please see Table 19). Other coping strategies utilized by the majority of the respondents were searching online for some strategies/related problem (DP3), proceeding in creating own strategy/plan/formula (DP4), asking friends/teacher/tutor to help explain/solve (DP7), and understanding fully, analyzing/thinking critically and pondered on what the formula would be (DP2). The least utilized coping strategy, that is, believing that the respondent did his/her best to advance the study (DP10) was evident in the respondents of the BS in Chemical Engineering and BS in Meteorology courses, both STEM-related academic programs. This strategy was emotion-focused in nature. It was followed by having computing gadgets (DP9) as utilized by two respondents of BS in Agricultural and Biosystems Engineering, one from BS in Meteorology, both STEM-related academic programs and another one from the BS in Sociology, a non-STEM related academic program.

Table 19

Common Coping Strategies Utilized by the Respondents (By Academic Programs) in Devising the Plan Phase (DP)

COURSES	COPING STRATEGIES										# of Problem-Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	DP 1	DP 2	DP 3	DP 4	DP 5	DP 6	DP 7	DP 8	DP 9	DP 10		
STEM-related												
BS-ABE	1	2	8	5	3	1	7	12	2		9	0
BS-CE	5	9	9	8	6	3	5	20			8	0
BS-CHEM E	1	1		3	4		1	4		1	6	1
BS-MATH		1	2	1		1	2	11			6	0
BS-METEO	1	1	1	1			3		1	1	6	1
NON-STEM related												
BA-COMM	1	2	2	6		3	2	1			7	0
BS-ECON		4	3	2	3		3	6			6	0
BS-NURSING	5	4	6	5	5		4	10			7	0
BS-SOCIO	4	2	4	1			2	6	1		7	0
TOTAL	18	26	35	32	21	8	29	70	4	2		

Note: A respondent can have multiple responses

Table 20 shows that the majority of the respondents (109) utilized the strategy of asking friends/teacher/tutor to help explain further the process/computation (CP7). This was followed by the strategy of understanding fully, analyzing/thinking critically and solved the problem alone carefully (UP1). Other strategies which the respondents utilized in most frequencies were on the use of guides and formulas and even computing gadgets necessary in the computational process (CP2), the need to read more books/references and lots of problem solving exercises (CP8), and the need to learn/review the process/computations (CP4). A lone respondent from the BA in Communication, a NON-STEM related academic program questioned himself how to solve the problem given him (CP5) as his coping strategy. This in fact, is the least utilized coping strategy. Two respondents, each coming from the BA in Communication and BS in Sociology, both NON-STEM related academic programs ignored the problem at hand. In addition, two respondents from the BS in Civil Engineering, a STEM-related academic program and one respondent from the BS in Nursing, a NON-STEM related academic program utilized the strategy of talking and praying (CP12) while two respondents from the BS in Civil Engineering and another one respondent from the BS in Nursing utilized the strategy of sharing their feelings with someone (CP10).

Except for the BS in Mathematics which is a STEM-related academic program and BS in Economics and BS in Sociology which are both NON-STEM related academic programs, the respondents in the other courses utilized a combination of problem-focused and emotion-focused coping strategies.

Table 20

Common Coping Strategies Utilized by the Respondents (By Academic Program) in Carrying out the Plan Phase (CP)

ACADEMIC PROGRAMS	COPING STRATEGIES												# of Problem-Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP 11	CP 12		
STEM-related														
BS-ABE	5	5	4	1		1	21		1				6	1
BS-CE	10	1	4	5		2	26	9		2		2	7	2
BS-CHEM E	4	1	3			1	4		1				5	1
BS-MATH	1	1	1	3		1	9	1					7	0
BS-METEO	2	2	1					1	1				5	1
NON-STEM related														
BA-COMM	5	1	2		1	2	5		1		1		5	2
BS-ECON	2		1			6	9	1					5	0
BS-NURSING	4	4	2	2			25	1	3	1		1	6	3
BS-SOCIO	2	2	2	1		1	10	2			1		7	0
TOTAL	35	17	20	12	1	14	109	15	7	3	2	3		

Note: A respondent can have multiple responses

In Table 21, one can observe that to help resolve the difficulty with looking back phase, the majority of the BS in Civil Engineering respondents resorted to the strategy of re-checking/re-evaluating the correctness of their answer (LB1). Other strategies that were commonly used by the respondents were as follows: thinking that things will get better next time (LB3), believing in one's self/confidence (LB9), understanding/analyzing the problem or having self-study (LB2), and asking friends/teacher/tutor to help explain the whole process (LB7). Though believing in one's self and asking friends are a bit conflicting, the former coping strategy emphasizes that students in the STEM program are really confident with their work in problem solving. However, there maybe times when they feel the need to ask for confirmation from their mates, thus, they seek assistance from their mates and teacher. The least utilized coping strategy was LB10 which involved concluding briefly. This was encountered by a lone respondent of the BS in Civil Engineering, a STEM-related academic program and another lone respondent of BA in Communication, a NON-STEM related academic program. This was followed by the strategy of ignoring the problem at hand. Two respondents, each coming from the BS in Nursing and BS in Sociology, both NON-STEM related academic program and a lone respondent from the BS in Civil Engineering, a STEM-related academic program just ignored the problem at hand (LB11). Another less utilized coping strategy was concerned about the need for English language skills (LB6). This implies that English proficiency is a necessity in any problem solving endeavor. Understanding the problem requires one to have the English language skill. Two respondents, one from the BS in Agricultural Biosystems Engineering and another one from the BS in Civil Engineering, both STEM-related academic programs and a lone respondent from the

BA in Communication, a NON-STEM-related academic program needed English language skills (LB6).

Table 21

Common Coping Strategies Utilized by the Respondents (By Course) in Looking Back Phase (LB)

ACADEMIC PROGRAMS	COPING STRATEGIES											# of Problem-Focused Coping Strategies Used	# of Emotion-Focused Coping Strategies Used
	LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB8	LB9	LB10	LB11		
STEM-related													
BS-ABE	17	2	8		3	1	1		5			5	2
BS-CE	17	4	17	8	1	1	2		6	1	1	6	4
BS-CHEM E	5	1	1					3	4			3	2
BS-MATH	4	4	4		1			3				4	1
BS-METEO	1		1		2		4		1			3	2
NON-STEM related													
BA-COMM	6	2	6			1	2			1		4	2
BS-ECON	1	1	2		3		6	3	2			5	2
BS-NURSING	7	6	12		3			1	3		1	4	3
BS-SOCIO	2		6	1	2		2		3		1	4	3
TOTAL	60	20	57	9	15	3	17	10	24	2	3		

Note: A respondent can have multiple responses

With limited literature relating to the coping strategies in each of the different phases of problem solving for the STEM-related and NON-STEM-related academic

programs, this study claims such observation and hopes that it will be used for future researches.

In summary, the respondents utilized 43 coping strategies, 11 of which were emotion-focused, while, the majority (32) were problem-focused. From the tables presented, the problem-focused coping strategies dominated the emotion-focused coping strategies. This is supported by the study of Ader and Erktin (2012) and Lazarus (1993) where they concluded that problem-focused coping strategies are more highly-valued than the emotion-focused coping strategies in Western societies. In addition, one of the observations noted was the strategy of listening attentively to the teacher, which was the most significant coping mechanism of the Education students of Bagasol, et. al. (2015).

The results imply that whether a student is a STEM or a non-STEM SHS graduate, there is a need to look into the strategies that go hand in hand with the activities and tasks that are given to students in any problem solving encounter. The teachers must make sure that the students are able to understand fully what they are doing. If still students don't get it, then they may be given additional tasks of reading related problems. Giving tasks to students by working with friends or seatmates through cooperative learning and checking whether their solutions fit the given conditions may also help one get alleviated with his problem solving difficulties apart from the fact that success comes to people who cooperate and work together in in attaining shared goals.

Models of Coping Strategies

Having identified the problem solving difficulties of the students in each of the phases of problem solving and their relationship with each other, the following models/representations were developed.

Developed Models

Model of Coping Strategies by Sex by Phase

The model in Figure 6 reveals the coping strategies of a male student in each of the phases of problem solving. For the first phase, he gives focus in analyzing the problem. Also, he thinks critically and enumerates all the given information as much as possible.

In forming the working equation or formula, he searches/looks for more exercises in books and notes the strategies/plans utilized in solving a particular problem. He needs much exposure in looking at problem solving exercises.

In the computational phase (third phase), he usually asks support or assistance from his friends/teachers or tutors to help explain further the process or computation, but this was limited only during seatwork and assignments, and not during examinations.

The last phase is usually more of the emotions. What he has done in the first three phases will serve as his lesson to get better in future problem solving encounters. He promises that he will be more matured enough to handle situations and makes sure to check every now and then time his solutions.

Likewise, the females also give focus in analyzing the problem. They too think critically and enumerate all the given information, too, as much as they could.

They also search/look for more exercises in books and take note of the strategies/plans that were utilized in solving different types of problems. They need lots of problems solving exercises for them to form the working equation or formula.

They ask assistance or support from their friends/teachers or tutors in explaining further the process or computation for the third phase.

The last phase (LB) is more of the problem focused type of coping. The females usually re-check or re-evaluate whether their derived answers are correct or not. This phase is what differentiates the females from the males.

Looking at the model in Figure 6, it can be seen that the problem-focused coping strategies dominated over the emotion-focused coping strategies for both males and females. This observation supports the finding of Okoro (2018), where the general education students utilized the strategy of active coping, which is a form of problem-focused coping strategy. It is only in the last phase (LB) where there is a point of comparison.

The said comparison contradicts the findings of Brougham's, et. al. (2009) where college women had a greater use of emotion-focused coping strategies than the college men.

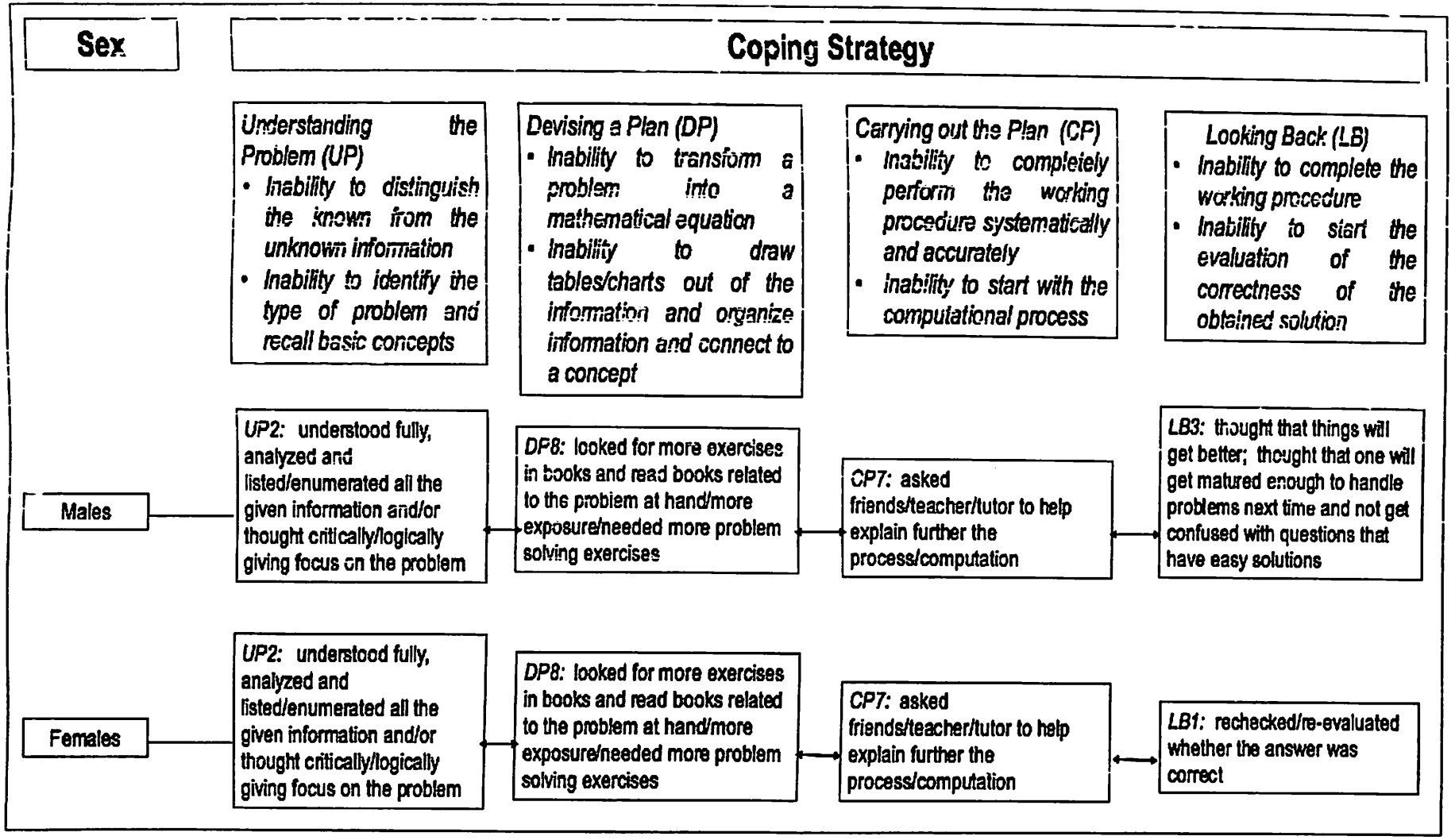


Figure 6. Coping Strategies by Sex by Phase Model

Model of Coping Strategies by Academic Program by Phase

STEM-related academic programs

In Figure 7, a BS Agricultural and Biosystems Engineering student applies the same coping strategies in the first and third phase of problem solving as a BS Communication student.

For the devising a plan phase (DP), a BS-ABE student exerts efforts in looking/searching for more exercises in books and notes down the plans/strategies used in solving the different types of problems. He needs more problem solving exercises to cope with computational difficulties.

The looking back (LB) phase shows that a BS-ABE student usually re-checks or re-evaluates his derived answer whether it fits the given conditions in the problem (please see Figure 7).

Meanwhile, a BS in Civil Engineering and a BS in Chemical Engineering student utilizes the same coping strategy in dealing with the first phase of problem solving. An additional strategy however is utilized by a BS Chemical Engineering student, that is, looking for more exercises in books that are related to the problem to have more exposure that can help him better understand the situation.

The above mentioned courses utilize the strategy of looking/reading for more exercises in books related to the problem at hand taking note of the strategies/plan that were used in attacking different types of problems.

For the third phase, (CP), a BS Civil Engineering student cope with his difficulties by seeking assistance from friends, teachers of tutors to explain further the process or computation while a BS Chemical engineering student proceeds with the computational process all by himself applying his strategy/plan in answering the

problem.

Rechecking or re-evaluating is the strategy of BS Civil Engineering and BS Chemical Engineering students in dealing with their difficulty in the last phase (LB).

The BS-Mathematics students utilize two possible strategies in managing their difficulties in understanding the problem (UP). Giving focus in a problem is understanding it fully, thinking critically what information is helpful in tackling the problem. This facilitates him to search online for the not so familiar terminologies or even in books or in other references (please see Figure 7).

To make sure that he is on the right track of solving the problem, he again looks for some exercises noting down the strategies that were applied in the solution process.

Then in the computation process, maybe to non-confidence, he asks assistance from his friends, teachers or tutors.

In the last phase, the BS Mathematics student usually applies three coping strategies which are a combination of problem-focused and emotion-focused coping strategies namely: rechecking or re-evaluating whether the answer is correct, analyzing the problem more by having self-study which are both problem-focused while thinking that things will be better next time is emotion-focused coping strategy. A closer look at these strategies together with the findings of Finalyson (2014) have something in common. These are, doing one's task (self-study) and having a positive outlook.

Meanwhile, the BS-Meteorology students also utilize two coping strategies for the first phase namely: understanding fully and listing all the given information and looking or reading for more exercises in books that are related to the problem at hand.

To relieve him from his difficulty of devising a plan, he asks support or assistance from his friends, teachers or tutors.

In the computational process, he applies two possible strategies such as: understanding fully and solving the problem by himself. He needs computing gadgets though in the computation.

The last phase involves coping with it by asking support support from friends, teachers or tutors. Through this, the student may be enlightened on what went wrong and what went well with his solutions.

NON-STEM-related academic programs

In Figure 8, a BA Communication student prefers the coping strategies as shown in each of the phases of problem solving. For the first phase, he gives focus in analyzing the problem, thinks critically and enumerates all the given information as much as possible.

He proceeds with his solution by creating his own plans/formulas and comes up with his working equation or formula (not so sure though of whether he is correct or not with his formula).

In the computational phase (third phase), he usually resorts to two possible coping strategies: 1) he applies his plan to answer the problem by himself or 2) he asks support of assistance from his friends/teachers or tutors to help explain further the process or computation.

Likewise, in the last phase, he utilizes either a problem-focused coping strategy, that is, rechecking or re-evaluating whether the derived answer is correct of not or an emotion-focused coping strategy that tells him to think that things will be better next time, and also, being more matured to handle problems.

Meanwhile, a BS Economics student utilizes the same coping strategy as a BS in Civil Engineering or BS in Chemical Engineering student in dealing with the first phase (UP) of problem solving.

Economics students utilize the strategy of looking/reading for more exercises in books related to the problem at hand taking note of the strategies/plan that were used in the attacking different types of problems (DP).

For the third phase, (CP), a BS Economics student copes with his difficulties by seeking assistance from friends, teachers of tutors to explain further the process or computation.

Asking assistance or support from friends, teachers or tutors to help explain the whole process is the strategy of a BS Economics student for the last phase.

The BS Nursing students on the other hand, apply the strategy of focusing on the problem, listing and enumerating all the given information in dealing with understanding the problem phase (UP).

To devise a plan or formula (DP), the student has to look/read for more exercises in books related to such problems giving attention to the strategies/plans that were applied in the solution.

In the computational process (CP), the student asks for support from his friends or teachers, that he may be clarified on the process.

In the last phase (LB), he utilizes an emotion-focused coping strategy that tells him to think that things will be better next time, and so, being more matured to handle problems.

Meanwhile, a BS Sociology student applies the same coping strategies in the first, second and third phases of problem solving as a BS Nursing student as revealed in Figure 7.

In the looking back (LB) phase, he utilizes a strategy, often an emotion-focused, that lets him think that things will be better next time, and being more matured to handle problems.

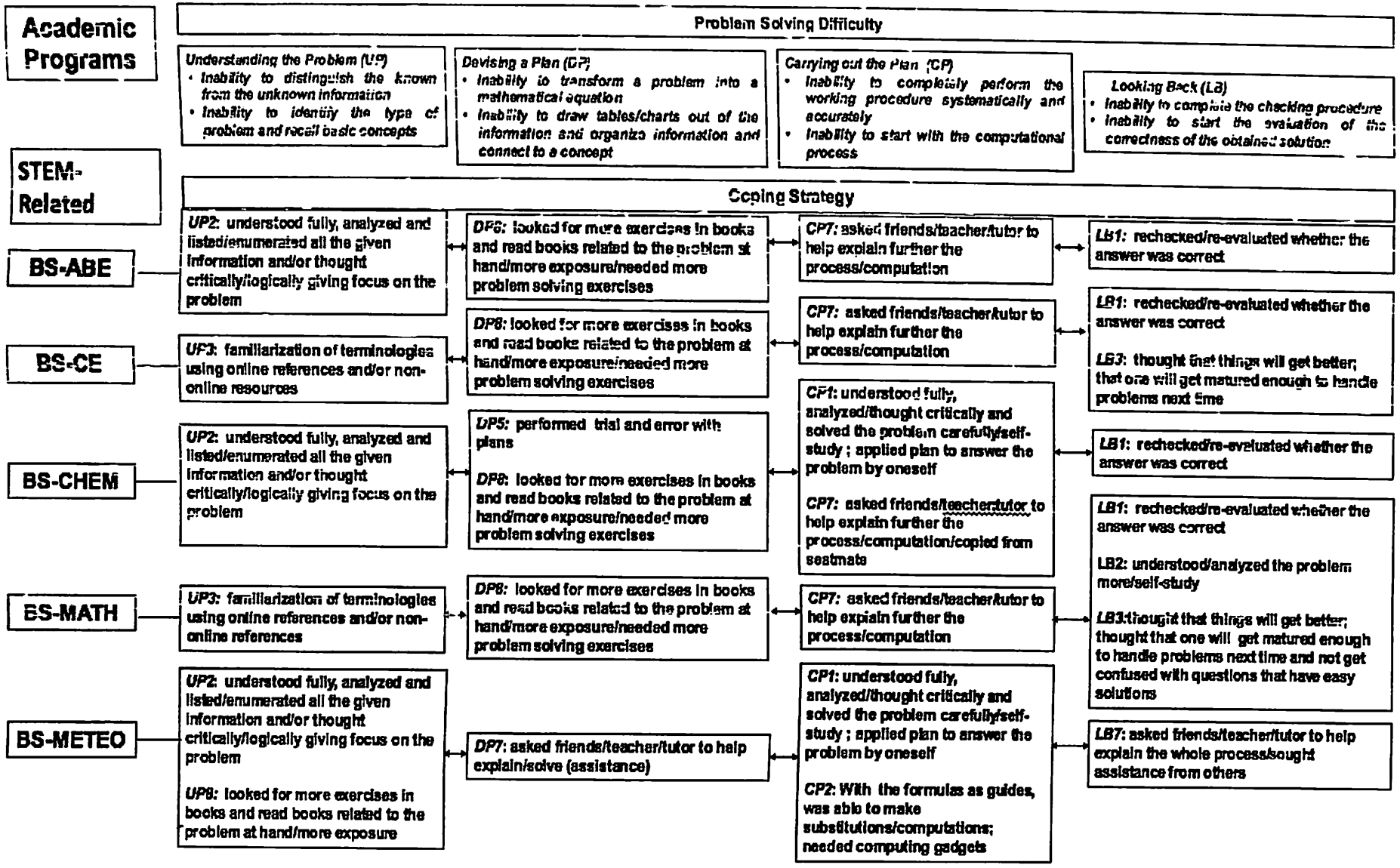


Figure 7. Coping Strategies by Academic Program (STEM-related) by Phase

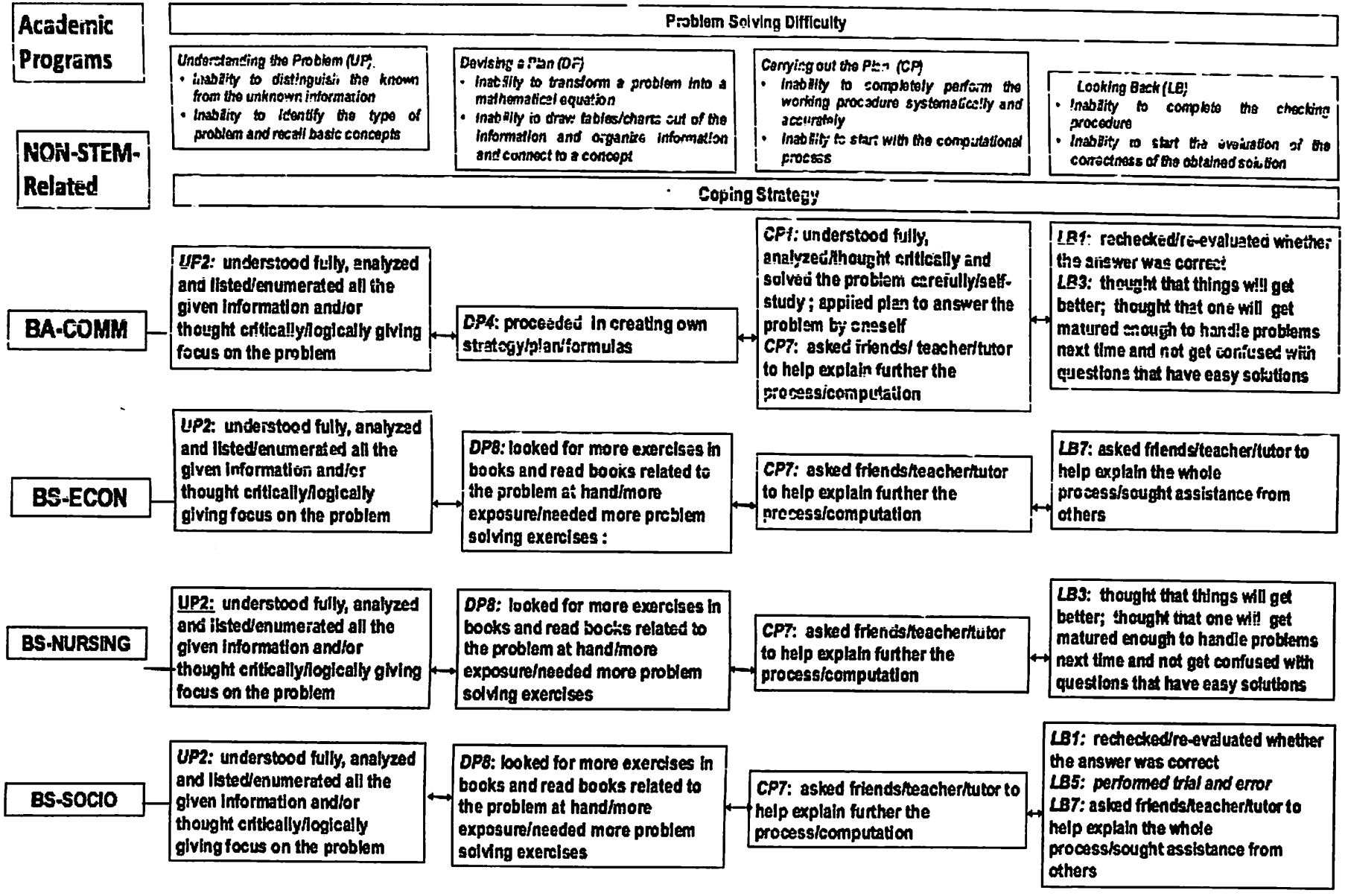


Figure 8. Coping Strategies by Academic Program (non STEM-related) by Phase

As a summary (please see Figure 9), one can observe that both groups of academic programs utilize the same set of coping strategies namely; understanding fully, analyzing and listing all the given information and/or logically giving focus on the problem in the understanding the problem (UP) phase, looking for more exercises in books and read books related to the problem at hand/more exposure/needed more problem solving exercises in the devising a plan (DP) phase, and asking friends/teachers/tutors to help explain further the process/computation for the carrying out the plan (CP) phase. For the last phase, one can check that the STEM-related and non-STEM-related respondents have the same common coping strategy which is rechecking/reevaluating whether the answer was correct or not. However, additional coping strategies were utilized by the respondents of the non-STEM academic programs which are: thinking that things will get better, and get matured enough to handle problems next time and asking friends/teacher/tutors to help explain the whole process/sough assistance from others.

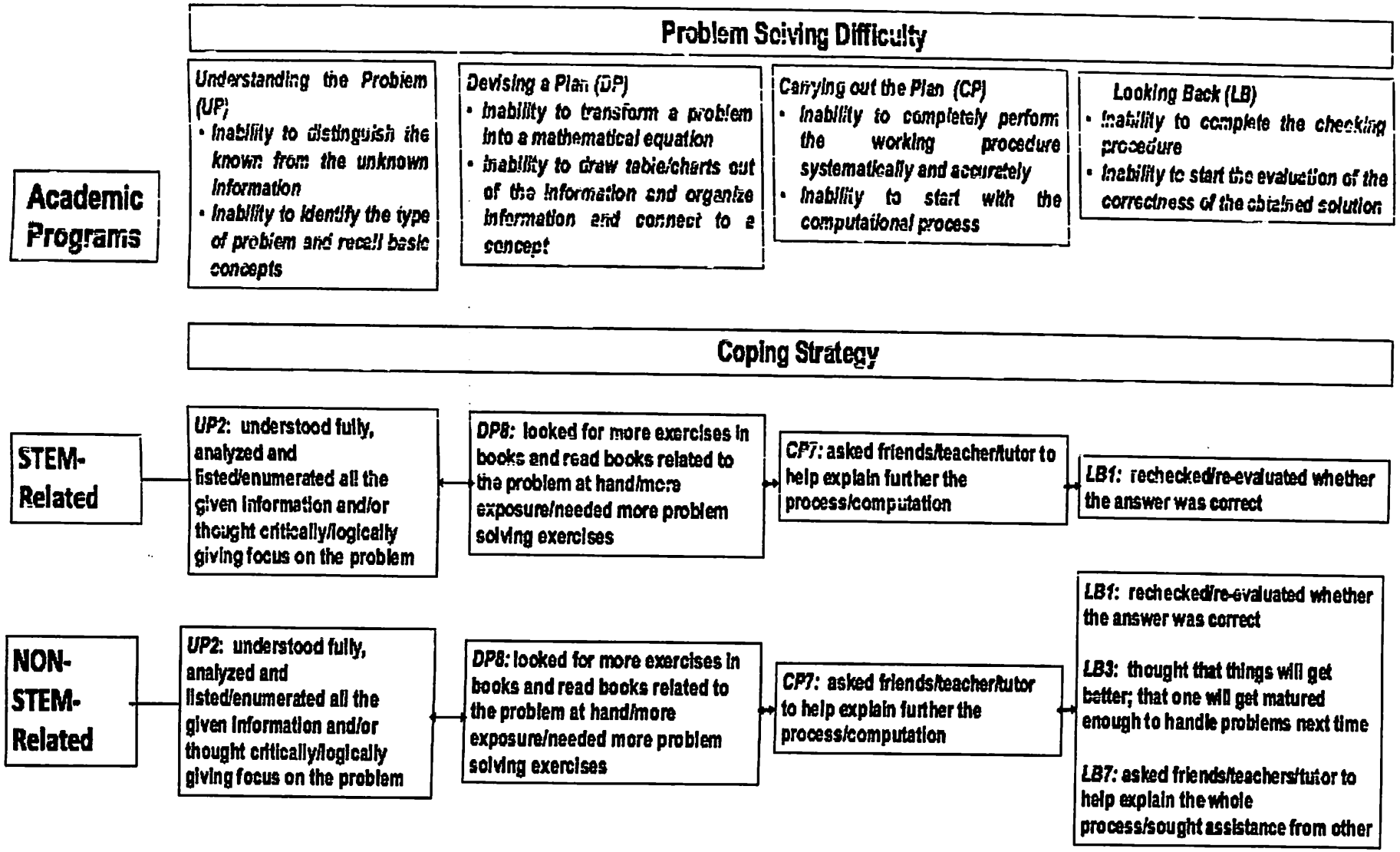


Figure 9. Coping Strategies by Academic Program (In General) by Phase

Results of the Validation

After the models have been developed, the next task was of demonstrating its reasonability by determining if it was a good representation of the actual system or if it was applicable to other groups of students and really helped address the difficulties of the students in their problem solving encounters.

Validation of the Coping Strategies by Sex by Phase Model

Eight males and 10 female respondents were purposively chosen by the researcher in the validation of the models. The selected samples came from the validation group which consisted of the 30 percent of the total respondents. They were the respondents who were then available during the time of the validation stage. Also, the students' coping strategies in the different phases of problem solving that matched at least one of the strategies in the developed models were considered in choosing the case samples. The highlighted coping strategies in the succeeding tables indicate a match to the model (please see Table 22). Exhibits showing the students' solutions before the models were developed and after applying their coping strategies as lifted from the respondent's papers are also shown.

Coping Strategies of Male Students by Phase Model Validation

Table 22. Model Validation of Coping Strategies of Male Students by Phase

MALE #	Coping Strategies				Difficulty	
	Understanding the Problem (UP)	Devising a Plan (DP)	Carrying out the Plan (CP)	Looking Back (LB)	Before	After
1	UP2	DP7	CP8	LB1	DP, CP, LB	LB
2	UP8	DP8	CP4	LB2	LB	-
3	UP3	DP8	CP7	LB10	LB	-
4	UP5	DP8	CP7	LB4	CP	-
5		DP8			LB	-
6	UP8	DP8	CP1	LB3	DP, CP, LB	CP, LB
7	UP1	DP1	CP7	LB1	LB	-
8	UP2	DP8	CP2	LB1	CP, LB	LB

As shown from the solutions (Exhibit #18), before, the student was not able to transform the problem into a mathematical equation (DP), hence was not able to proceed with the rest of the phases of problem solving, meanwhile, after analyzing and enumerating all the given information and giving focus on the problem (UP2), in the validation phase, it can be seen that he was able to form the mathematical equation (DP) and performed correct computation. He was not successful in checking his solution but he had a concluding statement. With this, his difficulties were lessened and therefore, were addressed.

EXHIBIT #18: Male #1; Difficulty: DP, CP, LB Coping Strategy/ies: UP2

BEFORE

1. *Deewye is twice as old as Jean. Three years ago, the sum of their ages is 39. How old are they?*

Let $2x$ =

$2y + x = 39$

AFTER

How old are they?

$2x = y$ $x + y = 39$ $\frac{2y}{2} = \frac{y}{2}$ $y = \frac{45}{3}$

$x + y = 39 + 6$ $x = 15$

$x + y = 45$ $x = \frac{y}{2}$ $y = 2x$

$y = 30$

Deewye is 30 years old

Jean is 15 years old

Focusing on the solution of the student before, it can be seen that he was successful in deriving the answers to the requirements of the problem (Exhibit #19). But after he utilized the strategy of looking for more exercises and reading more books with related problems (DP8), the student was able to check his derived values whether they fit the conditions given and concluded consequently. Hence, the student's difficulty which is looking back before was finally eliminated in the validation stage.

EXHIBIT #19: Male #2; Difficulty/ies: LB Coping Strategy: DP8

BEFORE

6. *Xander invested P35,000.00 in a savings account that pays 4% simple interest. How much will he earn after 3 years? What will the new balance be?*

$P = 35,000$

$r = 4\%$ or 0.04

$t = 3$ yrs

$I = Prt$

$= (35,000)(0.04)(3)$

$= 4,200$

$35,000 + 4,200 = 39,200$

AFTER

6. *Xander invested P35,000.00 in a savings account that pays 4% simple interest. How much will he earn after 3 years? What will the new balance be?*

Known:

① → money of Xander which is ₱35000

→ interest is 4% = 0.04

→ 3 years

Type: Money Relations

Unknown:

→ How much will he earn in 3 years?

→ What will be the new balance?

② Let x = interest balance

y = be the annual balance w/ interest

$(35,000)(0.04)3 = x$

Therefore, he will earn 4,200 for 3 years

→ his new balance is ₱39,200

₱35000 × .04 = ₱1400

₱35000 + ₱1400 = ₱36400 (1st year)

₱36400 + ₱1400 = ₱37800 (2nd year)

₱37800 + ₱1400 = ₱39200 (3rd year)

EXHIBIT #18: Male #1; Difficulty: DP, CP, LB Coping Strategy/ies: UP2

BEFORE

1. *Deewye is twice as old as Jean. Three years ago, the sum of their ages is 39. How old are they?*

Let $2x$ =

$2x + x = 39$

AFTER

$2x = y$ $x + y = 39$ $\frac{2x}{2} = \frac{y}{2}$ $y = \frac{45}{3}$

$x + y = 39 + 6$ $x = 15$

$x + y = 45$ $x = \frac{y}{2}$ $y = 2x$

$y = 30$

Deewye is 30 years old

Jean is 15 years old

Focusing on the solution of the student before, it can be seen that he was successful in deriving the answers to the requirements of the problem (Exhibit #19). But after he utilized the strategy of looking for more exercises and reading more books with related problems (DP8), the student was able to check his derived values whether they fit the conditions given and concluded consequently. Hence, the student's difficulty which is looking back before was finally eliminated in the validation stage.

EXHIBIT #19: Male #2; Difficulty/ies: LB Coping Strategy: DP8

BEFORE

6. *Xender invested P35,000.00 in a savings account that pays 4% simple interest. How much will he earn after 3 years? What will the new balance be?*

$P = 35,000$

$r = 4\%$ or 0.04

$t = 3$ yrs

$I = Prt$

$= (35,000)(0.04)(3)$

$= 4,200$

$35,000 + 4,200 = 39,200$

AFTER

6. *Xender invested P35,000.00 in a savings account that pays 4% simple interest. How much will he earn after 3 years? What will the new balance be?*

Known:

(1) → money of Xender which is ₱35000

→ interest is 4% = 0.04

→ 3 years

Type: Money Relations

Unknown:

→ How much should he earn in 3 years?

→ What will be the new balance?

(2) Let y = the new balance w/ interest

$(35,000)(0.04)3 = x$

Therefore, he will earn 4,200 per 3 year

→ His new balance is ₱39,200

₱35000 × .04 = ₱1400

₱35000 + ₱1,400 = ₱36,400 (1st year)

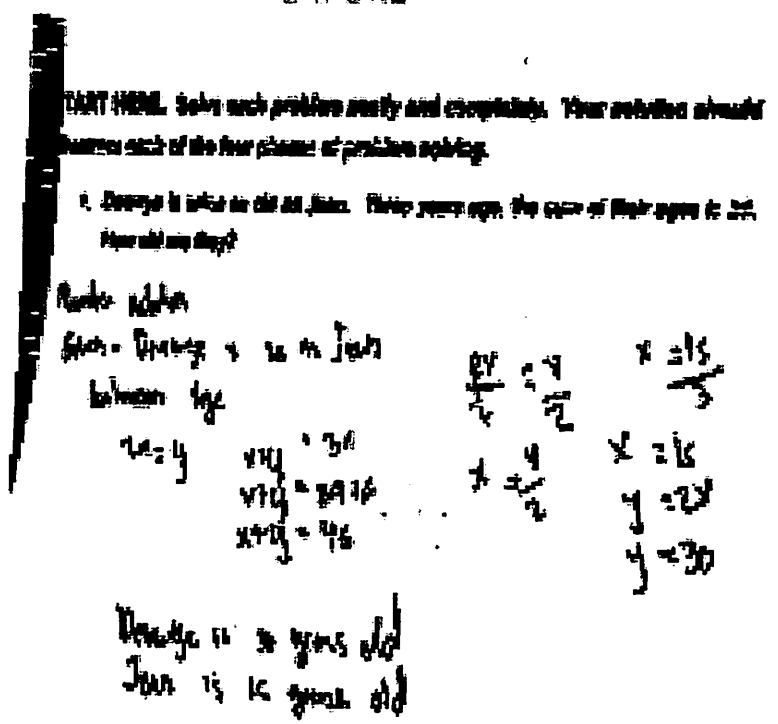
₱36,400 + ₱1,400 = ₱37,800 (2nd year)

₱37,800 + ₱1,400 = ₱39,200 (3rd year)

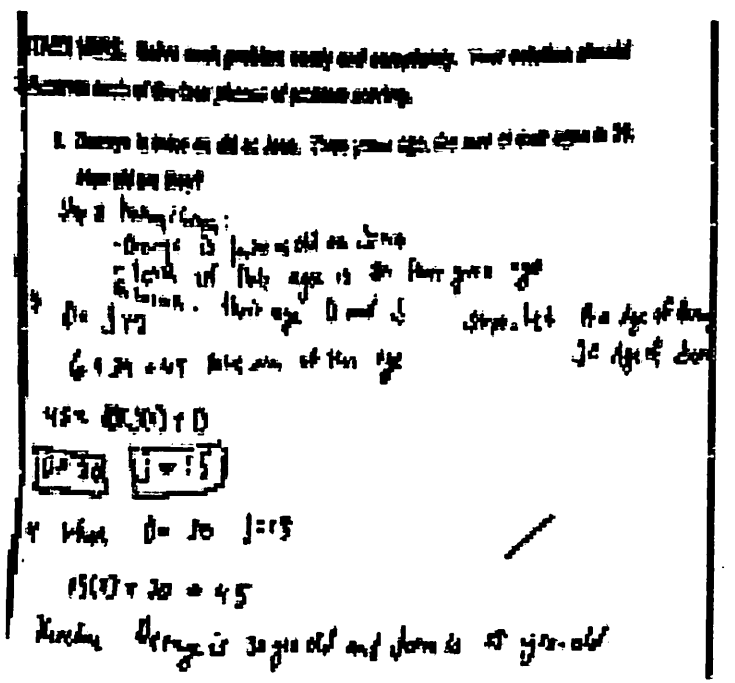
In the student's solution, before, the student merely concluded the ages of Deewye and Jean without checking the given conditions (Exhibit #20). But after he utilized the strategies of looking for more exercises and reading more books with related problems (DP8) and asking assistance from friends/teacher/tutor, the student was able to check his derived values whether they fit the conditions given and concluded consequently. Hence, the student's difficulty which is looking back before was finally eliminated in the validation stage.

EXHIBIT #20: Male #3; Difficulty: LB Coping Strategy/ies: DP8, CP7

BEFORE

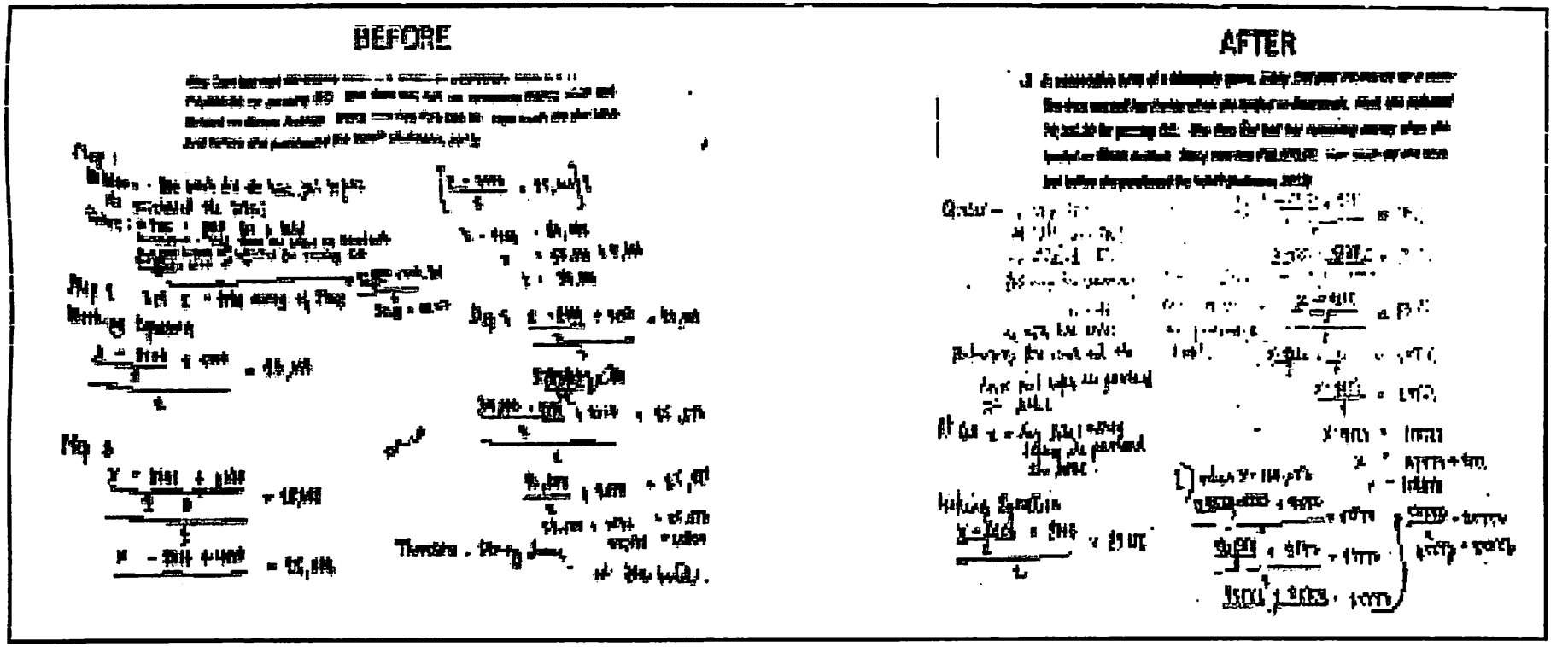


AFTER



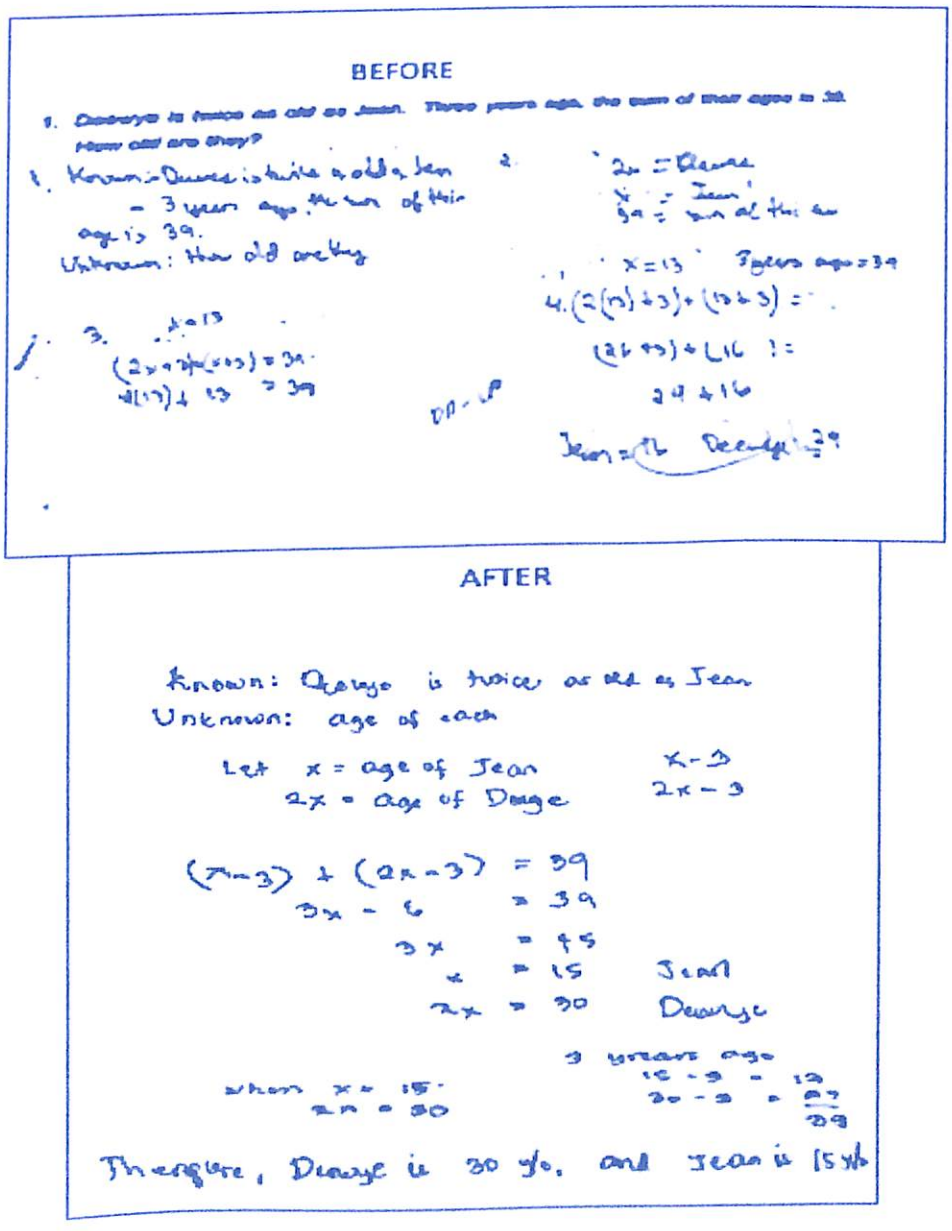
Male #4 has a pre-identified difficulty in carrying out the plan phase (Exhibit #21). Before, he was able to complete all the phases of problem solving though, however, looking at this computation, he failed. Then, after he applied the strategies of looking for more exercises and reading more books with related problems (DP8) and asking assistance from friends/teacher/tutor (CP7), he came up with the correct value that the problem required him of. Thus, the student's difficulty which is carrying out the plan (CP) before was eliminated after the validation stage.

EXHIBIT #21.; Male #4; Difficulty: CP Coping Strategy/ies: DP8,CP7



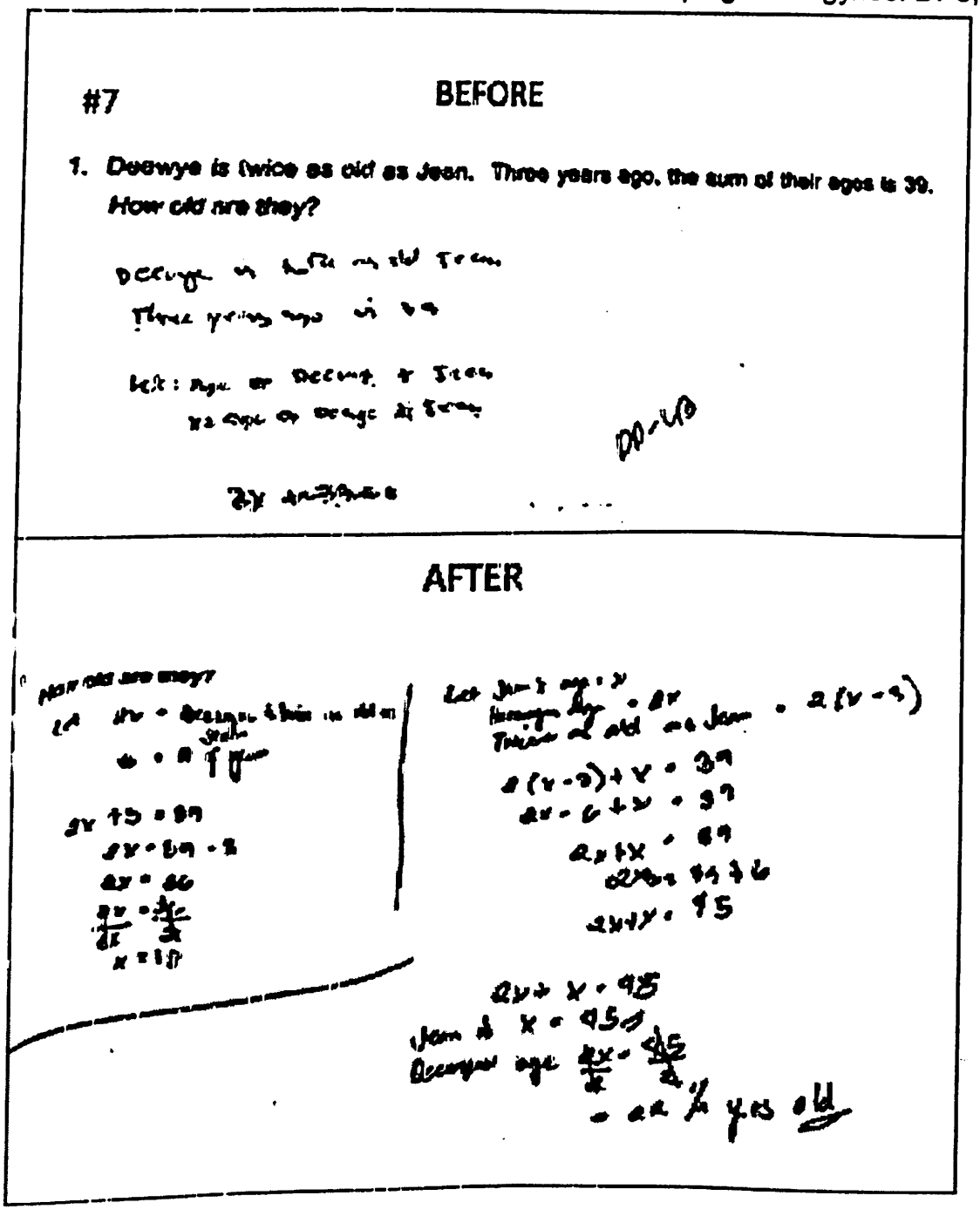
The student struggled in the looking back (LB) phase (Exhibit #22). Now, looking closely at the student's solution, before, he was able to check his solution but had incorrect computation. After utilizing the strategy of looking for more exercises and reading more books with related problems (DP8), the student was able to check with correct computation and with concluding statement. Generally, the student's difficulty which is looking back before was eliminated after the validation stage.

EXHIBIT #22: Male #5; Difficulty: LB Coping Strategy: DP8



Before, the student only knew how to write the given information in the problem (Exhibit #23). He knew how to represent the variables involved. However, he didn't know how to form the working equation and the rest of the phases of problem solving. After utilizing the coping strategies of looking for more exercises and reading more books with related problems (DP8) coupled with thinking that things will get better next time (LB3), he was able to form the working equation but did not arrive at the correct value and hence, was not able to check and make conclusion of his solution. Therefore, his difficulties of carrying out the plan and looking back were not addressed, but at least, were lessened.

EXHIBIT #23: Male #6; Difficulty/ies: DP,CP,LB Coping Strategy/ies: DP8, LB3



#7

BEFORE

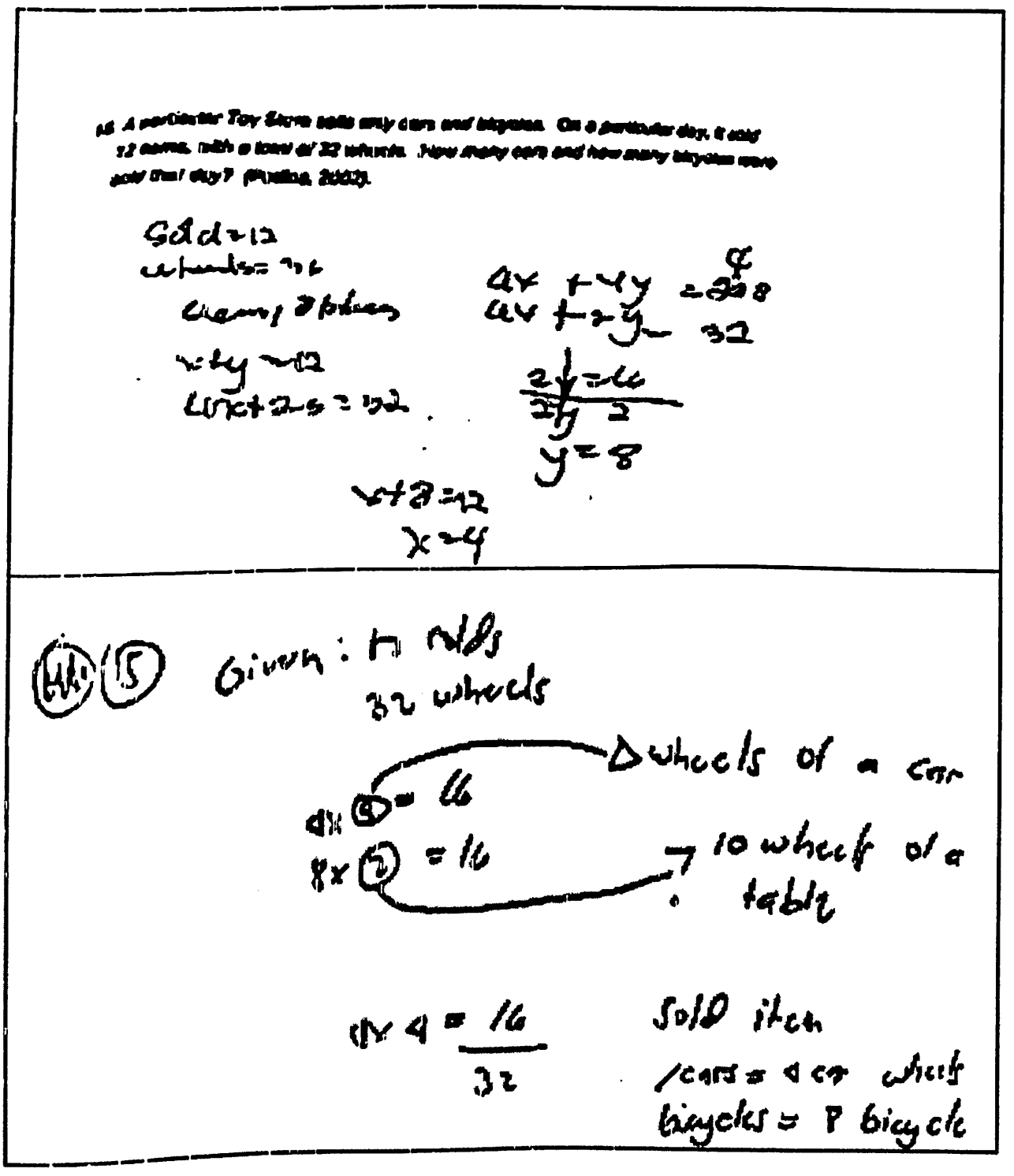
1. Deewye is twice as old as Jean. Three years ago, the sum of their ages is 39. How old are they?

DP,LB

AFTER

This student was able to perform the first three phases in his very simple way (Exhibit #24). He was not able to check his solution if it fits the given conditions. Then, after utilizing the strategy of seeking assistance from friend/teacher/tutors (CP7), he was able to check his solution in his own way. Hence, his difficulty was addressed.

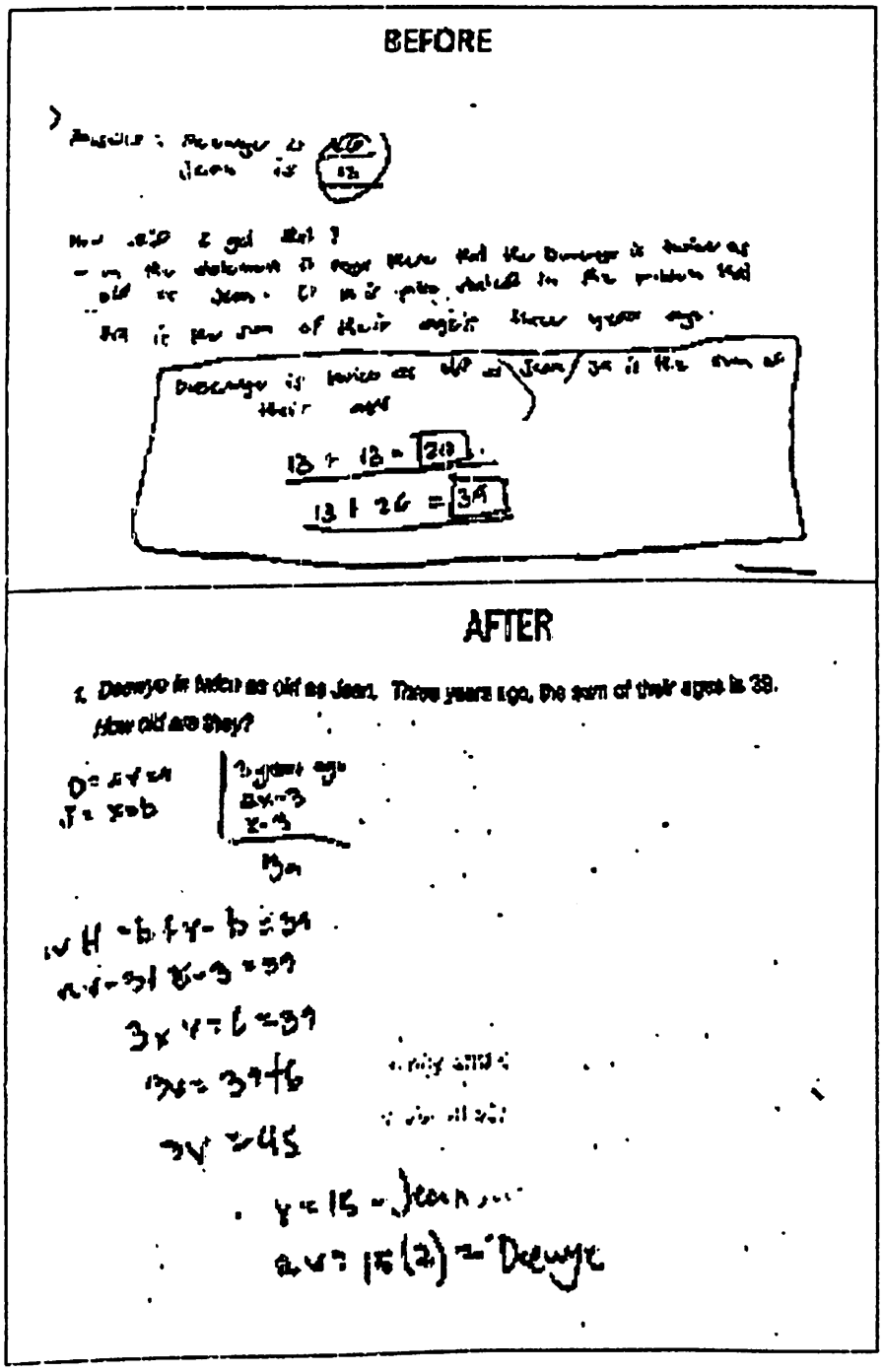
EXHIBIT #24: Male #7; Difficulty: I.B Coping Strategy: CP7



At first, the student only knew how to write the given information and formed the working equation with trial and error strategy (Exhibit #25). He was not able to perform the carrying out the plan and looking back phases of problem solving. After

utilizing the coping strategies of analyzing and enumerating all the given information and giving focus on the problem (UP2) and looking for more exercises and reading more books with related problems (DP8), he was able to form the correct mathematical equation (not by trial and error) and arrive at the correct value but was not able to check if the value fit the given conditions. Hence, only his difficulty of carrying out the plan was somehow addressed.

EXHIBIT #25 Male #8; Difficulty: CP, LB Coping Strategy/ies: UP2, DP8



Coping Strategies of Female Students by Phase Model Validation

Table 23 summarizes the coping strategies utilized by 10 female students in dealing with their phase difficulties.

Table 23. Model Validation of Coping Strategies of Female Students by Phase

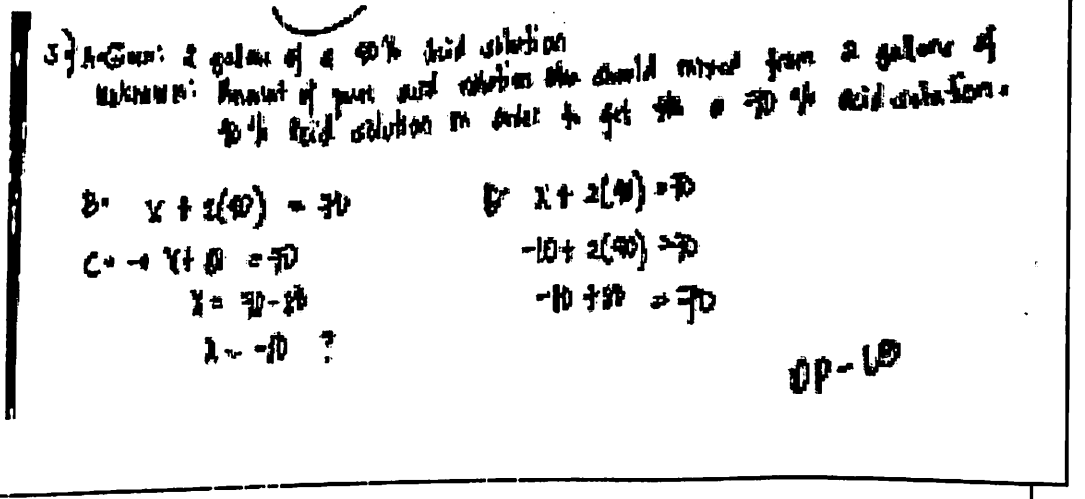
	Coping Strategies				Difficulty	
FEMALE #	Understanding the Problem (UP)	Devising a Plan (DP)	Carrying out the Plan (CP)	Looking Back (LB)	Before	After
1	UP2		CP7		DP, LB	LB
2	UP3	DP3	CP7	LB9	DP	
3	UP5	DP8	CP7	LB9	DP	-
4	UP8	DP8	CP7	LB3	DP, CP, LB	-
5	UP2	DP4	CP2	LB1	DP, CP, LB	-
6	UP3	DP8	CP7	LB9	DP	
7	UP3	DP8	CP7	LB2	DP, CP, LB	CP, LB
8	UP5	DP6	CP7	LB3	CP	-
9	UP3	DP3	CP7	LB1	CP, LB	CP
10	UP1	DP8	CP7	LB3	LB	-

Looking closely at the student's solution, her computation (CP) were valid (Exhibit #26). However, her mathematical equation (DP) was incorrect and she had no checking of solution. After utilizing her strategies of analyzing and enumerating all the given information and giving focus on the problem (UP2) and seeking assistance from friend/teacher/tutor (CP7), one can observe that she was able to form the mathetmatical equation and arrived at the correct solution. However, still, she was not able to check whether her solution fit the given conditions. With this, her pre-identified difficulties were lessened and hence were addressed

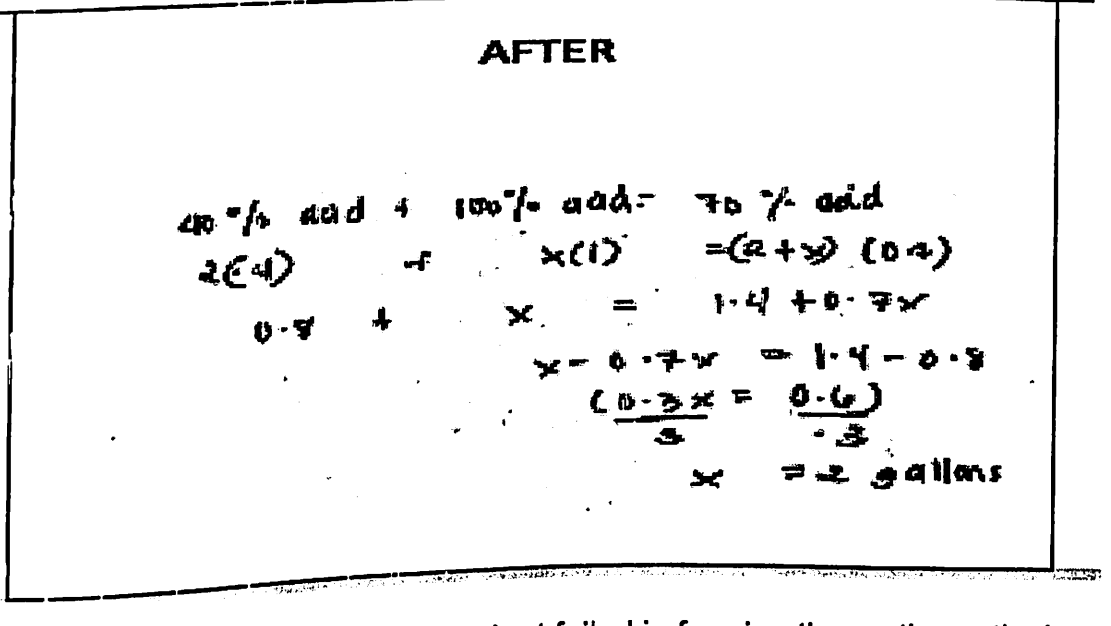
EXHIBIT #26: Fernale #1; Difficulty: DP, LB Coping Strategy/ies: UP2, CP7

BEFORE

6. How much pure acid should be mixed with 2 gallons of a 40% acid solution in order to get a 70% acid solution?



AFTER

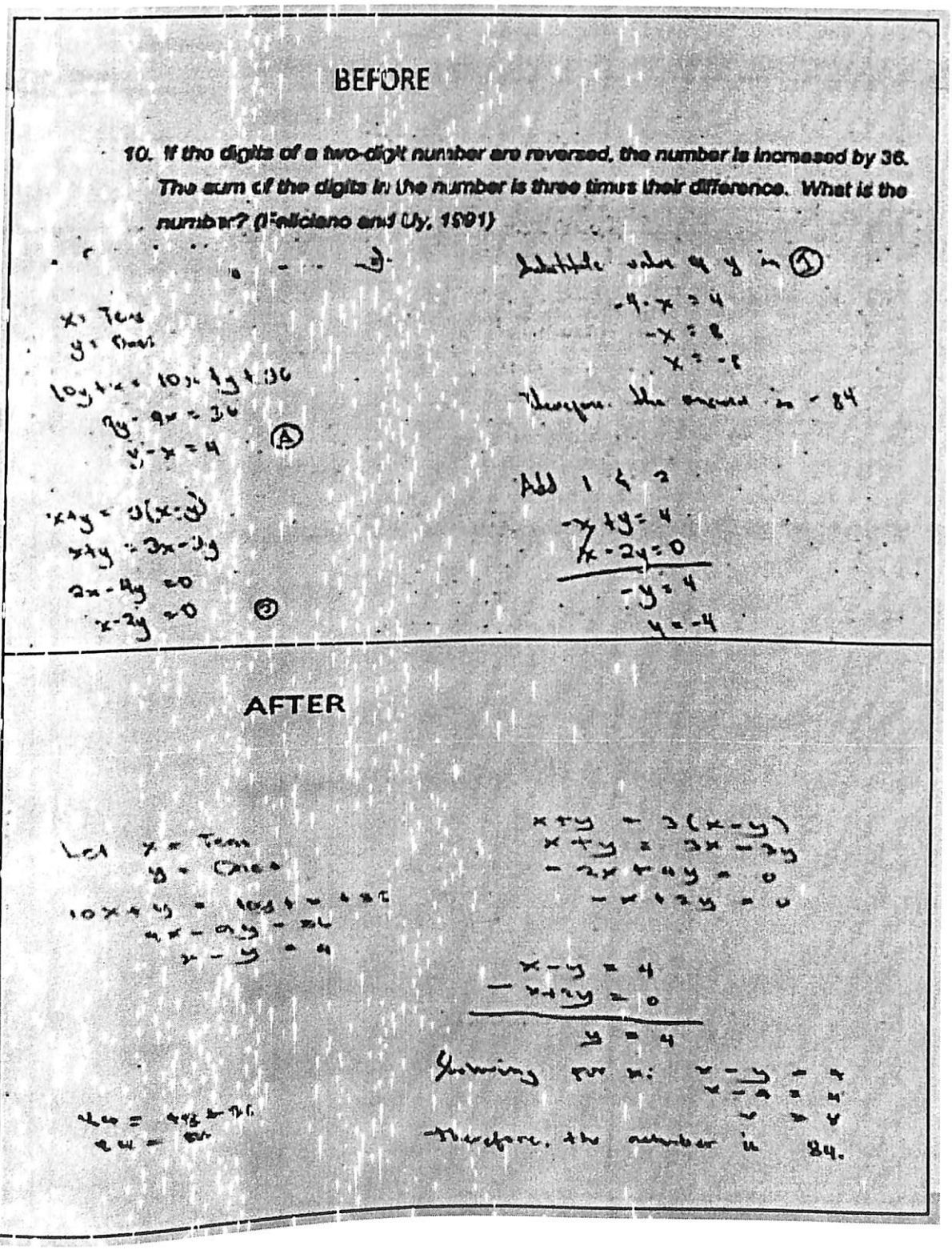


Looking at the solution, the student failed in forming the mathematical equation (DP) (Exhibit #27). She knew how to operate the equation she formed that she even had a concluding statement. However, after assistance from friends/teacher/tutor,

she was able to form the correct mathematical equation. With this, her difficulties of devising a plan was addressed.

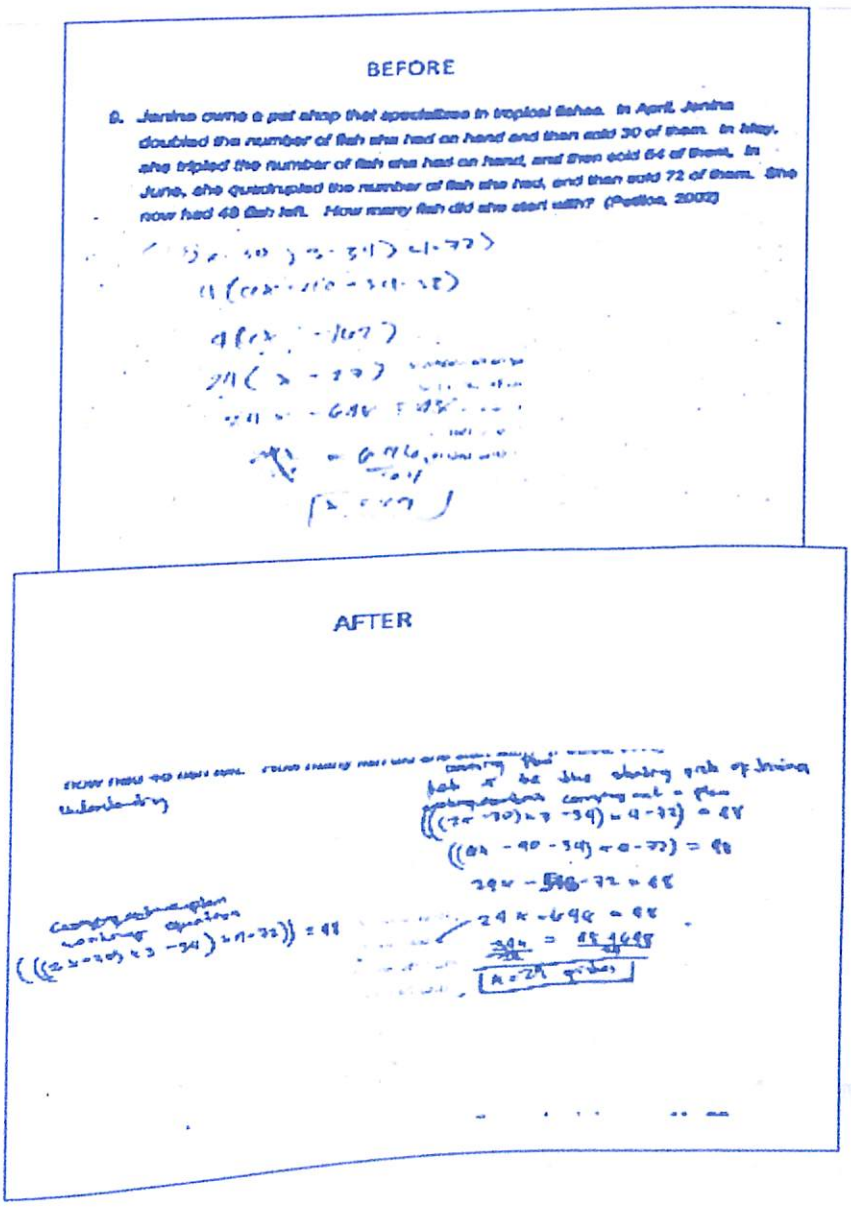
.

EXHIBIT #27: Female #2; Difficulty: DP Coping Strategy: CP7



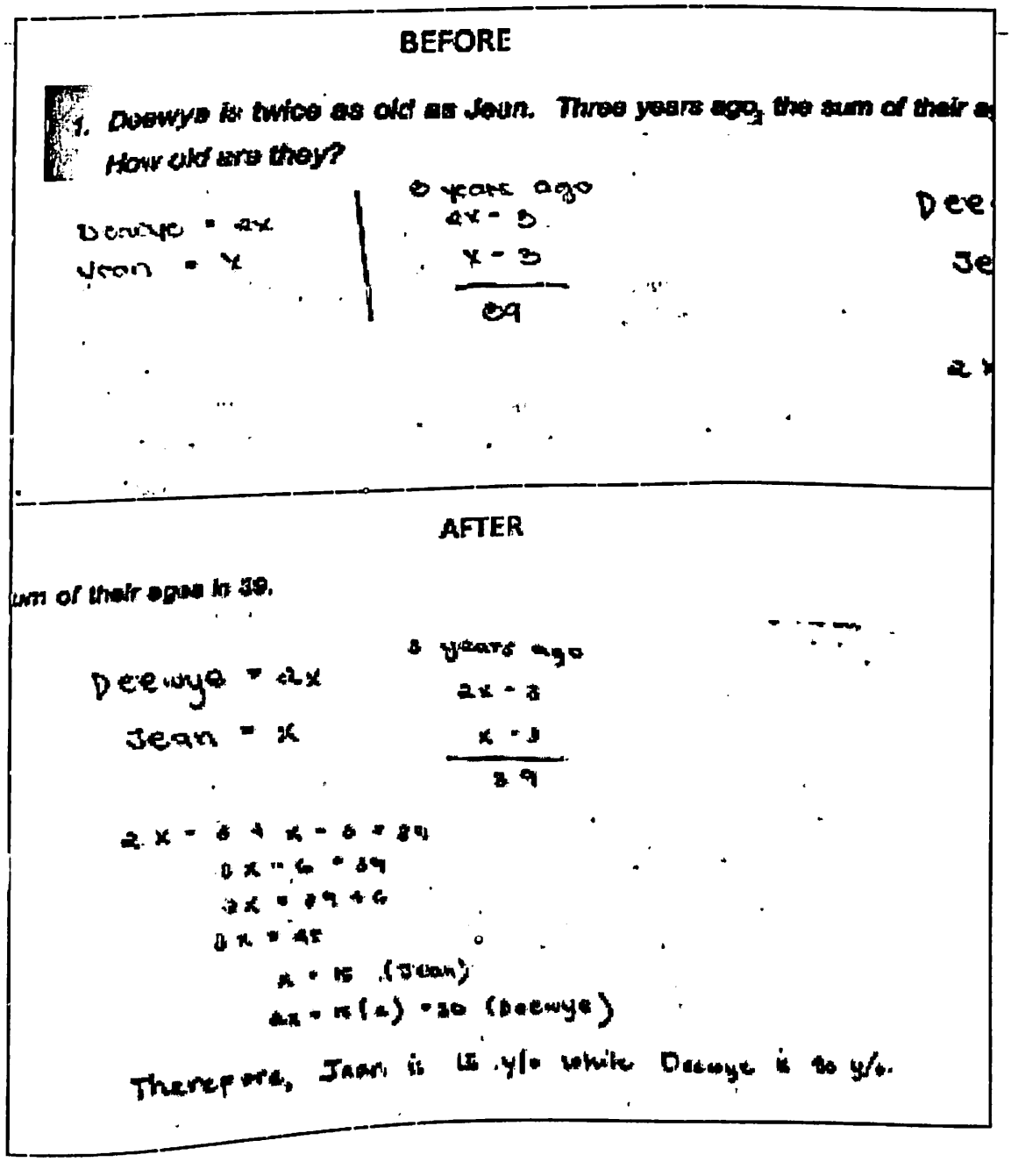
Before, focusing on the devising a plan (DP) phase, one can observe that she proceeded immediately with her computation (Exhibit #28). But in the validation stage where she utilized the strategy of looking for more exercises and reading more books with related problems (DP8) and seeking assistance from friends/teacher/tutor, one sees that she introduced a variable that represented the unknown, and from here on, she was able to form the mathematical equation and arrived at the correct value. Hence, her difficulty of devising a plan (DP) was addressed.

EXHIBIT #28: Female #3; Difficulty: DP Coping Strategy/ies: DP8, CP7



This student was able to perform only the first phase of problem solving. Then, after utilizing the strategies of looking for more exercises and reading more books with related problems (DP8) and seeking assistance from friends/teacher/tutor (CP7), she was able to perform all the phases of problem solving. Hence, her difficulties were addressed (Exhibit #29).

EXHIBIT #29: Female #4; Difficulty/ies: DP, CP, LB Coping Strategy/ies: DP8, CP7



BEFORE

1. *Deewyo is twice as old as Jean. Three years ago, the sum of their a*
How old are they?

Deewyo = 2x
Jean = x

3 years ago
2x - 3
x - 3

39

Dee
Je
2 x

AFTER

um of their ages is 39.

Deewyo = 2x
Jean = x

3 years ago
2x - 3
x - 3

39

2x - 3 + x - 3 = 39
3x - 6 = 39
3x = 39 + 6
3x = 45
x = 15 (Jean)
2x = 2(15) = 30 (Deewyo)

Therefore, Jean is 15 y/o while Deewyo is 30 y/o.

The student struggled in the last three phases of problem solving. She was able to construct a table illustrating the given information. After utilizing the strategy/ies of analyzing and enumerating all the given information giving focus on the problem (UP2) and rechecking/re-evaluating whether the answer was correct (LB1), she was able to form the mathematical equation but without the table anymore (Exhibit #30). She was not able to check her solution though she had a correct computation but had a concluding statement. Therefore, the student's pre-identified difficulties were reduced and hence, were addressed through the utilized coping strategies.

EXHIBIT #30 Female #5: Difficulty/ies: DP,CP,LB Coping Strategy/ies: UP2, LB1

BEFORE

AFTER

5. How much pure acid should be mixed with 2 gallons of a 40% acid solution in order to get a 70% acid solution?

% acid (as dec.)	# gallons	amount of pure acid	70%
2 gallons	x	2	x+2

Let x = the number of gallons of pure acid to be added to the 2 gallons of 40% acid solution.

40% = 0.4 and 70% = 0.7

$x+2(0.4) = (2+x)(0.7)$

$x+0.8 = 1.4+0.7x$

$x-0.7x+0.8 = 1.4$

$0.3x+0.8 = 1.4$

$0.3x = 1.4-0.8$

$0.3x = 0.6$

$x = 2$

You will need to mix 2 gallons of pure acid to the 2 gallons of 40% acid solution to obtain 4 gallons of 70% acid solution.

The student before struggled (Exhibit #31) with the second phase (DP) since she did not have the correct mathematical equation. But after utilizing the strategies of looking for more exercises and reading more books with related problems (DP8) and seeking assistance from friends/teacher/tutor (CP7), she was able to show correctly the four phases of problem, but without a concluding statement. With this, her difficulty in the second phase was eliminated, hence, was addressed.

EXHIBIT #31: Female #6: Difficulty: DP Coping Strategy: DP8, CP7

BEFORE

2. In consecutive turns of a Monopoly game, Stacy first paid P8,000.00 for a hotel. She then lost half her money when she landed on Boardwalk. Next, she collected P2,000.00 for passing GO. She then lost half her remaining money when she landed on Sinsi Avenue. Stacy now has P25,000.00. How much did she have just before she purchased the hotel? (Ashmann, 2013)

A Understanding the Problem
Type of Problem: Missing Problem
Unknown: How much did she have just before she purchased the hotel?

B Devising a Plan
Let x = total money she purchased
Working Equation

$\frac{x-1,000}{2} + 2,000 = 25,000$

C Carrying out the Plan

$\frac{x-8,000}{2} + 2,000 = 25,000$

$\left[\frac{x-1,000}{2} + 2,000\right]2$

$x-8,000+2,000$

$\left[\frac{x-6,000}{2} = 25,000\right]2$

$x-4,000 = 50,000$

$x = 54,000 + 4,000$

$\boxed{x = 54,000}$

D Looking Back

$\frac{54,000-2,000}{2} + 2,000 = 25,000$

$\frac{46,000}{2} + 2,000 = 25,000$

$23,000 + 2,000 = 25,000$

$25,000 = 25,000$

Therefore, Stacy had P54,000 before she purchased the hotel

AFTER

A Understanding the Problem
Known: she paid P8000
lost half her money
she collected 2000
lost half her remaining money
she now has 25,000
Unknown: how much did she have just before she purchased the hotel

B Devising a Plan
Let x = her total money before she purchased the hotel
Working Equation

$\frac{x-8,000}{2} + 2,000 = 25,000$

C Carrying out the Plan

$\frac{x-8,000}{2} + 2,000 = 25,000$

$\frac{x-4,000}{2} + 2,000 = 25,000$

$\frac{x-4,000}{2} + \frac{4,000}{2} = 25,000$

$\frac{x-4,000}{4} + 4,000 = 25,000$

Looking Back:
Let $x = 104,000$ $\quad x-4,000 = 100,000$
$x = 100,000 + 4,000$
$\boxed{x = 104,000}$

$\frac{104,000-8,000}{2} + 2,000 = 25,000$

$\frac{96,000}{2} + 2,000 = 25,000$

$\frac{50,000}{2} = 25,000$

$48,000 + 2,000 = 25,000$

$25,000 = 25,000$

From the student's solution, before she only wrote what is given in the problem (Exhibit #32). She struggled with the second phase (DP) up to the last phase (LB). Then, after utilizing the strategies of looking for more exercises and reading more books with related problems (DP8) and seeking assistance from friends/teacher/tutor (CP7), she was able to form the mathematical equation and proceeded with the computation, but she arrived an incorrect answer. Likewise, she was able to check but with incorrect computation. With this, her pre-identified difficulties were lessened and somehow were addressed.

EXHIBIT #32: Female #7; Difficulty: DP,CP,LB Coping Strategy/ies: DP8, CP7

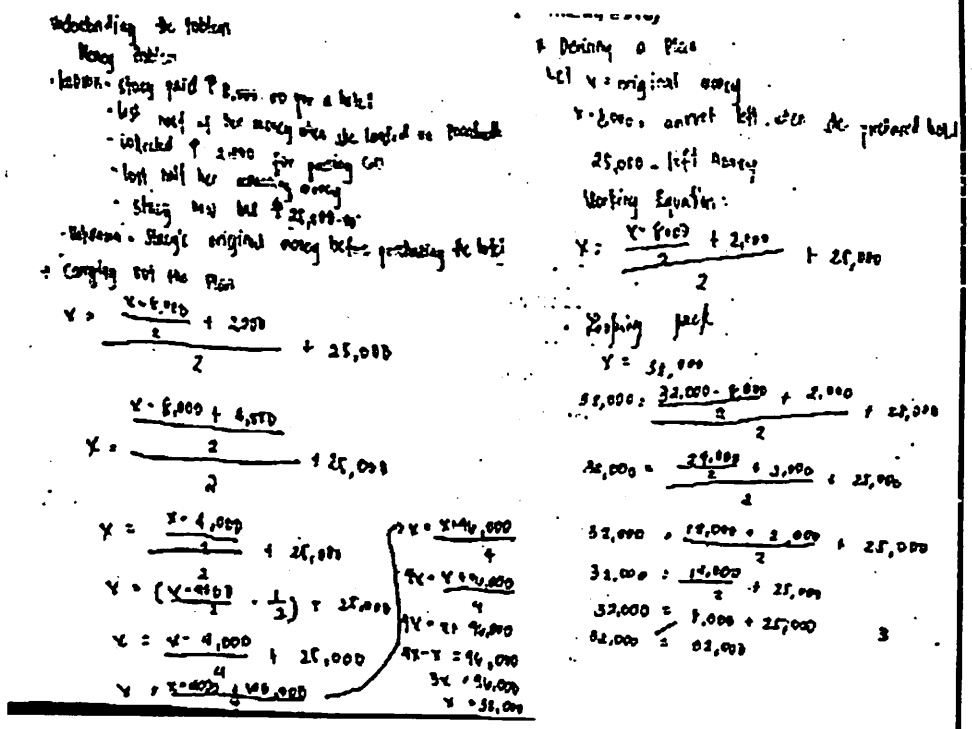
BEFORE

2. In consecutive turns of a Monopoly game, Stacy first paid P8,000.00 for a hotel. She then lost half her money when she landed on Boardwalk. Next, she collected P2,000.00 for passing GO. She then lost half her remaining money when she landed on Illinois Avenue. Stacy now has P25,000.00. How much did she have just before she purchased the hotel? (Aufmann, 2013)

= Stacy's money before purchasing a hotel

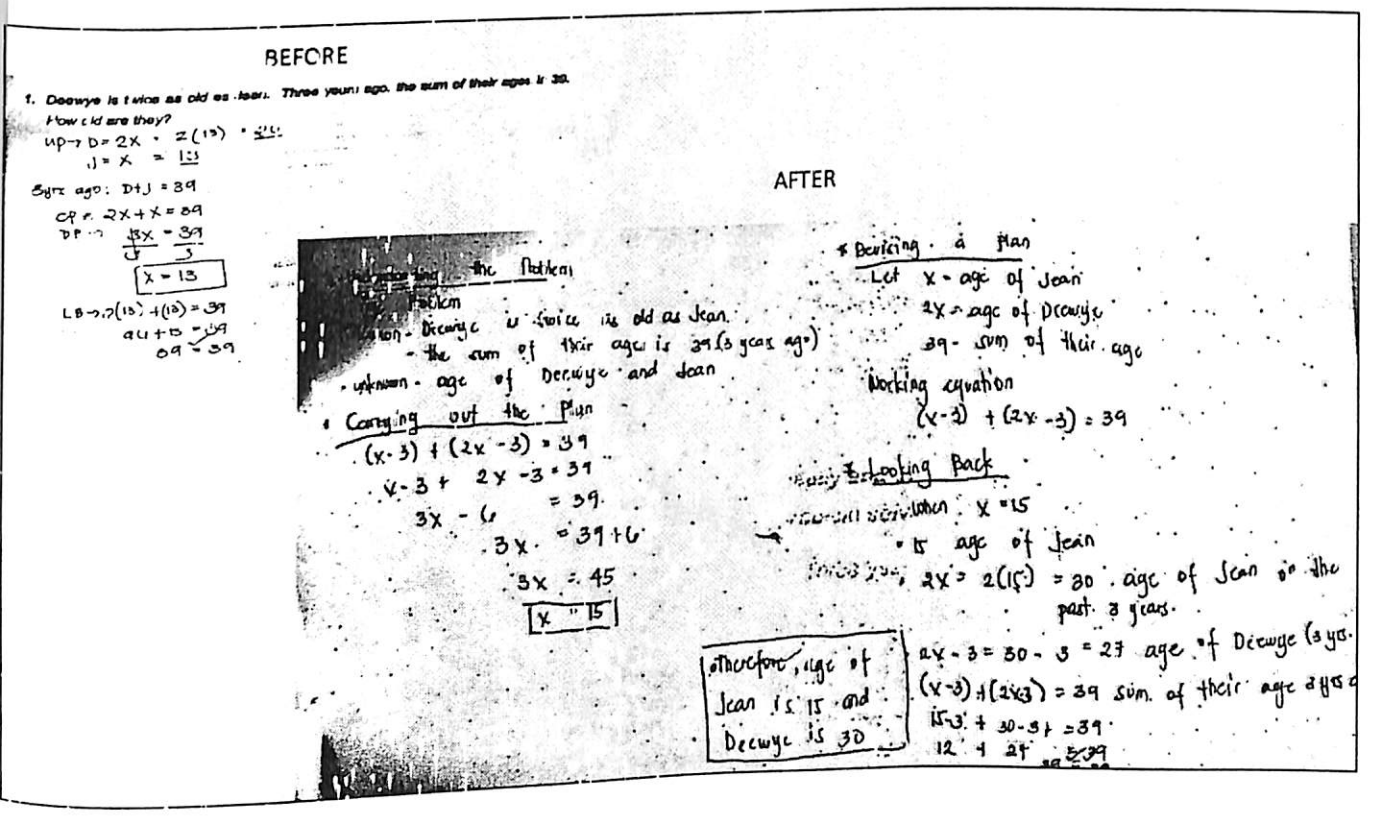
25,000 = remaining money
2,000 = GO
8,000 = hotel

AFTER



Focusing on the carrying out the plan (CP) phase, she got an incorrect value (Exhibit #33). Then, after she applied the strategies of seeking assistance from friends/teacher/tutor, she came up with the correct value that the problem required him of. Thus, the student's difficulty which is carrying out the plan before was eliminated in the validation stage.

EXHIBIT #33: Female #3; Difficulty: CP Coping Strategy: CP7



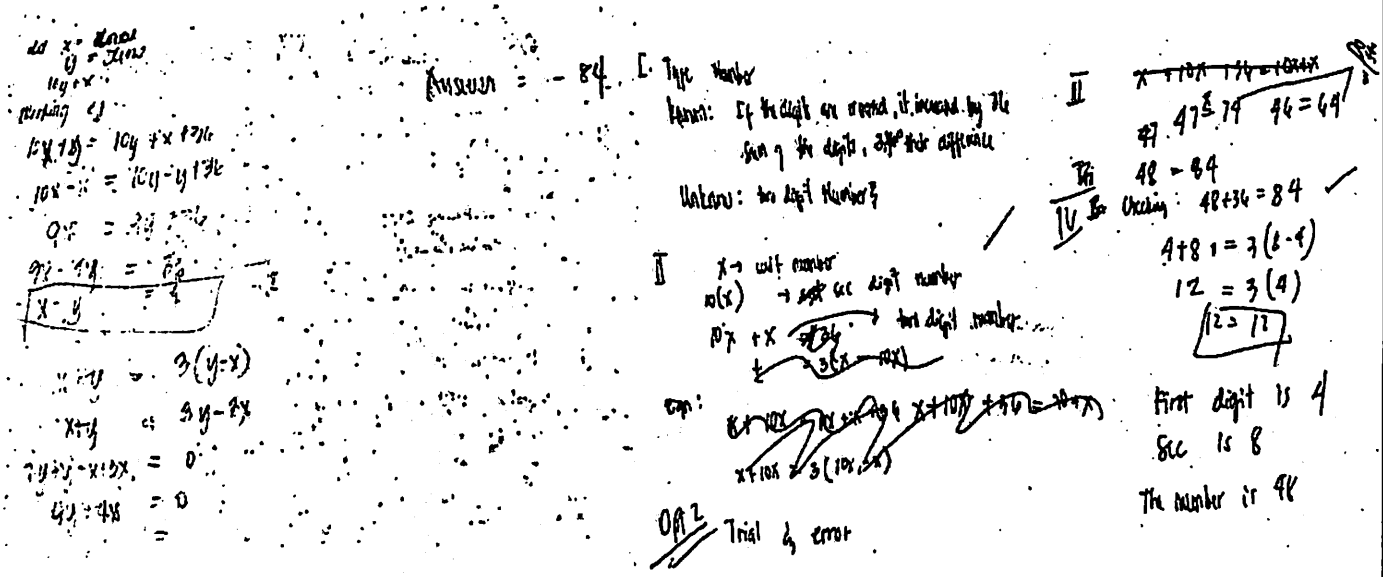
The student before struggled with the carrying out the plan and looking back phases (Exhibit #34). She had the mathematical equation but was not able to derive the correct value (Exhibit #33). She came up with a solution through a trial and error method. Though she applied her coping strategies like seeking assistance from friends/tutor/teacher (CP7) and rechecking/re-evaluating whether the answer was correct (LB1), still, she came up with the same solution through trial and error. She

was able to check but with incorrect computation and had a concluding statement. Thus, her difficulty in the last phase was lessened.

EXHIBIT #34: Female #9 Difficulty/ies: CP, LB Coping Strategy/ies: CP7, LB1

BEFORE

10. If the digits of a two-digit number are reversed, the number is increased by 36. The sum of the digits in the number is three times their difference. What is the number? (Feliciano and Uy, 1991)

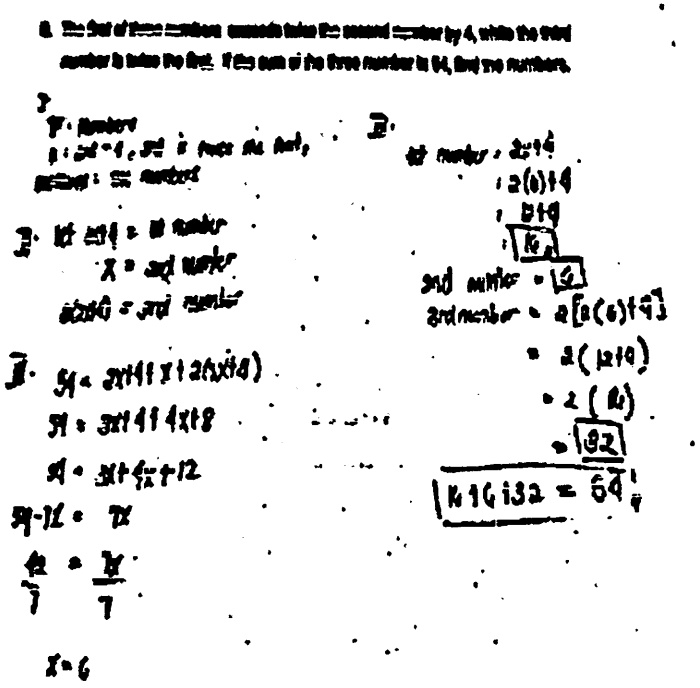


AFTER

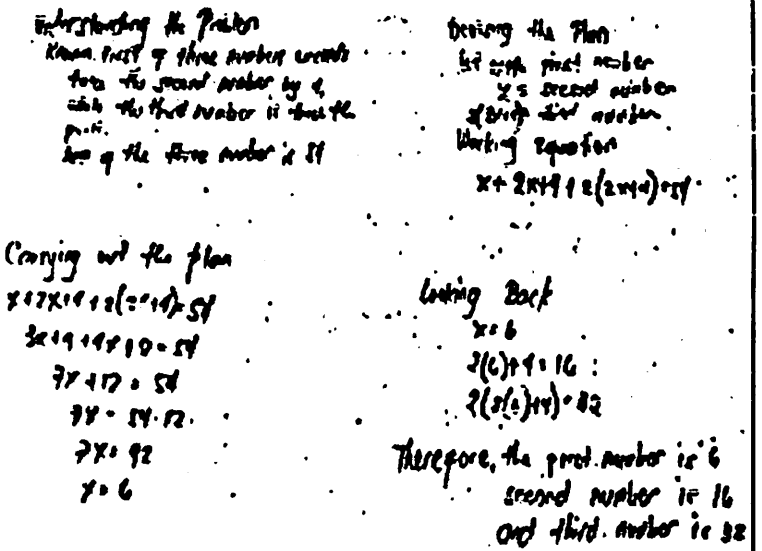
Her solution at first showed no checking of solution (LB) but was able to derive the correct values (Exhibit #35). But after she utilized her coping strategies of looking for more exercises and reading more books with related problems (DP8) and seeking assistance from friends/teacher/tutor, she was able to look back with a concluding statement. Therefore, her difficulty was addressed in the validation stage.

EXHIBIT #35 Female #10; Difficulty/ies: LB Coping Strategy/ies: DP8, CP7

BEFORE



AFTER



Validation of the Coping Strategies by Academic Program by Phase Model

Twenty-one respondents were purposively selected from the validation group composed of one-hundred twenty-eight respondents. Case samples for each academic program are shown in Table 24. The students' coping strategies in the different phases of problem solving that matched at least one of the strategies in the developed models were considered in choosing the case samples. The highlighted coping strategies in the succeeding table indicate a match to the model (please see Table 24). Sample exhibits showing the students' solutions before the models were developed and after applying their coping strategies as lifted from the respondent's papers are also shown.

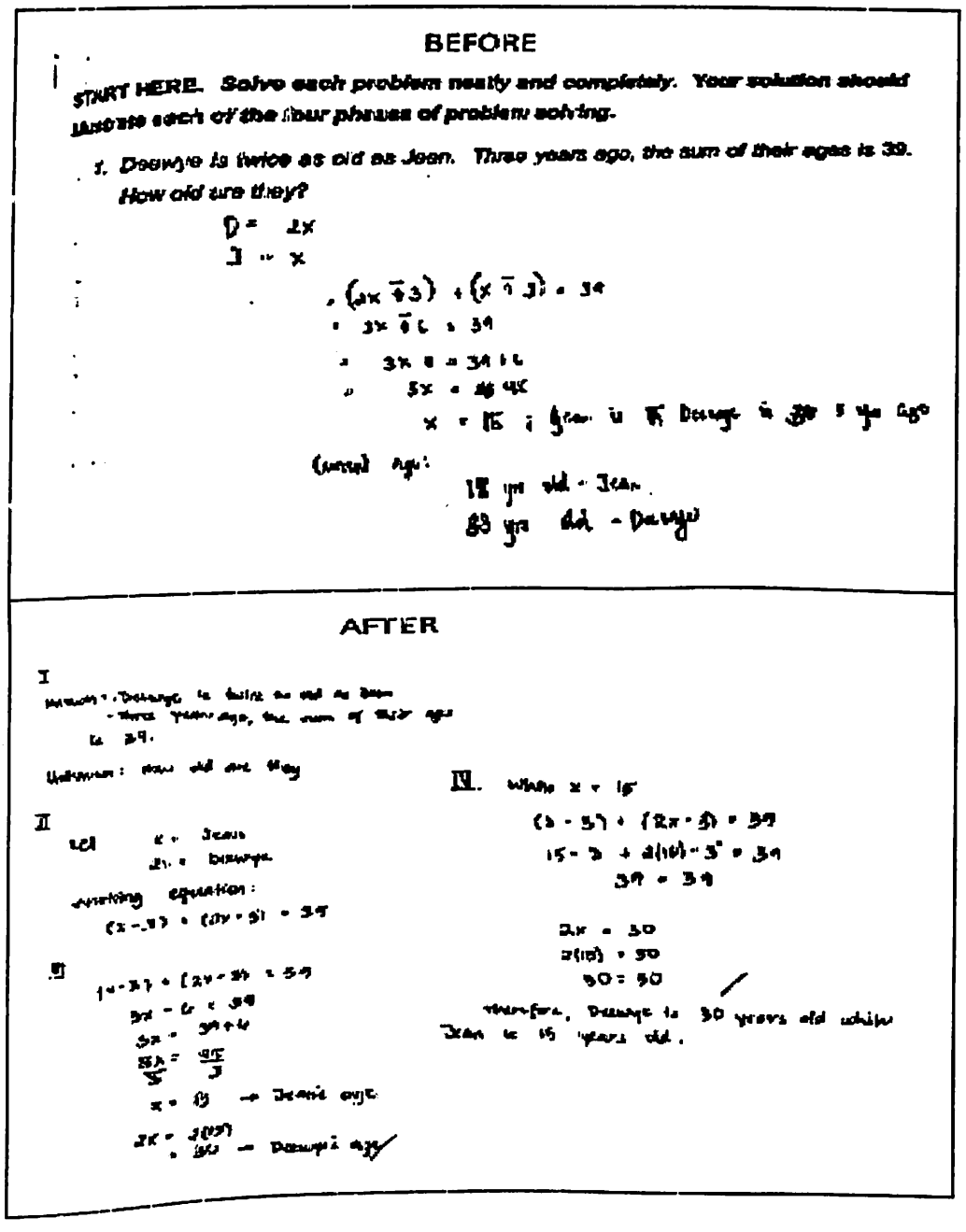
Table 24

Model Validation of Coping Strategies by Academic Program by Phase

	Coping Strategies				Difficulty		
Academic Program	Understanding the Problem (UP)	Devising a Plan (DP)	Carrying out the Plan (CP)	Looking Back (LB)	Before	After	Exhibit #
STEM-related							
BS-ABE	UP2	DP8	CP7	LB1			
BS-ABE-B6	UP2	DP7	CP8	LB1	DP, CP, LB	LB	17 (M)
BS-ABE-A1	UP2		CP7		DP, LB	LB	25 (F)
BS-CE	UP3	DP8	CP7	LB1;LB3			
BS-CE-A13	UP5	DP6	CP7	LB3	CP	-	32 (F)
BS-CE-B16	UP3	DP3	CP7	LB1	CP, LB	CP	33 (F)
BS-CHEM E	UP2	DP5; DP8	CP1; CP7	LB1			
BS-CHEM-15	UP1	DP1	CP7	LB1	LB	-	23 (M)
BS-CHEM-4	UP5	DP5	CP6	LB8	LB		35 (F)
BS-MATH	UP3	DP8	CP7	LB1; LB2; LB3			
BS-MATH-18	UP2	DP4	CP2	LB1	DP, CP, LB	-	29 (F)
BS-MATH-4	UP3	DP8	CP7	LB9	DP	-	30 (F)
BS-MATH-22		DP8			LB	-	21 (M)
BS-METEO	UP2;UP8	DP7	CP1; CP2	LB7			
BS-METEO-3	UP8	DP8	CP4	LB2	LB		18 (M)
NON-STEM-related							
BA-COMM	UP2	DP4	CP1; CP7	LB1; LB3			
BA-COMM-2	UP5	DP8	CP7	LB4	CP	-	20 (M)
BA-COMM-17	UP8	DP8	CP7	LB3	DP, CP, LB	-	28 (F)
BA-COMM-4	UP2	DP1	CP2	LB1	DP		36 (F)
BS-ECON	UP2	DP8	CP7	LB7			
BS-ECON-22	UP3	DP8	CP7	LB2	DP, CP, LB	-	31 (F)
BS-ECON-36	UP8	DP8	CP1	LB3	DP, CP, LB	CP, LB	22 (M)
BS-N	UP2	DP8	CP7	LB3			
BSN-A30	UP1	DP8	CP7	LB3	LB	-	34 (F)
BSN-A33	UP2	DP8	CP2	LB1	CP, LB	-	24 (M)
BSN-A36	UP7	DP7	CP7	LB4	LB		37 (M)
BS-SOCIO	UP2	DP8	CP7	LB1			
BS-SOCIO-21	UP3	DP3	CP7	LB9	DP	-	26 (F)
BS-SOCIO-14	UP3	DP8	CP7	LB10	LB	-	19 (M)

The student before was not able to check her derived value if it fit the given conditions (Exhibit 36). After utilizing her coping strategy which is performing trial and error with plans (DP5), she was able to correctly perform all the phases of problem solving in the validation stage. This coping strategy was able to address her difficulty.

EXHIBIT #36: Female (BS-CHEM E) ; Difficulty/ies: LB Coping Strategy/ies: DP5



BEFORE

START HERE. Solve each problem neatly and completely. Your solution should illustrate each of the four phases of problem solving.

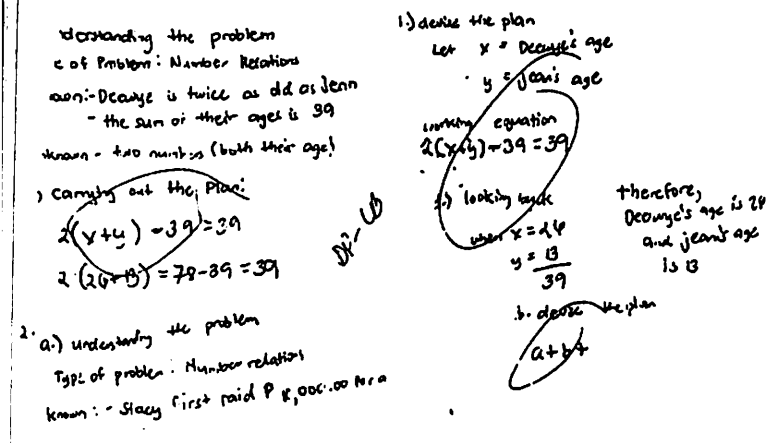
1. Dennis is twice as old as Joan. Three years ago, the sum of their ages is 39. How old are they?

AFTER

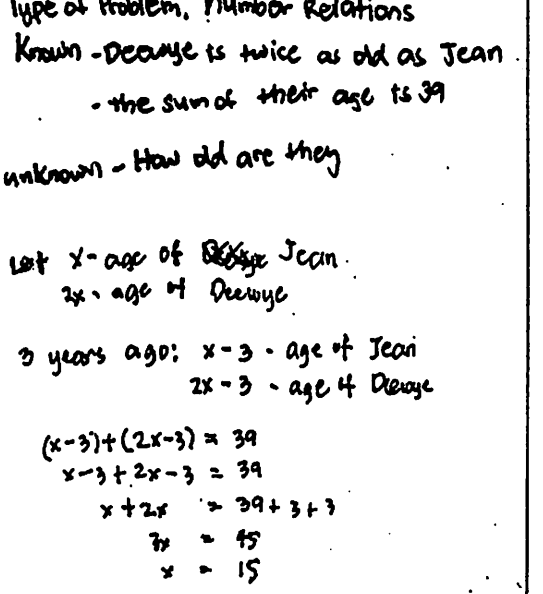
Before, the student was not able to form the mathematical equation (DP) which lead her not to perform successfully the rest of the phases of problem solving. But after rechecking/re-evaluating whether the answer was correct (LB1), she was able to form the mathematical equation until carrying out the computation. This means that her strategy was able to address her difficulty.

EXHIBIT #37: Female (BA-COMM) ; Difficulty/ies: DP Coping Strategy/ies: LB1

BEFORE

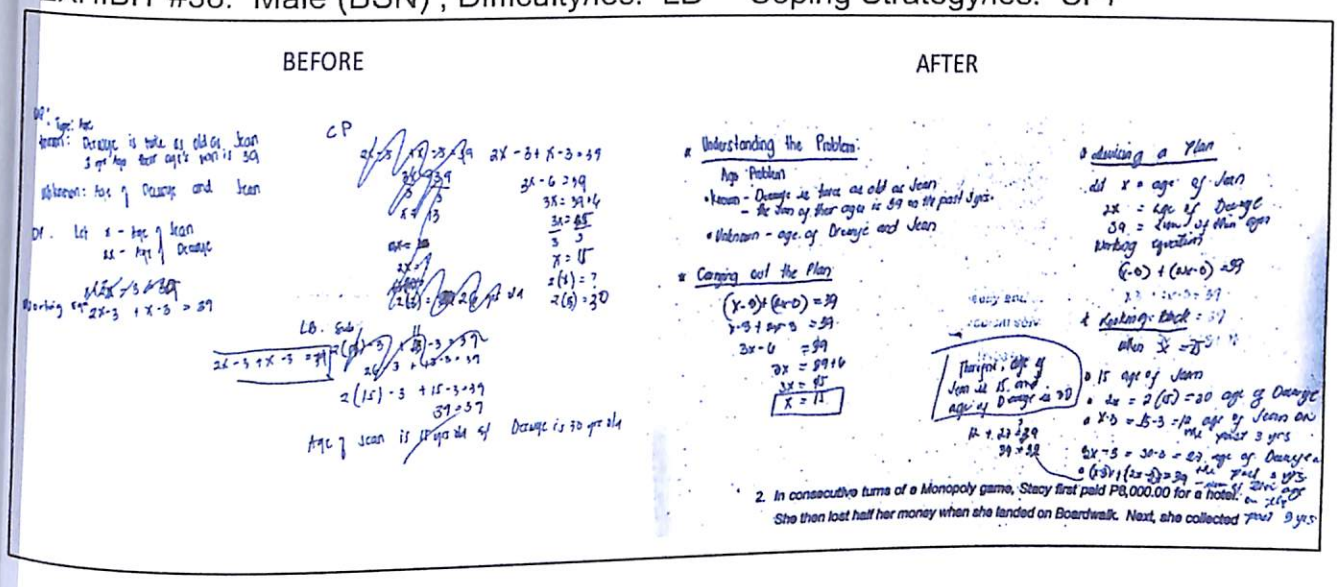


AFTER



Looking at the student's solution, he did well in the first three phases of problem solving but not in the checking of solution (LB) (Exhibit #38). But after utilizing his strategy of seeking assistance from friend/teacher/tutor (CP7), he completely performed all the phases of problem solving, thereby eliminating his difficulty of no checking of solution.

EXHIBIT #38: Male (BSN) ; Difficulty/ies: LB Coping Strategy/ies: CP7



Considering all the results of the validations in the different academic programs, it can be shown that the models developed for each program were able to address the problem solving difficulties of the students by means of their coping strategies.

EVALUATION

The last phase of the Model Building Framework in Figure 2 involves Evaluation. *This phase confirms the applicability of the developed models with other* group of students which provided conclusions to the study, that is, *if the models were* able to address the problem solving difficulties of the students through their coping strategies.

The applicability of the developed models was validated by a group of respondents that were purposively selected from the 30 percent of the total number of respondents. The results of the validation are as follows:

1. The Coping Strategies by Sex by Phase Model which included both sexes were applicable to other groups and were able to address the problem solving

difficulties of the students by utilizing the students' coping strategies.

2. The Coping Strategies by Academic Program by Phase Model which included the nine academic programs were seen to be applicable to other groups and were able to address the problem solving difficulties of the students.

In conclusion, coping strategies come in many forms. Some were positive (problem-focused) while others were negative (emotion-focused) in nature. This study presented these two forms, and the problem-focused coping strategies dominated over the emotion-focused strategies in all phases of problem solving.

The coping strategies as modelled that were utilized have shown their capability to eliminate/eradicate or lessen the problem solving difficulties of the students.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of the findings, the conclusions derived from the findings and the recommendations based on the findings.

SUMMARY

This study was conducted to develop models that can address the mathematics problem solving difficulties of students through coping strategies. This was made possible through the administration of a problem solving test and a survey questionnaire on coping strategies. The research participants were college freshmen of a certain university in the north who are currently enrolled in their mathematics subject, that is, Mathematics in the Modern World, a new General Education Core Course that has a chapter on problem solving. The problem solving test was a researcher-made problem solving test, which has a coverage that revolves around the applications on linear equations. Coupled with it was a survey questionnaire, a researcher-constructed instrument eliciting the students' ways of coping with their difficulties, particularly on problem solving. The two instruments were subjected to a group of experts for content validity and reliability. The results of the problem solving test and the responses of the survey were likewise counterchecked by the group of experts.

Specifically, the problem solving test aimed to identify the common difficulties of students and eventually generalized into the four phases of Polya's (1945) problem solving namely, understanding the problem (UP), devising a plan (DP), carrying out the plan (CP) and looking back (LB). On the other hand, the survey questionnaire

aimed to identify the most common coping strategies that the students applied/utilized in dealing with their problem solving phase difficulties.

Problem Solving Difficulties

The problem solving test aimed to identify the difficulties encountered by the students in each of the four phases:

- In understanding the problem phase (UP), two difficulties/deficiencies were revealed:
  a) Inability to distinguish the known from the unknown information and
  b) Inability to identify the type of problem and recall basic facts.
- In devising a plan phase (DP), two difficulties/deficiencies were also revealed:
  a) Inability to transform a problem into a mathematical equation and
  b) Inability to draw tables/charts out of the information and connect to a concept.
- In carrying out the plan phase (CP), two difficulties/deficiencies also emerged:
  a) Inability to completely perform the working procedure systematically and accurately and
  b) Inability to start with the computational process.
- in looking back phase (LB), two difficulties/deficiencies were observed:
  a) inability to complete the checking procedure and
  b) inability to start the evaluatio of the correctness of the obtained solution.

The identified problem solving difficulties/deficiencies were then used in comparing how frequent the males and females experienced them during the problem solving test and the findings were:

- The percentage of female respondents in encountering each difficulty in all the phases of problem solving was higher than the males.
- For the STEM-related academic programs,

In understanding the problem (UP) phase,

- The BS in Meteorology respondents had the highest percentage of being unable to distinguish the known from the unknown information, while the BS in Mathematics respondents had the least percentage of being unable to distinguish the known from the unknown information
- The BS in Meteorology respondents had the highest percentage of being unable to identify the type of problem and recall basic facts while the BS in Agricultural and Biosystems Engineering respondents had the least percentage of being unable to identify the type of problem and recall basic facts.

In the devising a plan (DP) phase,

- The BS in Meteorology respondents had the highest percentage of being unable to transform a problem into a mathematical equation while the BS in Mathematics respondents had the least percentage of of being unable to transform a problem into a mathematical equation.
- The BS in Agricultural and Biosystems Engineering respondents had the greatest percentage of being unable to draw tables/charts out of the information and connect to a concept while the BS in Chemical Engineering respondents had the least percentage of being unable to draw tables/charts out of the information and connect to a concept.

In carrying out the plan (CP) phase,

- The BS in Agricultural and Biosystems Engineering respondents had the greatest percentage of being unable to perform the working procedure systematically and accurately while the BS in Mathematics respondents had the least percentage of being unable to perform the working procedure systematically and accurately.
- The BS in Mathematics respondents had the highest percentage of being unable tto start the computational process while the BS in Chemical Engineering respondents had the least percentage being unable tto start the computational process.

In the looking back (LB) phase,

- The BS in Agricultural and Biosystems Engineering respondents had the greatest percentage of being unable to unable to complete the checking procedure while the BS in Mathematics respondents had the least percentage of being unable complete the checking procedure.
- The BS in Mathematics respondents and BS in Meteorology students had both the greatest percentage of being unable to start the evaluation of the correctness of the obtained solution while the BS in Chemical Engineering respondents had the least percentage.
- For the non- STEM-related academic programs,

In understanding the problem (UP) phase,

- The BS in Sociology respondents had the highest percentage of being unable to distinguish the known from the unknown information, while the

BS in Nursing respondents had the least percentage of being unable to distinguish the known from the unknown information

- The BS in Nursing respondents had the highest percentage of being unable to identify the type of problem and recall basic facts while the BA in Communication respondents had the least percentage being unable to identify the type of problem and recall basic facts.

In the devising a plan (DP) phase,

- The BS in Sociology respondents had the highest percentage of being unable to transform a problem into a mathematical equation while the BS in Economics respondent had the least percentage of of being unable to transform a problem into a mathematical equation.
- The BS in Sociology respondents and BA in Communication respondents had the greatest percentage of being unable to draw tables/charts out of the information and connect to a concept while the the BS in Econ respondents had the least percentage being unable to draw tables/charts out of the information and connect to a concept

In carrying out the plan (CP) phase,

- The BS in Nursing respondents had the greatest percentage of being unable to perform the working procedure systematically and accurately while the BS in Economics respondents had the least percentage of being unable to perform the working procedure systematically and accurately
- The BS in Sociology respondents had the highest percentage of being unable to start the computational process while the BS in Nursing respondents had the least percentage of being unable to start the computational process

In the looking back (LB) phase,

- The BA in Communication respondents had the greatest percentage of being unable to complete the checking procedure while the BS in Nursing respondents had the least percentage of being unable to complete the checking procedure.
- The BA in Communication and BS in Sociology respondents had both the greatest percentage of being unable to start the evaluation of the correctness of the obtained solution while the BS in Economics respondents had the least percentage being unable to start the evaluation of the correctness of the obtained solution.

Coping Strategies

The survey/questionnaire on coping strategies aimed to elicit responses from the respondents. After a thorough scrutiny of the students' papers, it was found out that of the 297 respondents in the model development stage, 43 themes emerged from where, as described by Lazarus and Folkman's Ways of Coping (1985), two major classifications in each of the four phases of problem solving arose namely: the Problem-Focused Strategies and the Emotion-Focused Strategies. The themes were grouped accordingly with codes as introduced by the researcher as seen in Tables 10 to 13. Thirty-two strategies belonged to the Problem-focused and 11 strategies belonged to the emotion-focused coping strategies.

Though classified into either problem-focused or emotion-focused coping strategies, they were all utilized by the respondents in each phase of problem solving as given in the summary below (please see Table 25).

The problem-focused coping strategies were greatly utilized by the respondents over the emotion-focused coping strategies. As a matter of fact,

- understanding, analyzing, thinking critically giving focus on the problem (UP2), a problem-focused coping strategy was greatly utilized by both males and females in dealing with their difficulty in understanding the problem (UP) phase;
- looking for more exercises in books and reading more books related to the problem at hand (DP8), also a problem-focused coping strategy was highly utilized by both males and females in dealing with their difficulty in devising a plan (DP) phase;
- seeking assistance from friends/teacher/tutor (CP7), another problem- focused coping strategy was greatly utilized by both males and females in dealing with their difficulty in carrying out the plan (CP) phase; and
- rechecking/re-evaluating whether the answer was correct (LB1), another problem-focused coping strategy was highly utilized by the female respondents, while, thinking that things will get better next time (LB3), a type of emotion-focused coping strategy was utilized by the male respondents in dealing with their difficulties in looking back (LB) phase.

- Moreover, the number of problem-focused coping strategies utilized was the same for both sexes as shown in Table 38.
- The number of emotion-focused coping strategies utilized by the female respondents was greater than the male respondents.

Table 25

Summary of Coping Strategies by Sex by Phase

	Coping Strategies						
Sex	Understa-nding the Problem (UP)	Devising a Plan (DP)	Carrying out the Plan (CP)	Looking Back (LB)	Total No. of Strategies	No. of Problem-Focused Coping Strategies	No. of Emotion-Focused Coping Strategies
Males	9	10	11	9	39	31	8
Females	8	10	11	11	40	31	9

It can also be noted that almost all strategies were utilized by the respondents in the different academic programs in each phase of problem solving as summarized in Table 26.

- The least number of utilized coping strategies was from the respondents of the BS-Meteorology (STEM-related academic program) followed by respondents of the BS Economics (non-STEM related) academic program, while, the highest number of utilized coping strategies was from the respondents of the BS Civil Engineering (STEM-related academic program) followed by the BS-Agricultural and Biosystems Engineering, also a STEM-related academic program and BS in Nursing (non-STEM-related) program. Moreover, it is also apparent in the table that the highest number of utilized emotion-focused coping strategies were from the respondents of the BS Civil Engineering (STEM-related) and BS in Nursing (non-STEM-related) academic programs, whereas, the least number of utilized emotion-focused coping strategies was from respondents of the BS-Mathematics (STEM-

related) academic program which was followed by the respondents of the BS-Economics (non-STEM-related) academic program.

Table 26

Summary of Coping Strategies by Academic Programs by Phase

Phases of Problem Solving	STEM-RELATED PROGRAMS					NON-STEM PROGRAMS			
	BS in Agricultural and Biosystems Engineering	BS in Chemical Engineering	BS in Civil Engineering	BS in Mathematics	BS in Meteorology	BA in Communication	BS in Economics	BS in Nursing	BS in Sociology
Understanding the Problem (UP)	6	5	6	7	3	5	4	6	6
Devising a Plan (DP)	9	7	8	7	7	7	6	7	7
Carrying out the Plan (CP)	7	8	9	7	5	7	5	9	7
Looking Back (LB)	7	5	10	5	5	6	7	7	7
Total No. of Coping Strategies	29	23	33	26	20	25	22	29	27
No. of Problem-Focused Coping Strategies	26	19	27	25	16	21	20	23	23
No. of Emotion-Focused Coping Strategies	3	4	6	1	4	4	2	6	4

Models/Representations

From the identified problem solving (phase) difficulties and common coping strategies of the respondents, models or representations relating these two variables are hereby summarized and presented. The models however only show the most common coping strategy bearing the greatest frequency that is utilized by the respondents in each of the different phases of problem solving. Top three most common coping strategies used in each of the phases are shown in Appendices M and N.

MODEL 1: Coping Strategies by Sex by Phase Model

A. It can be seen in the model (please see Figure 6) that males usually resort to the strategy of analyzing and understanding a given problem fully by enumerating all the given information (UP2). Then in forming the mathematical equation, they need to read more books and look for related problems noting down the specific strategies that are utilized for a particular problem (DP8). In the computation process, males usually ask the support/assistance of their friends, teachers and tutors to let them explain further about the process (CP7). Finally, in the last phase, males usually think that everything will get better the next time that they will encounter same distressful situation (LB3).

B. Females, according to the model usually have similar coping strategies in understanding the problem (UP), devising a plan (DP) and carrying out the plan (CP) as those with the males. However, in looking back phase, females tend to re-check or re-evaluate whether the answers they derived are correct or not (LB1).

This model, both for males and females were seen to be applicable to other groups of students, and hence, can address the problem solving difficulties of the students through their coping strategies.

MODEL 2. Coping Strategies by Academic Program by Phase Model

STEM-related Academic Programs

It is visible in the model (please see Figure 7) that of the five academic programs in the STEM-related group, the respondents from the BS in Agricultural and Biosystems Engineering, BS in Chemical Engineering and BS in Meteorology apply the same strategy of understanding fully/analyzing and listing/enumerating all the given information giving focus on the problem (UP2) in dealing with their difficulty in the understanding the problem (UP) phase. In devising a plan (DP) phase, except for the BS in Meteorology program, the respondents of the other four academic programs look for more exercises in books and read books related to the problem at hand (DP8) in dealing with their difficulty particularly in forming the working equation. Likewise, in carrying out the plan (CP) phase, asking assistance from friends/teacher/tutor (CP7) to explain the processes/computation is the strategy utilized by the respondents of BS in Agricultural and Biosystems Engineering, BS in Chemical Engineering, BS in Civil Engineering and BS in Mathematics academic programs. In the last phase, a common strategy utilized by the respondents of the STEM-related academic programs is rechecking/re-evaluating whether the answer was correct.

Non-STEM-related Academic Program

In Figure 8, it can be seen that all the non-STEM-related academic programs resort to the strategy of analyzing and understanding a given problem fully and enumerating all the given information (UP2). Then, in forming the working equation, except for the BA in Communication program, the respondents of the other non-STEM programs look for more exercises in books and read books related to the problem at hand (DP8). In the computation process, (CP), all respondents of the non-STEM-related programs resort to asking assistance from friends/teacher/tutor (CP7) to help explain further the process. While rechecking or re-evaluating whether the answer is correct (LB1) were the common strategy applied by the respondents of the BA in Communication and BS in Sociology programs. Seeking assistance from friends/teacher/tutor to help explain the whole process is the common strategy utilized by the respondents of the BS in Economics and BS in Sociology. Emotion focused strategy like thinking that things will get better next time (LB3) is the common strategy utilized by the BS in Nursing and BA in Communication.

This model, containing all the academic programs were seen to be applicable to other groups of students, and hence, can address the problem solving difficulties of the students through their coping strategies.

STEM-related versus Non-STEM-related academic programs

In general, the two groups of academic programs utilized the same set of coping strategies. In understanding the problem (UP) phase, they both utilized the problem focused coping strategy of understanding fully analyzing and enumerating

all the given infromation logically giving focus on the problem. In devising a plan (DP) phase, they both looked for more exercises in books and read books related to the problem at hand. In carrying out the plan (CP) phase, they both needed the assistance of friends/teachers or tutors to explain further the computational process. In the looking back (LB) phase, both groups utilzed the strategy of re-checking whether the answer was correct. The non-STEM-related group however utilized two more coping strategies, that is, thinking that things will get better next time which is an emotion-focused coing strategy and seeking assistance from friends/teachers or tutors to help explain the whole process which is a problem-focused coping strategy.

CONCLUSION

As for the results of the study is concerned, the following conclusions are drawn:

Students' Difficulties in Mathematics Problem Solving

Students found mathematics difficulties in the four phases of problem solving. In the understanding the problem (UP) phase, two difficulties were revealed namely; inability to distinguish the known from the unknown information inability to identify the type of problem and recall basic facts. In the devising a plan (DP) phase, two types of difficulties too were revealed namely; inability to transform a problem into a mathematical equation and inabilty to draw tables/charts out of the information and organize information and connect to a concept. In the carrying out the plan (CP) phase, two difficulties were revealed namely; inability to perform the working procedure systematically and accurately and inability to start with the computational process. The

last phase, looking back (LB) phase likewise revealed two difficulties namely: inability to complete the checking procedure and inability to start the evaluatio of the correctness of the obtained Possible reasons for these difficulties in each of the phases are the following based on the survey/questionnaire and informal conversations with the students:

Understanding the Problem (UP);

1. students have little knowledge or not enough.
2. Students are not familiar with some words/terminologies.
3. Some given information on the problem are confusing.

Devising a Plan (DP)

1. Students are not sure whether the plan/strategy is correct.
2. Students are confused with what to write.
3. Students do not know what symbol/s to use in order to have the correct equation.

Carrying out the Plan (CP)

1. students cannot move on because of an un-organized information.
2. students do not know where to place and what to do with the devised plan created.
3. Students cannot arrange the proper solution leading to the correct answer.

Looking Back (LB)

3. Students get messed up in checking the solutions.
3. Due to time allotment/constrains, students forget to look back.
3. They do not know how to emphasize/conclude their solution.

Students' Difficulties by Sex by Phase

In terms of phase difficulties, the study revealed that majority of the female respondents encountered the difficulties in the looking back (LB) phase. This was followed by the difficulties in the devising a plan (DP) phase, and then carrying out the plan (CP) phase. On the other hand, majority of the male respondents encountered the difficulties in the looking back (LB) phase phase. This was followed by the devising a plan (DP) phase and then the carrying out the plan (CP) phase.

Students' Difficulties by Academic Program by Phase

The nine academic programs were classified into either STEM-related or non-STEM related academic programs.

i. STEM-related Academic Programs

1. BS in Agricultural and Biosystems Engineering (BS-ABE)

The study revealed that the devising a plan (DP) phase was the most encountered phase difficulty among the BS-ABE respondents. This was followed by the carrying out the plan (CP) phase, and then the looking back (LB) phase.

2. BS in Chemical Engineering (BS-Chem E)

The phases of devising a plan (DP) and carrying out the plan (CP) were the most encountered phase difficulty among the BS-Chem E respondents. This was followed by the looking back (LB) phase.

3. BS in Civil Engineering (BS-CE)

Among the BS-CE respondents, the devising a plan (DP) phase was the most encountered phase. This was followed by the looking back (LB) phase, and then the carrying out the plan (CP) phase.

4. BS in Mathematics (BS-Math)

The study revealed that the looking back (LB) phase was the most encountered phase difficulty among the BS-Math respondents. This was followed by the carrying out the plan (CP) phase, and then the devising a plan (DP) phase.

5. BS in Meteorology (BS-Meteo)

The phases of devising a plan (DP) and looking back (LB) were the most encountered phase difficulty among the BS-Meteo respondents. This was followed by the carrying out the plan (CP) phase.

ii. Non-STEM-related Academic Programs

1. BA in Communication (BA-Comm)

The study revealed that the devising a plan (DP) phase was the most encountered phase difficulty among the BA-Comm respondents. This was followed by the phases of carrying out the plan (CP) and the looking back (LB).

2. BS in Economics (BS-Econ)

The devising a plan (DP) phase was the most encountered phase difficulty among the BS-Econ respondents. This was followed by the looking back (LB) phase, and then carrying out the plan (CP) phase.

3. BS in Nursing (BSN)

The phase of carrying out the plan (CP) was the most encountered phase difficulty among the BS-Nursing respondents. This was followed by the looking back (LB) phase, and then devising a plan (DP) phase.

4. BS in Sociology (BS-Socio)

The study revealed that the devising a plan (DP) phase was the most enccuntered phase difficulty among the BS-Socio respondents. This was followed by the phases of carrying out the plan (CP) and the lookiing back (LB).

Students' Coping Strategies

In their quest for alleviating the students' difficulties in each of the phases of problem solving, they find ways of coping with them. The study was able to list 43 themes of coping strategies which were generally classified into two; 32 problem-focused coping strategies and 11 emotion-focused coping strategies. Generally, the students applied the problem-focused coping strategies.

1. *Students' Coping Strategies by Sex by Phase*

In the four phases of problem solving, the problem-focused coping strategies were the most utilized strategies both for male and female respondents.

2. *Students' Coping Strategies by Academic Program by Phase*

The problem-focused coping strategies were the most utilized strategies both for the respondents of the STEM-related and non-STEM-related academic programs.

Developed Models

The study was able to develop models namely; 1) Coping Strategies by Sex by Phase Model and 2) Coping Strategies by Academic Program by Phase Model.

Applicability of Models

The developed models, after validations were found to be applicable to other groups of students and were seen their ability to address the problem solving difficulties of the students through their coping strategies.

In closing, this study is an integration of two major researches namely: difficulties of students in mathematics problem solving and coping strategies of students. Several studies have been conducted separately, however, this current research wanted to determine the ways by which the students cope with their difficulties in mathematics problem solving by sex and by academic program. Considering all the above conditions, literatures limit the search for information. Thus, the researcher firmly believes that this is a ground breaking study and its findings can be counted as contributory literature necessary in understanding the status of the current educational system in the country.

RECOMMENDATIONS

From the findings of the study, the following recommendations are forwarded:

1. The mathematics teachers should focus on the phase/s where students find struggling during a problem solving scenario. They need to provide the students with activities and tasks that are real-life that require them to understand, compute and check their solutions. Through these activities, the students will be able to discover their own learning. From the results, it is further recommended that an

assessment identifying the problem solving phase difficulties of students be administered at the beginning of the semester so that appropriate measures/strategies will be utilized by the mathematics teachers.

2. The coping strategies used to deal with a particular phase difficulty should be considered by the mathematics teachers. With the varied types of learners present in a mathematics classroom setting, grouping them according to their coping strategies by sex can help facilitate active discussion in the group and hence promotes learning.

3. To the instructional materials committee, modules can be developed incorporating coping strategies in the enrichment activities that are classified according to the phase difficulty of the students. For example, a student who struggles in understanding the problem phase maybe given an activity designed for him that includes defining terminologies; or a student who finds difficulty in computations, may be given several equations to process that will surely eradicate his difficulty, etc. In relation to this, a related research may be recommended to evaluate the effectiveness of the module that will be developed in accordance with the models developed.

4. The coping strategy of searching online for familiarization of terms, or for related problems or for watching you-tube for tutorials greatly recommends the installation of public-wifi in school premises for easy access of online resources by the students.

5. Books particularly on problem solving should be adequate in the library or reading center of a college or university for students' access.

6. Moreover, in relation to the applicability of the model to other groups of students, it is also worth pointing out and could be an added variable on the track or strand the respondent was enrolled during his/her Senior High School education. This is because of the case of the BS in Mathematics respondents. It is believed that they should excel in problem solving but it turned out otherwise. Looking at their profile revealed that most of them were not STEM graduates during their Senior High School.
7. A future research is recommended that focuses on extensive identification of the problem solving difficulties in each phase of Polya's problem solving approach.
8. From the models developed, it is recommended that future research will be conducted to validate the findings of this study. A bigger population may be taken into consideration, that is, a provincial or regional in scope giving attention to the two groups of academic programs. Moreover, such research may be long-term in nature to determine whether there will be an improvement in the mathematics problem solving performance of the students as mathematics teachers employ the recommended coping strategies presented in the models.
9. Further research may be done that focuses on improving the model building framework developed in this study such as employing a different theory for coping strategies.

REFERENCES

Ader, E. & Erktin, E. (2012). Development of the revised form of the coping with mathematics scale. Procedia-Social and Behavioral Sciences, *47*(1), 974-980. doi:10.1016/j.sbspro.2012.06.766 Retrieved from https://www.sciencedirect.com.

Asberg, K., Bowers, C., Renk, K., & McKinney, C. (2008). A structural equation modeling approach to the study of stress and psychological adjustment in emerging adults. *Child Psychiatry and Human Development*, *39* (4), 481-501. Retrieved from https://eric.ed.gov/?q=A+structural+equation+modeling+approach+to+the+study+of+stress+and+psychological+adjustment+in+emerging+adults.+&id=EJ813923.

Apostol, Enya Marie D. (2017). Problem Solving Heuristics on Non-Routine Problems of College Students. *American Journal of Educational Research. 5* (3), *338-443.* DOI:10.12691/education-5-3-16.

Bagasol, A., Corcoro, J., Gallegoes, B., Ramos, M., & Sagsagat, R. (2015). *College students' difficulties in solving Mathematics problems and their coping mechanisms.* College of Teacher Education. Unpublished undergraduate thesis. Mariano Marcos State University-College of Arts and Sciences, Batac City.

Banilower, E., Smith, P., Weiss, I., Malzahn, K., Campbell, K., & Weis, A. (2013). Report of The 2012 National Survey of Science and Mathematics Education. Retrieved from http://www.horizon-research.com/2012nssme/wp-content/uploads/2013/02/2012-NSSME-Full-Report1.pdf.

Brougham, R., Zail, C., Mendoza C., & Miller, J. (2009). Stress, sex differences, and coping strategies among college students. *Current Psychology*, *28* (2), 85-97. Retrieved from https://link.springer.com/article/10.1007/s12144-009-9047-0.

Callan, G. L., Marchant, G. L., Finch , W. H. & Flegge, L. (2017). Student and school *SES, gender, strategy* use, and achievement. *Psychology of Schools*, *54*(9), 1106-1122.

Carballo, Angelica Katheryn G. (2009). Analyzing the *Status of Math and Science* Education. *Growth Revoloution Magazaine*. Retrieved from https://growthrevolutionmag.wordpress.com/2009/09/22/educationanalyzing-the-status-of-math-science-education/.

Carnicer, J., & Calderon, C. (2012). Coping strategies and psychological well-being among teacher education students. *European Journal of Psychology of Education. 28*(4) 1127-1140. Retrieved from https://link.springer.com/article/10.1007%2Fs10212-012-0158-x.

Carnwell, R., & Harrington, C. (2001). Approaches to Study: Their Impact on Coping Strategies in Women Distance Learners. Retrieved from https://files.eric.ed.gov/fulltext/ED457734.pdf.

Carver. C., Scheier, M., & Weintraub, J. (1989). Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology, 56*(2) 267-283. Downloaded from www.academia.edu.

Castagnolo, Chuck. (2008). The ADDIE Model: Why Use it? Downloaded from http://theelearningsite.com/2011/03/the-addie-model-why-use-it/.

Chamundeswari, S. (2014). Conceptual errors encountered in mathematical operations in Algebra among students at the secondary level. *International Journal of Innovative Science, Engineering & Technology, 1*(8), 24-38. Downloaded from http://ijiset.com/v1s8/IJISET_V1_I8_04.pdf

Chinaveh, M. (2012). The effectiveness of problem-solving on coping skills and psychological adjustment. *Social and Behavioral Sciences, 84, 4-9* Retrieved from https://www.sciencedirect.com/science/article/pii/S1877042813015668.

Chun, J., & Poole, D. L. (2009). Conceptualizing stress and coping strategies of Korean social work students in the United States: A concept mapping application. *Journal of Teaching in Social Work, 29*(1), 1-17. Retrieved from https://eric.ed.gov/?q=Conceptualizing+stress+and+coping+strategies+of+Korean+social+work+students+in+the+United+States%3a+A+concept+mapping+application&id=EJ862286.

Cliche, Maxime. (2017). *Coping Strategies.* Center for Studies on Human Stress. Retrieved from https://humanstress.ca/stress/trick-your-stress/steps-to-instant-stress-management'.

Coiro, M. J., Bettis, A. H., & Compas, B. E. (2017). College students coping with interpersonal stress: Examining a control-based model of coping. *Journal of American College Health, 65*(3), 177-186. Retrieved from https://eric.ed.gov/?q=College+students+coping+with+interpersonal+stress%3a++Examining+a+control-based+model+of+coping&id=EJ1133448.

Dela Cruz, J. & Lapinid, M. (2014). *Students' difficulties in translating worded problems into mathematical symbol.* Paper presented at the DLSU Research Congress, De La Salle University, Manila, the Philippines.

Dep-Ed, Ilocos Norte.

Didis, M., Esbas, A. (2015). Performance and Difficulties of Students in Formulating and Solving Quadatic Equations with One Unknown. *Educational Sciences: Theory and Practice. 11*(4), 1137-1150. Downloaded from https://files.eric.ed.gov/fulltext/EJ1100800.pdf.

Duran, M. (2016). An academic survey concerning high school and university students' attitudes and approaches to problem solving in Chemistry. *International Journal of Environmental and Science Education, 11*(5), 819-837. Downloaded from https://eric.ed.gov/?q=An+academic+survey+concerning+high+school+and+university+students'+attitudes+and+approaches+to+problem+solving+in+Chemistry.+&id=EJ1114257.

Ernst, J. V. (2009). *Contextual Problem Solving Model Orientation.* Journal of Industrial Teacher Education, *46*(2), 27-47. Retrieved from https://scholar.lib.vt.edu/ejournals/JITE/v46n2/ernst.html.

Eschenbeck, H., Kohlmann, C., & Lohaus, A., (2007). Gender differences in coping strategies in children and adolescents. *Journal of Individual Differences*, *28*(1), 18-26. Downloaded from https://www.researchgate.net/publication/240218695_Gender_Differences_in_Coping_Strategies_in_Children_and_Adolescents.

Examination Board of Malaysia. (2009). *Result Announcement of Primary School Achievement Test (UPSR).* Ministry of Education, Kuala Lumpur. Retrieved from https://www.sciencedirect.com/science/article/pii/S187704281002029X.

Federis, T. (2006). Two-shift classroom scheme does not solve education crisis. Education Blues: A Bulatlat Special Report, *6*(17). Retrieved from https://www.coursehero.com/file/p562pc/D-2006-Successful-school-McCormick-M-J-Self-efficacy-and-leadership/.

Feliciano and Uy. (1991). Modern College Algebra. Merriam and Webster, Inc.

Ferguson, D. (1980). The language of Mathematics: How Calculus students cope with it. Retrieved from https://search.proquest.com/docview/302994299/A92A1070E6A7418CPQ/1?accountid=47253.

Finney, Roxi. (n. d.) Research in Problem-Solving: Improving the Progression from Novice to Expert. Downloaded from https://physicscourses.colorado.edu/phys4810/phys4810_fa06/4810_readings/finney.pdf.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology, 48* (1), 150-170. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/2980281.

Ganley, Colleen. (2018). Are Boys Better than Girls at Math? Scientific American. Retrieved from https://www.scientificamerican.com/article/are-boys-better-than-girls-at-math/.

Ganley, Colleen and Lubienski, S. (2016). Current Research on Gender Differences in Math. *National Council of Teachers of Mathematics.* Retrieved from https://www.nctm.org/Publications/Teaching-Children-Mathematics/Blog/Current-Research-on-Gender-Differences-in-Math/.

Ghana, Winneba. (2011). Coping with Stress: Strategies adopted by Students at the Winneba Campus of Universityof Education, 2(1) 290-299. Downloaded from https://eric.ed.gov/?id=ED528318.

Halland, E., De Vibe, M., Solhaug, I., Friborg, O., Rosenvinge, J.H., Tyssen, R., Sorlie, T., & Bjorndal, A. (2015). Mindfulness training improves problem-focused coping In psychology and medical students: Results from a randomized controlled trial. *College Student Journal*, *49*(3), 387-398. Retrieved from https://eric.ed.gov/?q=Mindfulness+training+improves+problem-focused+coping+In+psychology+and+medical+students%3a++Results+from+a+randomized+controlled+trial&id=EJ1095573.

Holahan, C. J., & Moos, R. H. (1987). Risk, resilience and psychological distress: A longitudinal analysis with adults and children. *Journal of Abnormal Psychology*, *96*, 3-13. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/3558946.

Holen, S., Waaktaar, T., Lervag, A., & Ystgaard, M. (2012). Exploring the associations between coping patterns for everyday stressors and mental health in young school children. *Journal of school psychology*. 50(2), 167-193. Retrieved from https://www.researchgate.net/publication/221884524_Exploring_the_associations_between_coping_patterns_for_everyday_stressors_and_mental_health_in_young_schoolchildren.

Houghton, J. D., Wu, J., Godwin, N. C., & Manz, C. (2012). *Effective stress management: A model of emotional intelligence, self-leadership, and student stress coping. Journal of Management Education, 36*(2), 220-238. Retrieved from https://asu.pure.elsevier.com/en/publications/effective-stress-management-a-model-of-emotional-intelligence-sel.

Hudson, Kathleen. (2016). Coping Complexity Model: Coping Stressors, Coping Influencing Facors and Coping Responses. *Psychology*, 7, 300-309. Retrieved from https://file.scirp.org/pdf/PSYCH_2016031615111106.pdf.

Inanloo, M., Baha, R., Seyedfatemi, N., & Hosseini, A. (2012). Stress coping Styles among nursing students. *Journal of Hayat*, *18*(3), 66-75. Downloaded from http://hayat.tums.ac.ir/browse.php?a_id=24&sid=1&slc_lang=en.

Kaiseler, M.m Polman, J., Nicholls, A. (2012). Gender differences in Appraisal and Coping: An examination of the situational and dispositional hypothesis. *International Journal Sport Psychology*. *43*, 1-14. https://www.academia.edu/1822466/Gender_differences_in_Appraisal_and_Coping_.

Labrague, L. J., Petitte, D. M., Gloe, D., Thomas, L., Papathanasiou, I. & Tsaras, K. (2016). A literature review on stress and coping strategies in nursing students. *Journal of Mental Health, 26*(5), 471-480. Retrieved from http://www.tandfonline.com/doi/full/10.1080/09638237.2016.1244721?src=recsys.

Folkman, S. & Lazarus, R. S. (1985). It if changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, *48*, 150-170. Retrieved from http://www.scirp.org/(S(vtj3fa45qm1ean45vvffcz55))/reference/ReferencesPapers.aspx?ReferenceID=354449.

Lazarus, R. S. (1993). Coping theory and research: past, present and future. *Psychosomatic Medicine*, *55*, 234-247.

Lester, F. (1987). Teaching Mathematical Problem Solving. Downloaded from http://ncm.gu.se/pdf/namnaren/3243_88_3.pdf.

Lockwood, E. (2013). A model of students' combinatorial thinking. *The Journal of Mathematical Behavior, 32*(2), 251-265. Retrieved from https://www.sciencedirect.com/science/article/pii/S0732312313000230.

Lopez, Lourdes. (2008). Helping at-risk students solve mathematical word problems through the use of direct instruction and problem solving strategies. Masters Thesis (Open Access). Electronic Theses and Dissertations. University of Central Florida. Retrieved from http://stars.library.ucf.edu/cgi/viewcontent.cgi?article=4668&context=etd.

Kirikkanat, B. & Soyer, M. K. (2018). A path analysis model pertinent to undergraduates' academic success examining academic confidence, psychological capital and academic coping factors. *European Journal of Educational Research*, *7*(1), 133-150. Retrieved https://eric.ed.gov/?q=A+path+analysis+model+pertinent+to+undergraduates'+academic+success+examining+academic+confidence%2c+psychological+capital+and+academic+coping+factors&id=EJ1166104.

Madhyastha, Sahana. (n. d.). Stress, Coping and Gender Differences in Third Year Medical Students. School of Allied Health Sciences. Manipal University. Downloaded from www.academia.edu.

Mehta, Akshita. (2019). Integrating Math Modelling Tasks in Teaching and Learning Mathematics. Downloaded from www.academiae.edu.

Moradi, F. & Amiripour, P. (2017). The prediction of the students' academic underachievement in Matnematics using the DEA model: A developing country case study. *European Journal of Contemporary Education*, *6*(3), 432-447. Downloaded from https://eric.ed.gov/?q=The+prediction+of+the+students'+academic+underachievement+in+Mathematics+using+the+DEA+model%3a++A+developing+country+case+study.+&id=EJ1154706.

Morales, R., Manuel, F., Torres, T., Victoria, M.V., & Paez, J. (2012). Gender and age differences in how children cope with daily stress. *Electric Journal of Research in Educational Psychology*, *10*(1), 95-110. Retrieved from www.eric.ed.gov.

National Council of Teachers of Mathematics. 1998. *Principles and Standards for School Mathematics: Discussion Draft.* Reston, Va.: National Council of Teachers of Mathematics. Retrieved from https://www.nap.edu/read/9605/chapter/9#88.

Nurrenberg, S. C. & Pickering M., (1987). Concept learning versus problem solving: Is there a difference? *Journal of Chemical Education*, *64*(6), 508-510. Downloaded from https://eric.ed.gov/?q=Concept+learning+versus+problem+solving%3a++Is+there+a+difference%3f&id=EJ357287.

Okoro, Emeka. (2018). *Assessment of stress related issues and coping mechanisms among college students.* A Master's Thesis, Minnesota State University. Retrieved from https://cornerstone.lib.mnsu.edu/cgi/viewcontent.cgi?article=1823&context=etds.

Ordinario, Cai U. (2013). Low NAT scores may worsen under K to 12. Retrieved from https://www.rappler.com/nation/24205-low-nat-scores-may-worsen-under-k-12.

Pearce, D., Skinner, K., Bruun, F., & Lopez-Mohler, C. (2013). What teachers say about student difficulties solving mathematical word problems in grades 2-5. *International Electronic Journal of Mathematics Education*, *8*(1), 3-19. Downloaded from https://www.researchgate.net/publication/286608143_What_teachers_say_about_student_difficulties_solving_mathematical_word_problems_in_grades_2-5.

Ferera, H., & Mcliveen, P. (2014). The role of optimism and engagement coping in college adaptation: A career construction model. *Journal of Vocational Behavior, 84*(3), 395-404. Downloaded from https://www.sciencedirect.com/science/article/abs/pii/S0001879114000451.

Petilos, G. P. (2002). *Constructivist model for teaching problem-solving: Effects on students' problem-solving and critical thinking skills.* Unpublished Dissertation, UP-Open University, Los Banos Laguna.

Philippine Education for All, (2015). Retrieved from https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/philippines_efa_mda.pdf.

Philippine Star (2005). *TIMMS 2003.* Retrieved from http://www.factfish.com/statistic-country/philippines/timss,%20mathematics,%20mean%20performance,%20grade%208,%20male.

Plomp, T. (2007). Educational design-based research: *An Introduction.* In T. Plomp & N. Nieveen (Eds.), An Introduction to Educational Design-based research. Proceedings of the seminar conducted at the East China Normal University, Shangai (PR China), November 23-26, 2007 9-33.

Polya, G. (1945). How to Solve it: A new aspect of mathematical method. Princeton, USA, Princeton University Press. Retrieved from http://www.math.wichita.edu/history/men/polya.html.

Quan, S. F. (2015). *The impact of stressful situations on Mathematics anxiety and Mathematics performance.* A Dissertation, Teacher's College, Columbia University. Downloaded from https://search.proquest.com/docview/1686872168/7A18ADA909F64C4DPQ/1?accountid=47253.

Rapson, K. E. (1990). *Relationship and achievement stressors: Gender differences in appraisals, coping and outcomes.* A Dissertation, Virginia Consortium for Professional Psychology. Retrieved from https://search.proquest.com/dissertations/docview/303907001/A76AEBB97F4744DPQ/31?accountid=47253.

Reddy, M., & Panacharoensawad, B. (2017). Students problem-solving difficulties and implications in Physics: An empirical study on influencing factors. *Journal of Education and Practice, 8*(14), 59-62. Retrieved from https://eric.ed.gov/?q=Students+problem-solving+difficulties+and+implications+in+Physics%3a++An+empirical+study+on+influencing+factors.+&id=EJ1143924.

Rioveros, J. A. (2013). *Finding Relations on Conceptual Knowledge, Science Process Skills and Coping Strategies of Students in the K to 12 Curriculum.* An Unpublished Master's Thesis, Philippine Normal University, Manila.

Rodriquez, M., Manuel, F., Torres, T., Victoria, M., Paez, M., & Jesus. (2012). Gender and age differences in how children cope with daily stress. *Electronic Journal of Research in Educational Psychology, 10*(1) 95-110. Retrieved from https://eric.ed.gov/?q=coping+strategies+in+problem+solving+of+engineering+students&pg=3&id=EJ970380.

Roesler, R. (2016). Toward solving the problem of problem solving: An analysis framework. Brigham Young University – Idaho, *26*(1), 28-42 Retrieved from https://eric.ed.gov/?q=Toward+solving+the+problem+of+problem+solving%3a+An+analysis+framework.+&id=EJ1112558.

Roces, Alejandro R. (2006). The decline in quality of Philippine education. Philstar Global. Retrieved from https://www.philstar.com/opinion/2006/11/21/369945/decline-quality-philippine-educationRonda, Rainier A. (2011). DepEd: Achievement rates of students declining. Philstar Global. Downloaded from www.philstar.com.

Ronda, Rainier A. (2011). DepEd: Achievement rates of students declining. Philstar Global. Retrieved from https://www.philstar.com/headlines/2011/05/26/689518/deped-achievement-rates-students-declining.

Rouse, M. (2018). Data Modeling. Retrieved from https://searchdatamanagement.techtarget.com/definition/data-modeling.

Ryan, Kate. (2013). How problem focused and emotion focused coping affects college students' perceived stress and life satisfaction. Retrieved from https://pdfs.semanticscholar.org/a2da/542c75c6b1d6b48f9d8320db7948489 6b22d.pdf.

Sawrey, B. A. (1990). Concept learning versus problem solving: Revisited. *Journal of Chemical Education. 67*(3), 253-254. Downloaded from https://eric.ed.gov/?id=EJ40941C.

Sincero, Sarah Mae. (2012). Theories of Coping. Psychology. Downloaded from https://explorable.com.

Siniguian, Marlon. (2017). *Students difficulty in solving mathematical problems. International Journal of Advanced Research in Engineering and Applied Sciences, 6*(2). 1-12. Downloaded from www.academia.edu.

Sultan, Lidey P. (2014). *Challenges Encountered by Students in Solving Algebra Word Problems.* An Undergraduate Thesis. College of Education, University of Southern Mindanao, Cotabato City.

Tambychik, T. & Meerah, T. S. M. (2010). *Students' difficulties in Mathematics problem-solving: What do they say?. Procedia-Social and Behavioural*

Sciences, 8, 142-151. Downloaded from https://www.sciencedirect.com/science/article/pii/S1877042810021257.

Tamres, L., Janicki, D., & Helgeson, V. (2002). Sex differences in coping behavior: A meta-analytic review and an examination of relative coping. *Personality and Social Psychology Review, 6*(1), 2-30. Downloaded from https://www.researchgate.net/publication/247759663_Sex_Differences_in_Coping_Behavior_A_Meta-Analytic_Review_and_an_Examination_of_Relative_Coping.

Taplin, Margaret. (n. d). Mathematics Through Problem Solving. Retrieved from https://www.mathgoodies.com/articles/problem_solving.

TIMMS 2003 International Mathematics Report. Trustees of Boston College Dowloaded from https://timss.bc.edu/timss2003/mathD.html.

Turchin, P., Korotayev, A. & Grinin, L. (n.d.). Almanac: History & Mathematics: Historical Dynamics and Development of Complex Societies. Retrieved from https://www.academia.edu/21958179/HISTORY_and_MATHEMATICS_Historical_Dynamics_and_Development_of_Complex_Societies.

Ulu, Mustafa. (2017). The Effect of Reading Comprehension and Problem Solving Strategies on Classifying Elementary 4th Grade Students with High and Low Problem Solving Success. *Journal of Education and Training Studies*, *5*(6), 44-63. Downloaded from https://files.eric.ed.gov/fulltext/EJ1141427.pdf.

Ways of Coping Questionnaire (n.d.) Retrieved from http://www.selfcareinsocialwork.com/wp-content/uploads/2013/03/WAYS-OF-COPING-was-designed-by-Lazaru-and-Folkman.pdf.

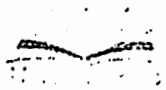
Ymas, S., Marilla, M., Leongson, J., Villacrucis, M., Blanco, G. & Cascante, M. (2005). *College Algebra.* Ymas Publishing House.

https://datascience.stackexchange.com/questions/17328/statistics-train-and-test-data-split)

https://www.edukasyon.ph/courses/senior-high-tracks/academic/stem-science-technology-engineering-and-mathematics-strand

APPENDIX A

MARIANO MARCOS STATE UNIVERSITY
University Research Ethics Review Board
City of Batac 2906 Ilocos Norte



COVER LETTER

June 18, 2018

Prof. Ryan Dean T. Sucgang
Chair - University Research Ethics Review Board
This University

Dear Sir,

The undersigned respectfully submits the hereto attached study protocol for ethics review. Our study titled **MODEL BUILDING FOR ADDRESSING THE MATHEMATICS PROBLEM SOLVING DIFFICULTIES THROUGH COPING STRATEGIES** will be conducted in partial fulfilment of the course PhD Education major in Mathematics Education. The study will be conducted in MMSU. Data gathering is expected to commence on July 2, 2018.

Thank you very much.

Respectfully yours,

DINAH C. VIDAD
Lead Researcher/Principal Investigator

Noted:

Dr. MARIA ANA T. QUIMBO
Research Adviser

APPENDIX B

MARIANO MARCOS STATE UNIVERSITY
University Research Ethics Review Board
City of Batac 2906 Ilocos Norte

EXEMPT RESEARCH CERTIFICATE

Reference Number:	**2018-131**
Research Title:	**MODEL BUILDING FOR ADDRESSING MATHEMATICS PROBLEM SOLVING DIFFICULTIES THROUGH COPING STRATEGIES**
Nature of Research:	**DOCTORAL DISSERTATION**
Lead Researcher:	**DINAH VIDAD**

On behalf of the University Research Ethics Review Board (URERB), I hereby certify that the above-mentioned research project is qualified as exempt research under the category/ies:

"1.Research involves only normal education practices such as research on regular and special education instructional strategies or research on effectiveness of or the comparison among instructional techniques, curricula or classroom management methods.

The researcher(s) may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the certification is effective **September 12, 2018 to September 12, 2019**. Likewise, post-approval submissions are not necessary; however, all modifications to the study that has been certified as exempt research must be submitted to the board for prospective review and certification of exemption prior to implementation.

CERTIFIED TRUE AND CORRECT:

APPENDIX C

SAMPLE LETTER REQUEST TO THE DIFFERENT CHAIRMAN OF THE UNIVERSITY

MMSU | College of Arts and Sciences

MARIANO MARCOS STATE UNIVERSITY

September 19, 2018

DR. JOSELITO I. ROSARIO
Dean-College of Agriculture Food and Sustainable Development
This University

Thru:

Sir:

Greetings!

I, a student of the University of the Philippines – Open University, will be conducting a research titled **"Model Building for Addressing Mathematics Problem Solving Difficulties Through Coping Strategies"** in fulfillment of the requirements for the degree of Doctor of Philosophy in Education, major in Mathematics Education. This study aims to:

1. identify the common problem solving difficulties (classified into the 4 phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex and course.
2. determine the most common coping strategies of students in each of the phases according to sex and course.
3. present and analyze models (representations) that can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
   a. the different phases of problem solving
   b. sex and
   c. course
4. evaluate the applicability of the developed model/s to other group of students.

In relation to this, may I request permission to conduct a try-out of my problem solving test covering the topic on Linear Equations which is included in Math 12 (College Algebra) to your BS-Environmental Science II students since they have just taken the subject last SY 2017-2018. The said research as reviewed by our University Research Ethics Review Board was qualified as exempt research with reference number 2018-131 and was given its clearance to commence. Please find attached certificate. Rest assured that the data gathered from your students will be kept confidential and will only be used for my research.

In addition, may I know the most convenient time (free time) of your students for the test administration as it requires at most two hours and the total number of the mentioned students.

Thank you very much and I hope for your favorable response on this matter.

Very truly yours,

Prof. E.O. Ramirez

For your approval
Achin

Noted by:

Dissertation Adviser

City of Batac, 2906 Ilocos Norte
Email: cas@mmsu.edu.ph, Telephone: 077-6702105

MMSU | College of Arts and Sciences
MARIANO MARCOS STATE UNIVERSITY

RECEIVED
SEP 19 2018

September 19, 2018

DR. MARIVIC M. ALIMBUYUGEN
Dean-College of Arts and Sciences
This University

Thru: DR. REY JOHN C. VILLANUEVA
Department Chair
Languages and Literature

Greetings!

I, a student of the University of the Philippines – Open University, will be conducting a research titled **"Model Building for Addressing Mathematics Problem Solving Difficulties Through Coping Strategies"** in fulfillment of the requirements for the degree of Doctor of Philosophy in Education, major in Mathematics Education. This study aims to:

1. identify the common problem solving difficulties (classified into the 4 phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex and course.
2. determine the most common coping strategies of students in each of the phases according to sex and course.
3. present and analyze models (representations) that can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
   a. the different phases of problem solving
   b. b. sex and
   c. course
4. evaluate the applicability of the developed models to other group of students.

In relation to this, may I request permission to conduct a try-out of my problem solving test covering the topic on Linear Equations which is included in Math 12 (College Algebra) to your AB-English Language II students since they have just taken the subject last SY 2017-2018. The said research as reviewed by our University Research Ethics Review Board was qualified as exempt research with reference number 2018-131 and was given its clearance to commence. Please find attached certificate. Rest assured that the data gathered from your students will be kept confidential and will only be used for my research.

In addition, may I know the most convenient time (free time) of your students for the test administration as it requires at most two hours and the total number of the mentioned students.

Thank you very much and I hope for your favorable response on this matter.

Noted by:

City of Batac, 2906 Ilocos Norte
Email: cas@mmsu.edu.ph, Telephone: 077-6702105

R2018-1134

MMSU | College of Arts and Sciences

MARIANO MARCOS STATE UNIVERSITY

November 13, 2018

DR. ANGELINA B. ABROGENA
Dean-College of Business Economics and Accountancy
This University

Madam:

Greetings!

I, a student of the University of the Philippines – Open University, am presently conducting a research titled **"Model Building for Addressing Mathematics Problem Solving Difficulties Through Coping Strategies"** in fulfillment of the requirements for the degree of Doctor of Philosophy in Education, major in Mathematics Education. This study aims to:

1. identify the common problem solving difficulties (classified into the 4 phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex and course.
2. determine the most common coping strategies of students in each of the phases according to sex and course.
3. present and analyze models (representations) that can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
   a. the different phases of problem solving
   b. sex and
   c. course
4. evaluate the applicability of the developed models to other group of students.

In relation to this, may I request permission to administer a problem solving test to your currently enrolled freshmen students in their Mathematics in the Modern World subject. The test recently has undergone a pilot testing to identified sophomores who have taken College Algebra last SY 2017-2018. Result of the pilot test revealed an acceptable Cronbach alpha coefficient. Also, a short questionnaire will be appended to the problem solving test to elicit responses relating their coping strategies on their encountered difficulties in problem solving. Rest assured that the data gathered from the students will be kept confidential and will only be used for my research.

Thank you very much for your favorable response on this matter.

UPOU student
(CAS Faculty)

Noted by:

City of Batac, 2906 Ilocos Norte
Email: cas@mmsu.edu.ph, Telephone: 077-6702105

MMSU | College of Arts and Sciences

MARIANO MARCOS STATE UNIVERSITY

November 13, 2018

RECEIVED
NOV 14 2018
BY: ----------

DR. NATHANIEL R. ALIBUYOG
Dean-College of Engineering
This University

Sir:

Greetings!

I, a student of the University of the Philippines – Open University, am presently conducting a research titled **"Model Building for Addressing Mathematics Problem Solving Difficulties Through Coping Strategies"** in fulfillment of the requirements for the degree of Doctor of Philosophy in Education, major in Mathematics Education. This study aims to:

1. identify the common problem solving difficulties (classified into the 4 phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex and course.
2. determine the most common coping strategies of students in each of the phases according to sex and course.
3. present and analyze models (representations) that can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
   a. the different phases of problem solving
   b. sex and
   c. course
4. evaluate the applicability of the developed model/s to other group of students.

In relation to this, may I request permission to administer a problem solving test to your currently enrolled freshmen students in their Mathematics in the Modern World subject. The test recently has undergone a pilot testing to identified sophomores who have taken College Algebra last SY 2017-2018. Result of the pilot test revealed an acceptable Cronbach alpha coefficient. Also, a short questionnaire will be appended to the problem solving test to elicit responses relating their coping strategies on their encountered difficulties in problem solving. Rest assured that the data gathered from the students will be kept confidential and will only be used for my research.

Thank you very much for your favorable response on this matter.

Very truly yours,

UPOU student
(CAS Faculty)

Approval provided your instrument have already ethics review board approve

Noted by:

Dissel Adviser

City of atac, 2906 Ilocos orte
Email: cas@mmsu.edu.ph, Telephone: 077-6702105

MARIANO MARCOS STATE UNIVERSITY
University Research Ethics Review Board
City of Batac 2906 Ilocos Norte

INFORMED CONSENT DOCUMENT

Title of Research	MODEL BUILDING FOR ADDRESSING MATHEMATICS PROBLEM SOLVING DIFFICULTIES THROUGH COPING STRATEGIES
Name of Researcher/ Principal Investigator	DINAH C. VIDAD

1. Purpose and Background

The study involves research that aims to build models that will address mathematics problem solving difficulties of students through their coping strategies, from where: a) the common problem solving difficulties (classified into the four phases: understanding the problem, devising a plan, carrying out the plan and looking back) b) the most common coping strategies of students in each of the phases according to sex and course will be identified. Then these models will be presented and analyzed and will be evaluated for its applicability to other groups of students.

Results of studies and various educational assessments conducted in the past decades such as TIMMS (Trends in International Mathematics and Science Studies) and NAT (National Achievement Test) revealed the deteriorating quality of mathematics education in the Philippines. This is due to the students' lack of many mathematical skills such as number-fact, visual-spatial and informational skill which are manifested in their problem solving capabilities.

Meanwhile, while students are continually faced with difficulties and depression in mathematics problem solving, they also learn how to manage and respond to these difficulties in different ways either cognitively and emotionally. These ways are known as coping strategies.

Many studies have already been conducted separately along each variable, (difficulties versus coping strategies) however, there is paucity on studies with the two variables combined. Hence, this study.

2. Procedures

This study will be conducted among the college freshmen of Mariano Marcos State University currently enrolled in the New GE Math Course which is the Mathematics in the Modern World for the first semester of SY 2018-2019. Representative sections will be determined through the fish bowl lottery (draw lots) by the researcher for courses with at least two sections while courses with only one section will automatically be included in the sample.

To start with the data collection, the researcher will first submit the study protocol and other assessment forms to be reviewed by the university's Research Ethics Review Board. Upon its approval, the researcher will request permission from the respective deans of all the participants including a few sophomore students who have taken College Algebra last SY 2017-2018 for the conduct of the initial try-out of the problem solving test down to the validation/implementation of the developed model/s. The initial try-out will be administered on the second or third week of September, 2018. Revisions on the problem solving test will follow coming up with the final revised problem solving test.

Prior to the handling of the final form of the problem solving test and coping strategy questionnaires to the respondents, the researcher will discuss with them the content and processes of the informed consent document. The purpose and background of the study; procedures commencing from the administration of the problem solving test up to data analysis, risks and inconveniences that may happen during the participation, benefits they can directly enjoy with the results of the study, compensation for participating in the study, provision for injury or related illness, their voluntariness/withdrawal of participation and confidentiality issues will all be discussed and explained. Then, the preliminary investigation/development phase of the study will commence on the second or third week of October, 2018.

After the discussion of the necessary topics included in the Informed Consent Document comes the administration of the final form of the problem solving test with a coping strategy questionnaire appended. The instrument will give an emphasis on the identification of student's mathematics problem solving difficulties on the four phases of Polya's problem solving. Coping strategies will likewise be elicited along with their difficulties in each of the phases of problem solving.

164

160

After all representative sections have taken the test, careful investigation and data tabulations and recordings will follow which may last for one and a half months. The said investigation will seek answers to the research problems. In the same manner as different model will be developed relating the difficulties in the 4 phases of problem solving and the coping strategies of the students.

The developed models will be validated through a few respondents (case studies), about 150 respondents. These respondents will be randomly selected from those who did not have a chance to be included in the preliminary investigation. They will confirm whether the developed models are valid or not.

Model validation involves comparing the coping strategies of students in this phase to the students in the development phase given that they: a) all experience similar problem solving difficulty phase; b) belong to the same sex, and c) belong to the same course. The aim of this stage of the study as a whole is to determine whether the developed model/s apply/ies to other group of students.

Duration of the respondents' participation may take from the third week of September until the end of the first semester of the SY 2018-2019.

After the analysis of the data gathered, the solutions to the problem solving test and accomplished questionnaires will be deposited in a sealed envelope at the Faculty room of the Department of Mathematics.

3. Risks and Inconveniences

As the study requires showing solutions to problems that involve critical thinking, the respondents may somewhat feel inconvenient especially that the test may last at most 2 hours, however, as to the testing environment and procedures as a whole, there will be no possible inconveniences which will be experienced by the respondents because the researcher will personally administer the test during their most convenient time and place. Moreover, since the study does not involve any medical procedures/treatments, there will be a negligible or minimal risks associated in the participation. Furthermore, the respondents will be informed about their right to refuse answering and withdraw from their participation from the problem solving test should they feel uncomfortable answering it without any

4. Direct Benefits

Knowing the students' mathematics problem solving difficulties and their coping strategies prior to the model development will serve as a guide for mathematics teachers in choosing the appropriate methodologies and ways of dealing with different kinds of students. In addition, the teachers will be given the hint that the coping strategies may have a contribution on the students' success in his mathematics course/subject.

Meanwhile, result of the study will serve as a basis for the instructional materials committee to work together with the teaching staff in developing varied instructional frameworks so that a specific course/sex with identified mathematics problem solving abilities will have a specific material incorporating the common coping strategies of the students. In short, the administration can conduct in-service seminar workshops and come up with instructional modules designed for mathematics problem solving difficulty reduction through coping strategies.

With these, students will be alleviated with their predicaments in problem solving, since their teachers will implement the most appropriate methodologies that suit their problem solving abilities coupled with their coping strategies.

With the development of models relating the mathematics problem solving difficulties and coping strategies of participants, they may be able to reflect which model fit them. If not, they may be able to utilize other forms of coping strategies in dealing with their identified problem solving difficulties.

5. Compensation

There will be no cash incentives or compensations involved in the study, however, simple refreshments will be distributed to the respondents.

6. Provision for Injury or Related Illness

There will be no free treatment in any case of injury or illness and the researcher will assure that there will be no physical harm and any form of threat that may happen during the respondents' participation in the study.

7. Voluntariness/Withdrawal of Participation

Participation in this study is highly voluntary. Should the respondent feel to withdraw his participation at any point without penalty or any risk of any kind, he may do so. If such instance happens, any information obtained from the respondents will no longer be used unless allowed by the respondents.

8. Confidentiality

The participants of the study will be assured of the confidentiality and anonymity of the responses. The first page of the problem solving test is a simple student's profile where the respondent identifies his course and sex. His name is in an "optional mode" of which he has the option to give information or not. Whether s/he writes his/her name, it is the responsibility of the researcher not to include the name in the research. The student's profile will be treated with anonymity. Confidentiality in the study on the other hand, will include the privacy of the respondents' solutions / methods in answering the problem solving test and the responses to the coping strategy questionnaire. The respondents, as part of the research will be able to access the result of the study at the College of Arts and Sciences and MMSU Main Library after the completion of the study.

9. Contact Person

The University Research Ethics Review Board (URERB) will approve the study and may be contacted regarding the rights of the research participants if there are any grievances and complaints, I can contact:

URERB Chair: **Prof. Ryan Dean T. Sucgang**
Address: Mariano Marcos State University, College of Health Science, Batac City
Email: mmsuerc@gmail.com
Tel.

For further inquiry or questions regarding your participation in the research study, you may contact the researcher **Dinah C. Vidad (09996644885)**

10. Consent

I have read and understood the above information and had been given the opportunity to consider and ask questions on the information regarding the involvement in this study. I have received a copy of this informed consent document.

Participant's Name	Signature	Date Signed

Witness or Legal Guardian's Signature (only when participant cannot read or sign)

Name of Witness/Guardian	Signature	Date Signed

APPENDIX F
REQUEST LETTER TO VALIDATORS

MMSU | College of Arts and Sciences

MARIANO MARCOS STATE UNIVERSITY

August 13, 2018

TO THE EXPERT VALIDATORS

Sir/Madam:

I am a student of UP-Open University and will be conducting a research titled "Model Building in Addressing Mathematics Problem Solving Difficulties through Coping Strategies" in partial fulfillment of the requirements for the degree, Doctor of Philosophy in Education, major in Mathematics Education. The study aims to identify the common problem solving difficulties (classified into the 4 phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex and course. This aim however, can only be achieved through the administration of a problem solving test, thus, this study requires the content validation of the constructed instrument.

Other objectives of the study are to:

1. determine the most common coping strategies of students in each of the phases according to sex and course.
2. present and analyze models (representations) that can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
    a. the different phases of problem solving
    b. sex
    c. course and
3. evaluate the applicability of the developed model/s to other group of students.

Above all, the study wishes to develop models that will address students' mathematics problem solving difficulties through their coping strategies.

In this regard, may I request your kind support and cooperation to this undertaking as one of the evaluators of the constructed Problem Solving Test on Linear Equations in One Variable. Your expertise in the field will surely contribute to the success of this research.

Attached herewith are the table of specifications, the problem solving test proper, solutions to the problems and the scoring rubrics. Problems are within the fields of arithmetic, algebra and geometry. Motion/distance, investment/interest, number relations, geometry/dimensions, mixture, work, money/coin and age problems are among the various types of problems considered in this endeavor.

I anticipate with extreme gratitude your favorable response to this request.

Thank you very much and God bless.

Very Truly Yours,

NOTED:

DR. MARIA ANA T. QUIMBO
Adviser

City of Batac, 2906 Ilocos Norte
Email: cas@mmsu.edu.ph, Telephone: 077-6702105

APPENDIX F
REQUEST LETTER TO VALIDATORS

M MSU College of Arts and Sciences
M. ARIANO MARCOS STATE UNIVERSITY

August 13, 2018

TO THE EXPERT VALIDATORS

Sir/Madam:

I am a student of UP-Open University and will be conducting a research titled "Model Building in Addressing Mathematics Problem Solving Difficulties through Coping Strategies" in partial fulfillment of the requirements for the degree, Doctor of Philosophy in Education major in Mathematics Education. The study aims to identify the common problem solving difficulties (classified into the 4 phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex and course. This aim however, can only be achieved through the administration of a problem solving test, thus, this study requires the content validation of the constructed instrument.

Other objectives of the study are to:

1. determine the most common coping strategies of students in each of the phases according to sex and course.
2. present and analyze models (representations) that can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
    a. the different phases of problem solving
    b. sex
    c. course and
3. evaluate the applicability of the developed model/s to other group of students.

Above all, the study wishes to develop models that will address students' mathematics problem solving difficulties through their coping strategies.

In this regard, may I request your kind support and cooperation to this undertaking as one of the evaluators of the constructed Problem Solving Test on Linear Equations in One Variable. Your expertise in the field will surely contribute to the success of this research.

Attached herewith are the table of specifications, the problem solving test proper, solutions to the problems and the scoring rubrics. Problems are within the fields of arithmetic, algebra and geometry. Motion/distance, investment/interest, number relations, geometry/dimensions, mixture, work, money/coin and age problems are among the various types of problems considered in this endeavor.

I anticipate with extreme gratitude your favorable response to this request.

Thank you very much and God bless.

Very Truly Yours,

NOTED:

DR. MARIA ANA T. QUIMBO
Adviser

City of Batac, 2906 Ilocos Norte
Email: cas@mmsu.edu.ph, Telephone: 077-6702105

APPENDIX G
EXPERT'S VALIDATION INSTRUMENT

MMSU

EXPERTS' VALIDATION INSTRUMENT: PROBLEM SOLVING TEST

Directions: Listed below are statements for evaluating the test prepared by the researcher. This test primarily aims to identify which among the 4 phases of Polya's problem solving **(understanding the problem, devising a plan/strategy in solving the problem, carrying out the plan/strategy, looking back at the given problem with the solution)** do students experience difficulty. Please indicate the number which corresponds to your response using the following scale:

4 – strongly agree

3 – agree

2 – disagree

1 – strongly disagree

Criteria	Ratings
1. The problems (questions) revolve within the content of College Algebra (or any related subject) particularly on the applications of linear equations as reflected in the table of specifications.	4
2. The problems include varied types of word problem applications.	4
3. The problems (questions) are relevant in relation to the objectives of the study.	4
4. The direction/instruction provided for the test as a whole is specific and direct to the point.	4
5. The problems (questions) involve the 4 phases of problem solving.	4
6. The problems (questions) require students to think.	4
7. The location of the answer space contributes to efficient test taking.	4
8. The problems (questions) are of varying difficulty.	4
9. The words used in the problems (questions) are simple, clear and comprehensible.	4
10. The problems are grammatically correct.	4

Other comments and suggestions:

Consider suggestions / recommendations / corrections provided in the problem solving solutions part.

Signature Over Printed Name
EVALUATOR

Legend: Interpretation of Mean

3.50 – 4.00 - Outstanding

2.50 – 3.49 - Highly Satisfactory

1.50 – 2.49 - Satisfactory 166

1.00 – 1.49 - Needs Improvement

APPENDIX H

PROBLEM SOLVING TEST (WITH COPING STRATEGY QUESTIONNAIRE)

STUDENT'S PROFILE

NAME (optional): _____

SEX/GENDER: _____

COURSE: _____ **TRACK (SHS)** _____

TO THE RESPONDENTS:

Greetings!

I, a student of the University of the Philippines – Open University, will be conducting a research titled **"Model Building for Addressing Mathematics Problem Solving Difficulties Through Coping Strategies"** in fulfillment of the requirements for the degree of Doctor of Philosophy in Education, major in Mathematics Education. This study aims to:

1. identify the common problem solving difficulties (classified into the 4 phases: understanding the problem, devising a plan, carrying out the plan and looking back) encountered by students according to sex and course.
2. determine the most common coping strategies of students in each of the phases according to sex and course.
3. present and analyze models (representations) that can be developed in overcoming students' mathematics problem solving difficulties through coping strategies classified according to:
   a. the different phases of problem solving
   b. sex and
   c. course
4. evaluate the applicability of the developed model/s to other group of students.

In relation to this, may I request for your ample time and patience in answering a problem solving test and provide honest responses to a coping strategy questionnaire. Rest assured that the data gathered will be kept confidential and will only be used for my research.

I can say that the result of the study will benefit you for this will reveal your weak side in terms of problem solving. This will also give you hints/ways of addressing your mathematics problem solving difficulties by means of coping strategies, that is, of how you will overcome these difficulties. In the future, should you need references that may relate to the result of the study, you are free to access he data with a simple communication/negotiation with me.

As the principal investigator, I also do not find any risks that may come with your participation. You also have the right to address any issue that may concern you throughout your participation in this study, and if you feel any discomfort or inconvenience within the duration of the study, you may withdraw anytime your participation.

I anticipate therefore, with utmost gratitude your favorable response to this request.

Thank you very much and God bless.

Very truly yours,

DINAH C. VIDAD
MMSU-CAS Faculty
(UPOU student)

Contact No:
Email add: d_cvidad@yahoo.com

PROBLEM SOLVING TEST

DIRECTION: Below are problems that need to be solved illustrating the four phases of Polya's problem solving: ***understanding the problem, devising/planning a strategy on how to solve the problem, carrying out the strategy/plan and looking back/checking of solution.***

Each phase of the problem solving process is described below. An example is likewise given below illustrating the 4 phases.

UNDERSTADING THE PROBLEM

- ☐ Can recall basic facts/concepts.
- ☐ Can define terminologies/notations used
- ☐ Can identify type of problem.
- ☐ Ability to distinguish known from the unknown
- ☐ Can rephrase the problem in own words.

DEVISING A PLAN/STRATEGY

- ☐ Ability to organize information or connect information to a concept
- ☐ Can draw pictures, tables or charts out of the information
- ☐ Ability to determine a formula or transform problems into mathematical sentences
- ☐ Can look for patterns

CARRYING OUT THE PLAN

- ☐ Ability to perform systematic working procedure (computational process) in solving the problem ensuring its accuracy.

LOOKING BACK

- ☐ Ability to evaluate the correctness of the obtained solution.

EXAMPLE: ***One number is 11 more than another number. Find the two numbers if three times the larger number exceeds four times the smaller number by 4.***

Understanding the problem
Type of Problem: Number Relations
Known: - A number is 11 more than another number
- Three times the larger number exceeds four times the smaller number by 4
Unknown: The two numbers

Devising a Plan:
Let x = smaller number
x + 11 = larger number

Working Equation:
$3(x + 11) - 4 = 4(x)$

Carrying out the Plan:
$3(x + 11) - 4 = 4(x)$
$3x + 33 - 4 = 4x$
$29 = x$

Looking Back:
When x = 29:
$3(29 + 11) - 4 = 4(29)$
$3(40) - 4 = 116$

Therefore, the numbers are 29 and and 40.

START HERE. *Solve each problem neatly and completely. Your solution should illustrate each of the four phases of problem solving.*

1. *Deewye is twice as old as Jean. Three years ago, the sum of their ages is 39. How old are they?*
2. *In consecutive turns of a Monopoly game, Stacy first paid P8,000.00 for a hotel. She then lost half her money when she landed on Boardwalk. Next, she collected P2,000.00 for passing GO. She then lost half her remaining money when she landed on Illinois Avenue. Stacy now has P25,000.00. How much did she have just before she purchased the hotel? (Aufmann, 2013)*
3. *A 12 cm by 16 cm rectangular piece of cardboard has a 2cm by 2 cm square cut out of each corner. Then the sides are folded up to make an open box. What is the volume of the box?*
4. *Jonathan can finish an accounting work in 8 hours. Carl can finish the same work in 6 hours. After 2 hours of working together, Jonathan left Carl for lunch and Carl finished the job. How long does it take Carl to finish the job?*
5. *How much pure acid should be mixed with 2 gallons of a 40% acid solution in order to get a 70% acid solution?*
6. *Xander invested P35,000.00 in a savings account that pays 4% simple interest. How much will he earn after 3 years? What will the new balance be?*
7. *Two cars leave a town and travel in opposite directions. One car travels at the rate of 45 kph, and the other at 55 kph. In how many hours will the two cars be 350 kilometers apart?*
8. *The first of three numbers exceeds twice the second number by 4, while the third number is twice the first. If the sum of the three number is 54, find the numbers.*
9. *Jenina owns a pet shop that specializes in tropical fishes. In April, Jenina doubled the number of fish she had on hand and then sold 30 of them. In May, she tripled the number of fish she had on hand, and then sold 54 of them, In June, she quadrupled the number of fish she had, and then sold 72 of them. She now had 48 fish left. How many fish did she start with? (Petilos, 2002)*
10. *If the digits of a two-digit number are reversed, the number is increased by 36. The sum of the digits in the number is three times their difference. What is the number? (Feliciano and Uy, 1991)*

11. A boat travels 46 km downsstream in the same time it takes to travel 30 km upstream. If the current's speed is 6 kph, determine the boat's speed in still water.
12. Ellah has exactly P200 in P5 coins and P10 bills. He has twice as many P10 as P5. How many of each does he have? (Petilos, 2002)
13. Deewye runs a motorcycle store. He sells a motorcycle for P 58,000.00. To determine his selling price, he added P 2,000.00 to the cost of the motorcycle for a compartment on the back. Then he added 15% of the total for his own markup. Lastly, he added P1,500.00 for sales tax. How much did the motorcycle cost Deewye?
14. (Aufman, et. al., n.d.) The four children in the Rivera family are Reynaldo, Ramiro, Shakira and Sasha. The ages of the two teenagers are 13 and 15. The ages of the younger children are 5 and 7. From the following clues, determine the age of each of the children.
    a. Reynaldo is older than Ramiro.
    b. Sasha is younger than Shakira.
    c. Sasha is 2 years older than Ramiro.
    d. Shakira is older than Reynaldo.
15. A particular Toy Store sells only cars and bicycles. On a particular day, it sold 12 items, with a total of 32 wheels. How many cars and how many bicycles were sold that day? (Petilos, 2002).
16. Terry is a sales representative for a cosmetic company. She is is paid P275.00 per hour each week plus a commission of 10% of the amount of sales over P250,000.00. She works 40 hours one week, and she sells P360,000.00 worth of cosmetics during that week. She has been offered a job for another cosmetic company that pays P250.00 per hour for a 40-hour week plus a commission of 4% of total sales. Which job would pay more? Should she change jobs?
17. An airplane flying with the wind can cover a certain distance in 1.5 hours. The return trip (against the wind) takes 2 hours. How fast is the plane and what is the speed of the air, if the one-way distance is 500 miles?
18. P 10,000.00 is divided between two accounts, one paying 4% interest and the other paying 5% interest. At the end of one interest period, the interest earned by the 4% account exceeds the interest earned by the 5% by P500.00. How much was invested in each account?

19. *Seven times a 2-digit number is equal to 4 times the number obtained by reversing the digits. The difference between the digits is 1. Find the number.*

20 *The area of a rectangle gets reduced by 10 square units if its length is reduced by 4 units and width is increased by 2 units. If we increase the length by 3 units and width by 4 units respectively, the area is increased by 96 square units. Find the length and width of the rectangle.*

COPING STRATEGY QUESTIONNAIRE

Below is a questionnaire that requests for your honest responses based from the problem solving test you just had and your past encounters with problem solving.

1. From the 4 phases of problem solving and their characteristics described above, what phase/s do you usually find difficulty? Please rank them according to the degree of how you experience the difficulty.

   ☐ Understanding the problem

   ☐ Devising a plan/strategy

   ☐ Carrying out the plan

   ☐ Looking back

2. Why were or are you hard up in the said phase/s? Can you share the reasons why?

UNDERSTANDING THE PROBLEM

_____

_____

DEVISING A PLAN/STRATEGY

_____

_____

CARRYING OUT THE PLAN

LOOKING BACK

1. How did you overcome or how do you plan to overcome this/these difficulty/ies? Please enumerate strategies of overcoming them according to the 4 phases

UNDERSTANDING THE PROBLEM

Ex. Look/ed for textbooks to familiarize oneself in the language terminologies.

CARRYING OUT THE PLAN

Ex Talk/ed to someone who could explain the processes in the solution.

DEVISING A PLAN/STRATEGY

Ex. Search/ed for related problems and the strategy/ies applied in attacking the problems.

LOOKING BACK

Ex. Promise/d that things would be different next time.

APPENDIX I

SUMMARY OF PROBLEM SOLVING DIFFICULTIES OF RESPONDENTS (MODEL DEVELOPMENT)

NO.	COURSE AND RESPONDENT NO.	SEX	UNDERSTANDING THE PROBLEM	DEVISING A PLAN			CARRYING OUT THE PLAN			LOOKING BACK				IDENTIFIED DIFFICULTY
				INCORRECT WORKING EQUATION	NO WORKING EQUATION	TOTAL	INCORRECT /INCOMPLETE COMPUTATION	NO COMPUTATION	TOTAL	ABLE TO CHECK BUT WITH INCORRECT COMPUTATION	NO CHECKING OF SOLUTION	WASN'T ABLE TO CHECK	TOTAL	
1	BS-ABE-A2	0	9	4	5	9	3	4	7	1	8	0	9	UP, DP, LB
2	BS-ABE-A3	1	0	4	1	5	2	1	3	4	1	0	5	DP, LB
3	BS-ABE-A5	1	2	2	5	7	4	1	5	1	6	0	7	DP, LB
4	BS-ABE-A7	0	5	2	4	6	3	2	5	1	5	0	6	DP, LB
5	BS-ABE-A8	0	0	3	0	3	2	0	2	0	3	0	3	DP, LB
6	BS-ABE-A9	1	0	5	1	6	3	1	4	2	4	0	6	DP, LB
7	BS-ABE-A10	1	2	8	0	8	7	0	7	6	2	1	9	LB
8	BS-ABE-A12	1	1	3	1	4	2	1	3	1	2	1	4	DP, LB
9	BS-ABE-A14	1	0	2	3	5	3	2	5	3	3	0	6	LB
10	BS-ABE-A15	0	0	4	2	6	4	1	5	2	4	0	6	DP, LB
11	BS-ABE-A19	0	2	1	4	5	1	3	4	1	6	0	7	LB
12	BS-ABE-A20	0	5	4	1	5	3	1	4	3	1	0	4	UP, DP
13	BS ABE-A21	1	0	3	1	4	2	1	3	1	3	0	4	DP, LB
14	BS-ABE-A22	1	1	3	4	7	2	3	5	1	6	0	7	DP, LB
15	BS-ABE-A23	0	0	1	2	3	1	1	2	1	2	0	3	DP, LB
16	BS-ABE-A24	1	1	4	4	8	3	4	7	1	7	0	8	DP, LB
17	BS-ABE-A25	0	5	4	2	6	3	2	5		7	0	7	LB
18	BS-ABE-A26	0	0	0	2	2	0	1	1	0	2	0	2	DP, LB
19	BS ABE-A27	0	1	3	3	6	3	2	5	1	6	0	7	LB
20	BS-ABE-A28	0	6	2	3	5	1	4	5	0	6	0	6	UP, LB
21	BS-ABE-A29	0	2	3	4	7	1	4	5	1	4	0	5	DP
22	BS-ABE-A30	1	2	5	1	6	4	1	5	4	3	0	7	LB
23	BS-ABE A31	1	2	3	2	5	2	1	3	1	4	0	5	DP, LB
24	BS-ABE-A32	0	2	5	2	7	3	2	5		5	0	5	DP
25	BS-ABE-A33	0	5	3	3	6	2	2	4		6	1	7	LB
26	BS-ABE-B1	1	1	6	6	12	6	6	12	6	5	0	11	DP, CP
27	BS-ABE-B2	0	2	3	3	6	4	1	5	1	4	1	6	DP, LB
28	BS-ABE-B4	1	2	6	2	8	5	2	7	2	6	0	8	DP, LB
29	BS-ABE-B7	0	0	3	3	6	3	3	6	1	5	0	6	DP, CP, LB
30	BS-ABE-B8	1	1	1	6	7	1	6	7	0	7	1	8	LB
31	BS-ABE-B9	1	0	4	1	5	3	2	5	1	5	1	7	LB
32	BS-ABE-B10	1	0	4	3	7	4	3	7	2	4	0	6	DP, CP
33	BS-ABE-B12	1	0	3	5	8	3	5	8	1	7	0	8	DP, CP, LB
34	BS-ABE-B14	1	1	2	6	8	2	6	8	2	7	1	10	LB
35	BS ABE-B15	1	1	2	14	16	2	13	15	1	12	0	13	DP
36	BS-ABE-B16	1	3	0	13	13	0	12	12	0	12	0	12	DP
37	BS-ABE-B17	1	1	3	16	19	2	17	19	2	19	0	21	DP, CP
38	BS-ABE-B18	1	1	4	4	8	4	3	7	2	5	1	8	DP, LB
39	BS-ABE-B19	1	0	2	2	4	2	2	4	2	2	0	4	DP, CP, LB
40	BS-ABE-B21	1	3	6	8	12	6	6	12	3	8	1	12	DP, CP, LB
41	BS-ABE-B22	0	1	6	3	9	7	2	9	5	4	0	9	DP, CP, LB
42	BS-ABE-B24	1	2	1	5	6	1	5	6	2	5	0	7	LB
43	BS-ABE-B25	1	1	4	11	15	5	12	17	3	14	0	17	CP, LB

44	BS-ABE-E27	1	0	6	1	7	6	2	8	5	3	0	8	CP, LB
45	BS-ABE-B29	0	3	4	0	4	4	2	6	1	3	0	4	CP
46	BS-ABE-B31	0	5	2	1	3	2	0	2	1	0	2	3	UP
47	BS-ABE-B32	0	1	2	7	9	2	8	10	1	9	1	11	CP
48	BS-ABE-B35	0	0	4	0	4	4	0	4	2	2	0	4	DP, CP, LB
49	BS-ABE-B36	0	0	2	5	7	1	4	5	1	5	1	7	DP, LB
50	BS-ABE-B37	1	0	3	2	5	3	2	5	1	3	0	4	DP, CP
51	BS-COMM-3	0	2	4	1	5	5	0	5	0	5	3	8	LB
52	BS-COMM-5	1	3	6	2	8	4	3	7	3	4		7	CP, LB
53	BS-COMM-6	1	0	4	5	9	4	5	9	3	5		8	DP, CP
54	BS-COMM-7	1	4	3	14	17	3	14	17	2	14		16	DP, CP
55	BS-COMM-9	1	0	1	1	2	1	1	2	1	1		2	DP, CP,LB
56	BS-COMM-10	1	0	0	10	10	0	10	10	0	9		9	DP, CP
57	BS-COMM-11	1	1	1	11	12		11	11	1	10		11	DP
58	BS-COMM-13	1	2	1	4	5	1	5	6	2	3	1	6	CP, LB
59	BS-COMM-14	1	1	3	10	13	1	11	12	1	10		11	DP
60	BS-COMM-15	1	0	1	5	6	1	5	6	1	4		5	DP, CP
61	BS-COMM-18	1	0	1	8	9	1	7	8	1	7		8	DP
62	BS-COMM-19	1	0	2	3	5	2	4	6	1	4		5	CP
63	BS-COMM-20	0	1	2	2	4	1	3	4	1	3		4	DP, CP, LB
64	BS-COMM-21	1	0	3	1	4	3	1	4	3	1	1	5	LB
65	BS-COMM-22	1	5	4	7	11	4	7	11	2	8		10	DP, CP
66	BS-COMM-23	1	0	3	0	3	3	0	3	3	0		3	DP, CP, LB
67	BS-COMM-24	1	0	6	3	9	6	4	10	4	4	4	12	LB
68	BS-COMM-25	0	3	4	5	9	4	4	8	4	3	3	10	LB
69	BS-COMM-26	1	0	4	2	6	4	3	7	4	2		6	CP
70	BS-COMM-27	1	0	5	0	5	5	0	5	5	0		5	DP, CP, LB
71	BS-COMM-28	0	5	5	0	5	5	0	5	4	0		4	DP, CP
72	BS-COMM-32	0	1	3	2	5	3	2	5	2	2		4	DP, CP
73	BSN-A1	1	8	8	0	8	8	0	8	2	6	2	10	LB
74	BSN-A2	1	9	7	1	8	8	0	8	1	7	3	11	LB
75	BSN-A3	1	2	7	2	9	7	1	8	3	5	4	12	LB
76	BSN-A4	1	3	4	1	5	5	0	5	1	3	2	6	LB
77	BSN-A5	1	4	7	1	8	7	0	7	1	6	3	10	LB
78	BSN-A6	0	9	5	4	9	6	1	7	1	5	2	8	UP, DP
79	BSN-A7	1	15	6	6	12	6	2	8	0	8	4	12	UP
80	BSN-A8	1	11	7	4	11	7	1	8	1	7	3	11	UP, DP, LB
81	BSN-A9	0	10	7	2	9	7	0	7	1	8	0	9	UP
82	BSN-A11	0	5	4	3	7	4	2	6	0	6	5	11	LB
83	BSN-A12	1	2	9	3	12	9	2	11	1	11	0	12	DP, LB
84	BSN-A13	1	1	5	0	5	6	0	6	1	5	0	6	CP, LB
85	BSN-A14	0	5	5	1	6	6	0	6	0	5	2	7	LB
86	BSN-A15	1	4	5	2	7	6	1	7	0	7	2	9	LB
87	BSN-A17	1	0	5	1	6	7	0	7	1	6	1	8	LB
88	BSN-A18	1	11	6	4	10	9	1	10	0	12	2	14	LB
89	BSN-A19	0	10	5	4	9	7	1	8	0	7	2	9	UP
90	BSN-A21	1	1	5	1	6	7	0	7	1	5	3	9	LB
91	BSN-A22	0	7	6	0	6	6	0	6	2	4	6	12	LB
92	BSN-A23	1	0	6	1	7	5	0	5	1	5	1	7	DP, LB
93	BSN-A24	1	8	10	2	12	9	1	10	1	11	1	13	LB
94	BSN-A25	1	5	11	3	14	7	0	7	0	9	1	10	DP
95	BSN-A26	1	4	9	5	14	7	2	9	0	10	3	13	DP

96	BSN-A28	1	5	7	1	8	5	1	6	2	5	3	10	LB
97	BSN-B1	1	5	2	7	9	2	5	7	0	7	0	7	DP
98	BSN-B2	0	4	2	2	4	2	2	4	1	3	1	5	LB
99	BSN-B4	1	0	1	6	7	1	6	7	0	7	0	7	DP, CP, LB
100	BSN-B5	1	1	1	0	1	1	0	1	1	0	1	2	LB
101	BSN-B6	1	3	4	1	5	3	2	5	1	4	0	5	DP, CP, LB
102	BSN-B7	1	7	5	2	7	4	3	7	0	7	0	7	UP, DP, CP, LB
103	BSN-B9	1	0	3	0	3	3	0	3	1	2	0	3	DP, CP, LB
104	BSN-B10	1	0	2	0	2	1	1	2	1	1	0	2	DP, CP, LB
105	BSN-B11	1	0	2	0	2	1	1	2	1	1	0	2	DP, CP, LB
106	BSN-B12	1	0	0	14	14	0	15	15	0	15	0	15	CP, LB
107	BSN-B13	0	3	2	5	7	3	4	7	1	6	0	7	DP, CP, LB
108	BSN-B14	1	2	2	5	7	3	4	7	1	7	0	8	LB
109	BSN-B15	1	6	1	5	6	2	4	6	0	6	0	6	UP, DP, CP, LB
110	BSN-B16	1	2	2	2	4	1	3	4	1	3	1	5	LB
111	BSN-B17	1	0	1	2	3	1	2	3	1	2	0	3	DP, CP, LB
112	BSN-B19	1	0	3	2	5	3	2	5	1	5	0	6	LB
113	BSN-B20	1	0	4	2	6	3	3	6	1	5	0	6	DP, CP, LB
114	BSN-B21	1	0	1	4	5	1	4	5	1	4	0	5	DP, CP, LB
115	BSN-B22	1	7	0	8	8	3	5	8	0	8	0	8	UP, DP, CP, LB
116	BSN-B23	0	7	0	7	7	1	7	8	0	6	0	6	CP
117	BSN-B24	0	1	0	0	0	0	0	0	0	0	1	1	UP, LB
118	BSN-B25	1	0	1	0	1	1	0	1	1	0	1	2	LB
119	BSN-B26	1	4	1	3	4	3	1	4	0	4	0	4	UP, DP, CP, LB
120	BSN-B27	1	1	2	3	5	3	2	5	1	4	0	5	DP, CP, LB
121	BSN-B28	0	0	1	0	1	1	0	1	0	0	0	0	DP, CP
122	BSN-B29	1	4	0	4	4	2	1	3	0	3	0	3	UP, DP
123	BSN-B30	1	0	4	4	8	2	5	7	0	8	0	8	DP, LB
124	BSN-B32	1	0	3	1	4	4	0	4	0	4	1	5	LB
125	BSN-B33	1	3	2	2	4	2	2	4	2	3	0	5	LB
126	BSN-B35	1	3	3	1	4	3	1	4	1	3	0	4	DP, CP, LB
127	BS-CE-A1	0	17	3	10	13	3	10	13	2	10	1	13	UP
128	BS-CE-A2	0	10	6	4	10	6	3	9	5	4	2	11	LB
129	BS-CE-A3	0	9	4	4	8	5	6	11	3	8	0	11	CP, LB
130	BS-CE-A4	1	0	8	3	11	9	3	12	3	9	1	13	LB
131	BS-CE-A5	1	7	7	2	9	7	2	9	2	7	1	10	LB
132	BS-CE-A6	1	2	3	4	7	4	4	8	1	7	1	9	LB
133	BS-CE-A9	1	3	2	4	6	1	5	6	1	5	1	7	LB
134	BS-CE-A10	0	1	4	6	10	4	5	9	2	7	3	12	LB
135	BS-CE-A12	1	4	3	5	8	2	6	8	1	7	2	10	LB
136	BS-CE-A15	1	4	2	2	4	2	2	4	1	3	1	5	LB
137	BS-CE-A16	0	1	5	3	8	5	2	7	2	5	1	8	DP, LB
138	BS-CE-A17	0	3	3	4	7	3	2	5	3	4	1	8	LB
139	BS-CE-A18	1	3	3	2	5	3	2	5	2	3	1	6	LB
140	BS-CE-A19	1	0	3	0	3	4	0	4	1	3	0	4	CP, LB
141	BS-CE-A20	0	10	11	1	12	12	0	12	2	0	0	2	DP, CP
142	BS-CE-A21	0	3	5	3	8	6	3	9	3	6	2	11	LB
143	BS-CE-A23	0	4	3	1	4	2	1	3	3	1	3	7	LB
144	BS-CE-A26	1	2	1	0	1	1	0	1	2	0	1	3	LB
145	BS-CE-A28	0	6	5	2	7	5	1	6	2	4	3	9	LB
146	BS-CE-A30	0	1	2	4	6	3	4	7	2	5	0	7	CP, LB
147	BS-CE-A31	0	9	4	6	10	5	3	8	2	6	2	10	DP, LB

148	BS-CE-A32	0	3	8	0	8	7	1	8	1	7	1	9	LB
149	BS-CE-B3	0	1	2	7	9	2	7	9	1	8	0	9	DP, CP, LB
150	BS-CE-B5	0	1	2	2	4	1	3	4	1	3	0	4	DP, CP, LB
151	BS-CE-B7	1	1	0	2	2	0	2	2	0	2	0	2	DP, CP, LB
152	BS-CE-B9	0	0	5	3	8	4	4	8	1	7	1	9	LB
153	BS-CE-B11	0	0	0	1	1	0	1	1	0	2	0	2	LB
154	BS-CE-B12	1	0	2	3	5	3	3	6	1	5	0	6	CP, LB
155	BS-CE-313	0	0	2	0	2	1	0	1	2	0	0	2	DP, LB
156	BS-CE-B14	0	0	1	1	2	2	1	3	0	1	0	1	CP
157	BS-CE-B15	0	5	7	0	7	8	0	8	4	3	0	7	CP
158	BS-CE-B17	0	0	3	1	4	3	1	4	2	2	1	5	LB
159	BS-CE-B18	1	1	2	2	4	2	2	4	2	3	0	5	LB
160	BS-CE-B19	0	0	1	3	4	0	4	4	0	4	1	5	LB
161	BS-CE-B21	1	0	4	3	7	4	3	7	2	5	1	8	LB
162	BS-CE-B22	0	0	1	6	7	1	6	7	1	6	0	7	DP, CP, LB
163	BS-CE-B23	1	0	0	5	5	0	4	4	0	5	0	5	DP, LB
164	BS-CE-B24	0	1	2	3	5	2	3	5	0	6	0	6	LB
165	BS-CE-B25	0	3	5	3	8	5	3	8	4	4	1	9	LB
166	BS-CE-B26	0	1	5	0	5	5	0	5	1	4	1	6	LB
167	BS-CE-B27	1	1	6	0	6	6	0	6	4	0	2	6	DP, CP, LB
168	BS-CE-B28	1	0	3	3	6	2	4	6	2	5	0	7	LB
169	BS-CE-B29	0	1	4	0	4	4	0	4	2	2	0	4	DP, CP, LB
170	BS-CE-B30	0	0	4	1	5	4	1	5	1	2	1	4	DP, CP
171	BS-CE-B31	1	0	2	1	3	2	1	3	0	3	0	3	DP, CP, LB
172	BS-CE-B32	1	1	4	2	6	3	5	8	3	4	0	7	CP
173	BS-CE-B33	0	0	5	1	6	4	3	7	4	2	1	7	CP, LB
174	BS-CE-B34	0	0	2	3	5	2	2	4	1	3	0	4	DP
175	BS-CE-B35	0	0	5	5	10	4	5	9	3	6	0	9	DP
176	BS-CE-B36	1	0	4	4	8	4	4	8	1	7	0	8	DP, CP, LB
177	BS-CE-B37	0	3	0	1	1	0	1	1	0	1	1	2	LB
178	BS-CE-B38	0	0	1	0	1	0	1	1	0	1	0	1	DP, CP, LB
179	BS-CE-C1	1	1	4	2	6	3	3	6	1	6	3	10	LB
180	BS-CE-C2	0	5	5	1	6	4	3	7	0	9	1	10	LB
181	BS-CE-C4	1	0	4	2	6	5	3	8	1	7	0	8	CP, LB
182	BS-CE-C6	1	1	5	1	6	5	1	6	2	3	2	7	LB
183	BS-CE-C7	0	0	1	1	2	3	1	4	0	4	1	5	LB
184	BS-CE-C8	0	8	9	0	9	10	0	10	1	9	0	10	CP, LB
185	BS-CE-C9	0	4	2	1	3	1	2	3	0	5	0	5	LB
186	BS-CE-C10	0	1	3	0	3	3	1	4	0	4	4	8	LB
187	BS-CE-C12	0	5	5	1	6	5	1	6	0	5	2	7	LB
188	BS-CE-C13	0	7	5	2	7	4	4	8	0	8	0	8	CP, LB
189	BS-CE-C15	1	0	2	1	3	2	0	2	0	3	0	3	DP, LB
190	BS-CE-C17	1	0	2	1	3	0	2	2	0	2	1	3	DP, LB
191	BS-CE-C18	0	10	3	9	12	3	12	15	0	12	0	12	CP
192	BS-CE-C19	1	1	4	0	4	2	2	4	0	4	0	4	DP, CP, LB
193	BS-CE-C20	0	5	3	3	6	2	4	6	0	6	0	6	DP, CP, LB
194	BS-CE-C21	1	1	5	3	8	5	3	8	2	6	0	8	DP, CP, LB
195	BS-CE-C22	1	0	2	0	2	2	0	2	1	1	0	2	DP, CP, LB
196	BS-CE-C23	0	3	5	1	6	5	1	6	0	6	1	7	LB
197	BS-CE-C24	0	5	4	1	5	5	1	6	0	6	1	7	LB
198	BS-CE-C25	1	0	2	1	3	2	1	3	2	1	0	3	DP, CP, LB
199	BS-CE-C27	1	4	3	2	5	2	3	5	1	4	1	6	LB

200	BS-CE-C29	1	1	3	0	3	3	0	3	2	1	0	3	DP, CP, LB
201	BS-CE-C30	1	0	3	4	7	3	4	7	3	4	0	7	DP, CP, LB
202	BS-CE-C31	1	1	2	2	4	2	2	4	1	1	1	3	DP, CP
203	BS-CE-C33	0	2	4	0	4	3	1	4	1	3	0	4	DP, CP, LB
204	BS-CE-C35	0	7	1	0	1	1	0	1	0	0	5	5	LB
205	BS-CE-C36	0	4	3	1	4	3	1	4	0	4	1	5	LB
206	BS-CHEM1	0	2	0	2	2	0	2	2	0	2	0	2	UP, DP, CP, LB
207	BS-CHEM3	1	0	1	2	3	1	2	3	1	2	0	3	DP, CP, LB
208	BS-CHEM6	0	6	4	2	6	4	2	6	0	6	2	8	LB
209	BS-CHEM7	1	0	1	0	1	1	0	1	0	1	0	1	DP, CP, LB
210	BS-CHEM8	0	2	2	2	4	2	2	4	0	4	0	4	DP, CP, LB
211	BS-CHEM10	1	2	4	0	4	4	0	4	3	1	0	4	DP, CP, LB
212	BS-CHEM11	0	3	0	2	2	0	1	1	0	0	0	0	UP
213	BS-CHEM12	0	1	1	0	1	2	0	2	0	3	7	10	LB
214	BS-CHEM13	1	1	1	0	1	1	0	1	1	0	0	1	UP, DP, CP, LB
215	BS-CHEM14	1	1	2	0	2	2	0	2	1	1	0	2	DP, CP, LB
216	BS-CHEM17	0	2	1	1	2	1	1	2	1	1	1	3	LB
217	BS-CHEM18	1	0	0	1	1	0	1	1	0	1	0	1	DP, CP, LB
218	BS-CHEM19	1	0	0	0	0	0	0	0	0	0	0	0	
219	BS-CHEM21	0	0	1	0	1	1	0	1	1	0	0	1	DP, CP, LB
220	BS-CHEM22	0	0	1	0	1	1	0	1	1	0	0	1	DP, CP, LB
221	BS-SOCIO-1	0	2	11	2	13	9	1	10	0	11	1	12	DP
222	BS-SOCIO-3	1	6	9	0	9	10	0	10	6	3	1	10	CP, LB
223	BS-SOCIO-4	1	5	9	0	9	9	1	10	1	8	0	9	CP
224	BS-SOCIO-5	1	1	2	3	5	3	3	6	2	3	0	5	CP
225	BS-SOCIO-6	0	0	18	0	18	18	0	18	8	13	1	22	LB
226	BS-SOCIO-8	1	1	3	4	10	5	3	8	1	7	0	8	DP
227	BS-SOCIO-9	1	13	11	5	16	9	6	15	7	6	2	15	DP
228	BS-SOCIO-11	1	1	6	5	11	7	5	12	1	9	2	12	CP, LB
229	BS-SOCIO-12	1	11	4	8	12	4	6	10	1	10	1	12	DP, LB
230	BS-SOCIO-16	1	3	3	2	5	5	3	8	0	9	0	9	LB
231	BS-SOCIO-18	1	3	7	6	13	6	6	12	0	12	0	12	DP
232	BS-SOCIO-19	1	0	0	13	13	0	11	11	2	6	1	9	DP
233	BS-SOCIO-20	1	0	5	2	7	7	1	8	2	6	1	9	LB
234	BS-SOCIO-22	1	0	5	3	8	4	4	8	1	5	0	6	DP, CP
235	BS-SOCIO-23	1	4	3	4	7	3	4	7	5	6	0	11	LB
236	BS-SOCIO-24	1	3	10	2	12	10	1	11	1	13	1	15	LB
237	BS-SOCIO-25	1	2	7	9	16	7	7	14		10	1	11	DP
238	BS-SOCIO-26	0	1	9	5	14	7	4	11	1	7	1	9	DP
239	BS-SOCIO-28	1	1	6	2	8	4	3	7	1	4	0	5	DP
240	BS-SOCIO-29	1	4	4	2	6	3	2	5	1	18	0	19	LB
241	BS-SOCIO-30	1	14	1	19	20	2	15	17		13	2	15	DP
242	BS-SOCIO-31	0	1	3	11	14	2	9	11			0	0	DP
243	BS-MATH-2	0	0	0	0	0	1	1	2	0	1	1	2	CP, LB
244	BS-MATH-3	1	1	0	1	1	0	1	1	0	1	0	1	UP, DP, CP, LB
245	BS-MATH-5	1	0	0	2	2	1	3	4	0	3	2	5	LB
246	BS-MATH-6	1	0	0	2	2	0	1	1	0	1	1	2	DP, LB
247	BS-MATH-8	1	1	0	2	2	2	2	4	0	4	0	4	CP, LB
248	BS-MATH-9	0	0	2	1	3	0	1	1	0	3	0	3	DP, LB
249	BS-MATH-10	1	2	0	4	4	0	4	4	0	4	1	5	LB
250	BS-MATH-11	1	0	0	2	2	0	2	2	0	2	1	3	LB
251	BS-MATH-12	1	1	1	4	5	1	4	5	0	5	0	5	DP, CP, LB

252	BS-MATH-13	1	1	6	0	6	6	0	6	2	2	1	5	DP, CP
253	BS-MATH-14	1	2	1	0	1	1	2	3	1	2	1	4	LB
254	BS-MATH-15	1	0	2	2	4	2	2	4	2	2	1	5	LB
255	BS-MATH-16	1	0	1	2	3	1	2	3	1	2	0	3	DP, CP, LB
256	BS-MATH-17	0	1	0	3	3	0	3	3	0	3	0	3	DP, CP, LB
257	BS MATH-20	1	1	3	1	4	3	1	4	0	4	0	4	DP, CP, LB
258	BS-MATH-23	1	1	2	1	3	0	3	3	0	3	0	3	DP, CP, LB
259	BS-MATH-24	1	3	2	3	5	1	4	5	1	4	0	5	DP, CP, LB
260	BS-MATH-25	1	0	2	0	2	1	1	2	1	1	1	3	LB
261	BS ECON-2	1	3	1	2	3	3	0	3	1	2	1	4	LB
262	BS-ECON3	0	10	4	3	7	5	1	6	0	6	5	11	LB
263	BS-ECON4	1	2	3	1	4	3	1	4	2	2	2	6	LB
264	BS-ECON5	1	5	1	1	2	2	0	2	2	1	0	3	UP
265	BS-ECON6	1	3	2	3	5	6	0	6	1	5	0	6	CP, LB
266	BS-ECON7	1	3	4	1	5	4	0	4	3	1	3	7	LB
267	BS ECON8	1	3	5	1	6	4	2	6	0	6	3	9	LB
268	BS-ECON9	1	3	2	3	5	4	1	5	0	5	1	6	LB
269	BS-ECON10	1	0	2	4	6	3	3	6	0	6	0	6	DP, CP, LB
270	BS-ECON12	1	0	6	0	6	6	0	6	4	2	0	6	DP, CP, LB
271	BS-ECON13	1	0	4	0	4	3	1	4	3	1	0	4	DP, CP, LB
272	BS-ECON17	1	1	4	2	6	2	4	6	0	6	0	6	DP, CP, LB
273	BS-ECON19	1	2	1	3	4	0	4	4	0	4	0	4	DP, CP, LB
274	BS-ECON20	1	1	1	3	4	0	4	4	0	4	0	4	DP, CP, LB
275	BS-ECON23	1	4	1	3	4	0	4	4	0	4	1	5	LB
276	BS-ECON21	0	3	2	0	2	1	1	2	2	0	0	2	UP
277	BS-ECON25	0	2	2	2	4	2	2	4	2	2	1	5	LB
278	BS-ECON26	0	1	2	2	4	2	2	4	2	2	1	5	LB
279	BS-ECON28	0	0	2	1	3	2	1	3	2	0	0	2	DP, CP
280	BS-ECON29	0	0	0	2	2	0	2	2	0	2	0	2	DP, CP, LB
281	BS-ECON30	1	0	0	0	0	0	0	0	1	0	1	2	LB
282	BS-ECON31	0	1	3	0	3	3	0	3	2	1	1	4	LB
283	BS-ECON33	1	4	1	6	7	1	6	7	0	7	0	7	DP, CP, LB
284	BS-ECON34	0	0	2	1	3	2	1	3	3	0	0	3	DP, CP, LB
285	BS-ECON35	0	1	0	2	2	0	2	2	0	2	1	3	LB
286	BS-METEO-1	0	4	6	2	8	4	2	6	3	5	2	10	LB
287	BS-METEO-2	1	2	3	0	3	1	0	1	1	2	0	3	DP, LB
288	BS-METEO-6	0	0	2	0	2	2	0	2	0	2	1	3	LB
289	BS-METEO-7	0	7	6	0	6	5	0	5	0	5	1	6	UP
290	BS-METEO-8	0	4	5	6	11	2	8	10	0	9	1	10	DP
291	BS-METEO-9	0	2	8	0	8	5	1	6	5	2	0	7	DP
292	BS-METEO-10	1	2	6	1	7	4	1	5	4	2	0	6	DP
293	BS-METEO-11	1	2	5	3	8	3	2	5	1	5	1	7	DP
294	BS-METEO-13	0	1	1	1	2	0	3	3	0	2	2	4	LB
295	BS-METEO-14	0	8	3	3	6	2	3	5	1	3	3	7	UP
296	BS-METEO-15	1	3	2	3	5	2	3	5	0	5	2	7	LB
297	BS-METEO-16	1	3	5	2	7	5	1	6	2	4	3	9	LB

APPENDIX J
SUMMARY OF COPING STRATEGIES OF RESPONDENTS (MODEL DEVELOPMENT)

NO	COURSE	SEX	IDENTIFIED DIFFICULTY	COPING STRATEGIES			
				UNDERSTANDING THE PROBLEM (UP)	DEVISING THE PLAN (DP)	CARRYING OUT THE PLAN (CP)	LOOKING BACK (LB)
1	BS-COMM-3	0	LB	UP2		CP3	LB2
2	BS-COMM-20	0	DP, CP, LB		DP3	CP6	LB7
3	BS-COMM-25	0	LB	UP5		CP3	LB3
4	BS-COMM-28	0	DP, CP	UP1	DP4		LB3
5	BS-COMM-32	0	DP, CP	UP2	DP8	CP9	LB1
6	BS-ABE-A2	0	UP, DP, LB	UP7		CP7	
7	BS-ABE-A7	0	DP, LB	UP2	DP3		LB3
8	BS-ABE-A8	0	DP, LB	UP2	DP7	CP7	LB3
9	BS-ABE-A15	0	DP, LB	UP2	DP5	CP1	LB1
10	BS-ABE-A19	0	LB	UP2	DP9		LB6
11	BS-ABE-A20	0	UP, DP	UP8	DP3	CP7	LB5
12	BS-ABE-A23	0	DP, LB	UP2	DP8	CP6	LB1
13	BS-ABE-A25	0	LB	UP3	DP8	CP3	LB9
14	BS-ABE-A26	0	DP, LB	UP5	DP8	CP7	
15	BS-ABE-A27	0	LB	UP7	DP7	CP2	LB7
16	BS-ABE-A28	0	UP, LB	UP6	DP4	CP7	
17	BS-ABE-A29	0	DP				
18	BS-ABE-A32	0	DP	UP8	DP7	CP3	LB9
19	BS-ABE-A33	0	LB		DP8		
20	BS-ABE-B2	0	DP, LB	UP2	DP7	CP7	LB1
21	BS-ABE-B7	0	DP, CP, LB	UP2	DP2	CP7	LB1
22	BS-ABE-B22	0	DP, CP, LB				
23	BS-ABE-B29	0	CP	UP2	DP4	CP7	LB3
24	BS-ABE-B31	0	UP	UP2	DP7	CP7	LB1
25	BS-ABE-B32	0	CP	UP2	DP3	CP4	LB3
26	BS-ABE-B35	0	DP, CP, LB	UP5	DP5	CP7	LB2
27	BS-ABE-B36	0	DP, LB		DP3		LB5
28	BS-CE-A1	0	UP	UP3	DP1	CP7	LB1
29	BS-CE-A2	0	LB				
30	BS-CE-A3	0	CP, LB	UP4	DP1	CP8	LB2
31	BS-CE-A9	0	LB	UP5	DP6	CP1	LB9
32	BS-CE-A10	0	LB	UP4	DP4	CP3	LB9
33	BS-CE-A16	0	DP, LB	UP2	DP6	CP8	LB1
34	BS-CE-A17	0	LB	UP2	DP4	CP4	LB6
35	BS-CE-A20	0	DP, CP	UP2	DP5	CP1	LB1
36	BS-CE-A21	0	LB	UP9	DP3	CP7	LB3
37	BS-CE-A23	0	LB	UP3	DP7	CP1	LB2
38	BS-CE-A28	0	LB	UP8	DP3	CP4	LB1
39	BS-CE-A30	0	CP, LB	UP4	DP8	CP7	LB7
40	BS-CE-A31	0	DP, LB	UP8	DP2	CP8	LB1
41	BS-CE-A32	0	LB	UP5	DP5	CP1	LB1

42	BS-CE-B3	0	DP, CP, LB	UP8			
43	BS-CE-B5	0	DP, CP, LB		DP8	CP8	
44	BS-CE-B9	0	LB	UP3	DP8	CP8	LB1
45	BS-CE-B11	0	LB	UP2	DP4	CP7	LB3
46	BS-CE-B13	0	DP, LB	UP2	DP5		
47	BS-CE-B14	0	CP	UP2			
48	BS-CE-B15	0	CP	UP2	DP1	CP4	LB1
49	BS-CE-B17	0	LB	UP2	DP4	CP6	LB1
50	BS-CE-B19	0	LB	UP2	DP3	CP7	LB3
51	BS-CE-B22	0	DP, CP, LB	UP3	DP3	CP7	LB3
52	BS-CE-B24	0	LB	UP2			
53	BS-CE-B25	0	LB	UP3	DP2	CP8	LB4
54	BS-CE-B26	0	LB	UP2	DP4	CP4	LB3
55	BS-CE-B29	0	DP, CP, LB	UP2	DP3	CP1	LB1
56	BS-CE-B30	0	DP, CP	UP2	DP6		
57	BS-CE-B33	0	CP, LB	UP8		CP7	LB3
58	BS-CE-B34	0	DP	UP9	DP5	CP7	LB2
59	BS-CE-B35	0	DP	UP4			
60	BS-CE-B37	0	LB	UP5	DP4	CP1	LB3
61	BS-CE-B38	0	DP, CP, LB				
62	BS-CE-C2	0	LB	UP8	DP3	CP11	LB3
63	BS-CE-C7	0	LB	UP8			
64	BS-CE-C8	0	CP, LB	UP7	DP3	CP11	LB3
65	BS-CE-C9	0	LB	UP3	DP8	CP7	LB3
66	BS-CE-C10	0	LB	UP8	DP8	CP1	LB5
67	BS-CE-C12	0	LB	UP3		CP7	LB3
68	BS-CE-C13	0	CP, LB	UP4	DP8	CP7	LB3
69	BS-CE-C18	0	CP				
70	BS-CE-C20	0	DP, CP, LB	UP4	DP8	CP8	LB1
71	BS-CE-C23	0	LB	UP8	DP7	CP3	LB9
72	BS-CE-C24	0	LB	UP2		CP7	
73	BS-CE-C33	0	DP, CP, LB		DP2		LB3
74	BS-CE-C35	0	LB	UP8	DP8	CP8	LB1
75	BS-CE-C36	0	LB	UP8	DP8	CP3	LB9
76	BS-CHEM1	0	UP, DP, CP, LB	UP2	DP5	CP2	LB1
77	BS-CHEM6	0	LB	UP4	DP8	CP3	LB8
78	BS-CHEM8	0	DP, CP, LB	UP12	DP5	CP7	LB3
79	BS-CHEM11	0	UP	UP8	DP8	CP6	LB9
80	BS-CHEM12	0	LB	UP2	DP4	CP1	LB9
81	BS-CHEM17	0	LB	UP2	DP4	CP9	LB9
82	BS-CHEM21	0	DP, CP, LB	UP1	DP8	CP7	LB1
83	BS-CHEM22	0	DP, CP, LB	UP5	DP5	CP10	LB1
84	BS-ECON3	0	LB				
85	BS-ECON24	0	UP	UP5	DP8	CP8	
86	BS-ECON25	0	LB	UP2	DP5	CP6	LB7
87	BS-ECON26	0	LB	UP2	DP5	CP6	LB5

88	BS-ECON28	0	DP, CP	UP3	DP7		LB7
89	BS-ECON29	0	DP, CP, LB	UP8	DP8	CP7	LB8
90	BS-ECON31	0	LB	UP4	DP7		LB3
91	BS-ECON34	0	DP, CP, LB	UP5		CP6	
92	BS-ECON35	0	LB	UP4	DP4	CP7	LB9
93	BS-MATH-2	0	CP, LB	UP3	DP8	CP8	LB5
94	BS-MATH-9	0	DP, LB	UP3	DP3	CP4	LB2
95	BS-MATH-17	0	DP, CP, LB	UP6	DP8	CP2	LB3
96	BS-METEO-1	0	LB	UP8	DP2	CP1	LB7
97	BS-METEO-6	0	LB	UP2	DP4	CP3	LB5
98	BS-METEO-7	0	UP	UP8	DP7		
99	BS-METEO-8	0	DP				LB3
100	BS-METEO-9	0	DP	UP2	DP1	CP9	LB7
101	BS-METEO-13	0	LB	UP2		CP1	LB7
102	BS-METEO-14	0	UP		DP11	CP2	LB9
103	BSN-A6	0	UP, DP				
104	BSN-A9	0	UP	UP8	DP4	CP7	LB3
105	BSN-A11	0	LB	UP7	DP7	CP7	
106	BSN-A14	0	LB				
107	BSN-A19	0	UP	UP5	DP5	CP9	LB1
108	BSN-A22	0	LB	UP7	DP4	CP13	LB1
109	BSN-B2	0	LB	UP5	DP2	CP7	LB2
110	BSN-B13	0	DP, CP, LB				
111	BSN-B23	0	CP	UP2	DP1	CP7	LB3
112	BSN-B24	0	UP, LB	UP2	I believe that being a beauty eveen is not just	A year ago I earned the tittle of miss Internatio	To the next miss internatio nal, may prove to be the
113	BSN-B28	0	DP, CP		DP8		
114	BS-SOCIO-1	0	DP	UP2	DP2	CP7	LB5
115	BS-SOCIO-6	0	LB	UP8	DP1	CP7	LB3
116	BS-SOCIO-26	0	DP	UP11	DP4	CP2	LB9
117	BS-SOCIO-31	0	DP	UP2	DP9	CP7	LB3

APPENDIX K

SUMMARY OF COPING STRATEGIES OF RESPONDENTS
(MODEL VALIDATION)

	ACADEMIC PROGRAMS	SEX	IDENTIFIED DIFFICULTY	COPING STRATEGIES			
				UP	DP	CP	LB
1	BS-COMM-1	1	DP, CP, LB	NONE	NONE	NONE	NONE
2	BS-COMM-2	0	CP	UP5	DP8	CP7	LB4
3	BS-COMM-4	1	DP	UP2	DP1	CP2	LB1
4	BS-COMM-8	1	DP, CP, LB	UP2	DP6	CP5	LB2
5	BS-COMM-12	0	DP, CP				
6	BS-COMM-16	1	DP, CP	UP2	DP6		LB1
7	BS-COMM-17	1	DP, CP, LB	UP8	DP8	CP7	LB3
8	BS-COMM-29	1	DP, CP	UP9	DP7	CP1	LB3
9	BS-COMM-30	1	DP, CP				
10	BS-COMM-31	0	LB	UP8			LB1
11	BS-ABE-A1	1	DP, LB	UP2		CP7	
12	BS-ABE-A4	1	DP, LB	UP2	DP4	CP7	
13	BS-ABE-A6	1	DP, LB	UP5	DP6	CP2	LB9
14	BS-ABE-A11	0	DP, LB	UP7	DP8		
15	BS-ABE-A13	1	DP, LB	UP3	DP8	CP3	
16	BS-ABE-A16	1	DP, LB	UP7	DP3	CP9	LB3
17	BS-ABE-A17	1	DP, CP, LB	UP2	DP2	CP1	LB3
18	BS-ABE-A18	1	LB	UP8	DP8	CP7	LB8
19	BS-ABE-A34	0	LB	UP3	DP7	CP1	
20	BS-ABE-B3	1	UP				
21	BS-ABE-B5	1	DP, CP, LB	UP5	DP7		
22	BS-ABE-B6	0	DP, CP, LB	UP2	DP7	CP8	LB1
23	BS-ABE-B11	1	DP, CP, LB				
24	BS-ABE-B13	1	CP				
25	BS-ABE-B20	1	CP, LB	UP2	DP5	CP2	LB1
26	BS-ABE-B23	1	LB	UP5	DP6	CP6	LB1
27	BS-ABE-B26	1	DP, CP	UP2	DP8	CP4	LB9
28	BS-ABE-B28	0	DP, CP, LB	UP2	DP10	CP7	LB1
29	BS-ABE-B30	0	DP, CP, LB	UP2	DP4	CP7	
30	BS-ABE-B33	1	CP, LB				
31	BS-ABE-B34	0	DP	UP3	DP3	CP1	LB1
32	BS-CE-A7	0	LB	UP3	DP8	CP7	LB9
33	BS-CE-A8	0	LB				
34	BS-CE-A11	1	CP, LB	UP3	DP2	CP7	LB3
35	BS-CE-A13	1	CP, LB	UP3	DP3	CP7	LB1
36	BS-CE-A14	1	DP, CP, LB	UP2	DP2	CP8	LB1
37	BS-CE-A22	1	LB				
38	BS-CE-A24	0	LB				
39	BS-CE-A25	0	DP, LB	UP5			
40	BS-CE-A27	1	LB	UP8	DP2	CP7	LB9
41	BS-CE-A29	1	LB	UP2	DP2	CP7	LB2
42	BS-CE-A33	0	LB	UP2	DP4	CP2	LB1

43	BS-CE-A34	0	DP, CP, LB	UP2	DP6	CP2	LB1
44	BS-CE-A35	0	LB	UP8	DP8	CP2	LB9
45	BS-CE-A36	0	LB		DP3		
46	BS-CE-A37	0	LB	UP8	DP7	CP1	LB1
47	BS-CE-A38	0	DP	UP2	DP2	CP2	LB1
48	BS-CE-B1	0	LB	UP2	DP6	CP6	LB1
49	BS-CE-B2	0	LB	UP2	DP8	CP1	LB3
50	BS-CE-B4	1	LB	UP6	DP5	CP6	
51	BS-CE-B6	0	LB	UP3	DP8	CP7	LB3
52	BS-CE-B8	0	DP		DP7		
53	BS-CE-B10	0	LB	UP8	DP3	CP8	LB1
54	BS-CE-B16	1	CP	UP5	DP6	CP7	LB3
55	BS-CE-B20	0	DP	UP2	DP5	CP6	LB7
56	BS-CE-B39	1	DP, CP, LB				
57	BS-CE-C3	1	DP, CP	UP2	DP2		
58	BS-CE-C5	1	CP, LB	UP8	DP8		
59	BS-CE-C11	1	CP	UP8	DP7	CP7	
60	BS-CE-C14	1	CP, LB	UP8	DP8	CP7	LB1
61	BS-CE-C16	0	CP				
62	BS-CE-C26	1	DP, CP, LB				
63	BS-CE-C28	0	DP, CP, LB	UP3	DP7	CP7	LB9
64	BS-CE-C32	1	DP, CP, LB				
65	BS-CE-C34	0	LB	UP8	DP8	CP8	LB8
66	BS-CHEM-2	0	LB	UP3	DP2	CP9	LB11
67	BS-CHEM4	1	LB	UP5	DP5	CP6	LB8
68	BS-CHEM5	1	LB	UP2	DP8	CP7	LB8
69	BS-CHEM9	1	DP, CP, LB	UP2	DP8	CP9	LB1
70	BS-CHEM15	0	LB	UP1	DP1	CP7	LB1
71	BS-CHEM16	1	DP, CP, LB	UP8	DP3	CP8	LB9
72	BS-CHEM20	1		UP2	DP4		
73	BS-ECON1	1	DP, CP,	UP5	DP8		LB2
74	BS-ECON11	1	CP,	UP3	DP2	CP7	LB1
75	BS-ECON14	1	DP, CP,	UP2	DP2		LB3
76	BS-ECON15	1	LB	UP2	DP5	CP3	LB3
77	BS-ECON16	1	DP, CP,	UP8	DP8	CP7	LB5
78	BS-ECON18	1	DP	UP2	DP7	CP7	LB7
79	BS-ECON21	0	DP, CP,	UP5	DP2	CP1	LB2
80	BS-ECON22	1	DP, CP,	UP3	DP8	CP7	LB2
81	BS-ECON27	1	DP, CP,	UP2	DP8	CP7	LB1
82	BS-ECON32	1	DP, CP,	UP3	DP2	CP4	LB2
83	BS-ECON36	0	DP, CP,	UP8	DP8	CP1	LB3
84	BS-MATH-1	1	UP, DP, CP,	UP3	DP8	CP7	LB2
85	BS-MATH-4	1	DP	UP3	DP8	CP7	LB9
86	BS-MATH-7	1	LB	UP10	DP3	CP7	LB8
87	BS-MATH-16	1	DP, CP, LB	UP2	DP4	CP2	LB1

88	BS-MATH-19	1	LB	UP3	DP8	CP7	LB1
89	BS-MATH-21	1	DP, CP, LB	UP4	DP3	CP7	LB2
90	BS-MATH-22	0	LB		DP8		
91	BS-MATH-26	0	DP, CP,				
92	BS-METEO-3	0	LB	UP8	DP8	CP4	LB2
93	BS-METEO-4	0	DP, LB				
94	BS-METEO-5	1	DP, LB	UP5	DP8	CP7	LB9
95	BS-METEO-12	1	LB				
96	BS-METEO-17	1	UP, LB				
97	BSN-A10	1	UP, LB	UP7	DP3	CP7	LB9
98	BSN-A16	1	DP, CP,				
99	BSN-A20	0	DP, CP,	UP1			
100	BSN-A27	1	LB	UP7	DP7	CP7	LB4
101	BSN-A28	1	LB	UP2	DP4	CP6	LB9
102	BSN-A29	1	DP	UP5	DP5	CP6	LB9
103	BSN-A30	1	LB	UP1	DP8	CP7	LB3
104	BSN-A31	1	LB	UP2	DP3	CP7	LB9
105	BSN-A32	1	DP	UP5	DP3	CP7	LB3
106	BSN-A33	0	CP, LB	UP2	DP8	CP2	LB1
107	BSN-A34	1	LB	UP5	DP4	CP6	LB1
108	BSN-A35	1	LB	UP5	DP4	CP6	LB1
109	BSN-A36	0	LB	UP7	DP7	CP7	LB4
110	BSN-A37	1	CP, LB	UP1		CP2	
111	BSN-A39	1	LB				
112	BSN-A40	1	LB				
113	BSN-A41	1	LB	UP7	DP4	CP2	LB1
114	BSN-A42	1	LB				
115	BSN-B3	0	UP, LB				
116	BSN-B8	1	DP, CP, LB	UP1	DP1	CP7	LB9
117	BSN-B18	1	DP, CP, LB	UP8	DP1	CP7	
118	BSN-B31	1	LB	UP5	DP4	CP1	LB11
119	BSN-B34	1	LB	UP5	DP2		
120	BS-SOCIO-2	0	LB	UP3	DP3	CP3	LB2
121	BS-SOCIO-7	1	LB	UP8	DP1	CP1	LB2
122	BS-SOCIO-10	0	DP, CP	UP9	DP3	CP3	LB10
123	BS-SOCIO-13	0	DP	UP1	DP1	CP3	LB8
124	BS-SOCIO-14	0	LB	UP3	DP8	CP7	LB10
125	BS-SOCIO-15	1	DP	UP7	DP3	CP7	LB3
126	BS-SOCIO-17	1	LB			CP7	
127	BS-SOCIO-21	1	DP	UP3	DP3	CP7	LB9
128	BS-SOCIO-27	1	DP, CP,	UP5	DP3	CP7	LB3

APPENDIX L

TOP 3 MOST COMMON COPING STRATEGIES BY SEX BY PHASE
(Frequency Based)

SEX	UNDERSTANDING THE PROBLEM (UP)			DEVISING A PLAN (DP)			CARRYING OUT THE PLAN (CP)			LOOKING BACK (LB)		
	1	2	3	1	2	3	1	2	3	1	2	3
MALES	UP 2	UP 3	UP 8	DP 8	DP 4	DP3	CP 7	CP1	CP 8	LB 3	LB 1	LB 9
FEMALES	UP 2	UP 3	UP 5/UP8	DP 8	DP3	DP7	CP 7	CP1	CP 2	LB1	LB 3	LB 2

APPENDIX M

TOP 3 MOST COMMON COPING STRATEGIES BY ACADEMIC PROGRAMS BY PHASE (Frequency Based)

ACADEMIC PROGRAMS	UNDERSTANDING THE PROBLEM (UP)			DEVISING A PLAN (DP)			CARRYING OUT THE PLAN (CP)			LOOKING BACK (LB)		
STEM-related	1	2	3	1	2	3	1	2	3	1	2	3
BS in Agric. And Biosystems Eng'g	UP 2	UP 8	UP 5	DP 8	DP 3	DP7	CP 7	CP1/ CP2	CP 3	LB 1	LB 3	LB 9
BS in Civil Engineering	UP 3	UP 2	UP 8	DP 8	DP2 /DP 3	DP4	CP 7	CP1	CP 8	LB1 /LB 3	LB 4	LB 9
BS in Chemical Engineering	UP 2	UP3 /UP 8	UP1 /UP 5	DP5 /DP 8	DP 4	DP1/ DP2/ DP7/ DP10	CP 1/C P7	CP3	CP2 /CP 6/C P9/ CP1 0	LB 1	LB 9	LB 8
BS in Mathematics	UP 3	UP 2	UP 8	DP 8	DP3 /DP 7	DP2/ DP4/ DP6	CP 7	CP4	CP1 /CP 2/C P3/ CP6 /CP 8/C P9	LB 1/L B2/ LB 3	LB 8	LB 5
BS in Meteorology	UP2 /UP 8	UP 1		DP 7	DP1 /DP 2/D P3/ DP4 /DP 9/D P10		CP 1/C P2	CP3, CP8, CP9		LB 7	LB 5	LB 1, LB 3,L B9
NON-STEM-related	1	2	3	1	2	3	1	2	3	1	2	3
BA in Communication	UP 2	UP 5	UP 1	DP 4	DP 6	DP2/ DP3/ DP7	CP 1/C P7	CP3/ CP6	CP2 /CP 5/C P9/ CP1 1	LB1 /LB 3	LB2 /LB 7	LB 6/L B1 0
BS in Economics	UP 2	UP 8	UP3 /UP 5	DP 8	DP 2	DP3/ DP5/ DP7	CP 7	CP6	CP 1	LB 7	LB5 /LB 8	LB 3/L B9
BS in Nursing	UP 2	UP 5	UP 7	DP 8	DP 3	DP1 /DP 4/D P5	CP 7	CP1/ CP2	CP 9	LB 3	LB 1	LB 2
BS in Sociology	UP 2	UP 3	UP 8	DP 8	DP1 /DP 3	DP2/ DP7	CP 7	CP1/ CP2/ CP3/ CP8	CP4 /CP 6/C P11	LB 3	LB 9	LB 1/L B5/ LB 7

APPENDIX N

MODIFIED SCORING RUBRICS FOR THE PROBLEM SOLVING TEST

Problem SolvingPhases	0	1	2	3	4
	Nothing written in the answer sheet				
Understanding the Problem		Correct type of problem; Correct known and unknown quantities			
Devising a Plan/Strategy		Correct type of problem; Correct known and unknown quantities	Correct formulation of the working equation; Correct chart/table representation		
Carrying out the Plan		Correct type of problem; Correct known and unknown quantities	Correct formulation of the working equation; Correct chart/table representation	Correct derived value with correct manipulation	
Looking Back		Correct type of problem; Correct known and unknown quantities Incorrect substitution of values but with correct conclusion	Correct formulation of the working equation; Correct chart/table representation	Correct derived value with correct manipulation	Correct substitution of values and correct conclusion

APPENDIX O

RESPONSES FROM INTERVIEWS:

Teacher: In solving problems, the last step is to check whether you derived the correct value, right? Do you usually do this? If not, why?

Student 1: I usually don't do it coz i find it time consuming during the exams but I am sure of my solution and i guess this part is useful.)

Student 2: This would be easy but because I have a wrong working equation, therefore i cannot check my answer *(Inability to check/evaluate derived value ensuring the accuracy and facts of the problem).*

Student 3: How can I check it if I can't even evaluate the equations? *(had no idea how* to evaluate the derived value that ensured the accuracy and facts of the problem)

Student 4: Kung minsan po, ay hindi na, kasi alam ko naman na tama ang sagot ko Ma'am. *(not a difficulty)*

Student 5: Can't evaluate the correctness of the obtained solution. (had no idea how to evaluate the derived value that ensured the accuracy and facts of the problem)

Student 6: It's so complicated and very confusing.

Student 7: I don't check because sometimes, I got problems with signs. (*Inability to check/evaluate derived value ensuring the accuracy and facts of the problem).*

Student 9: I got mess up in checking solution. (*Inability to check/evaluate derived value ensuring the accuracy and facts of the problem).*

Student 10: Baka wrong ti interpretation ko Ma'am. (Maybe I got the wrong interpretation). (*Inability to check/evaluate derived value ensuring the accuracy and facts of the problem).*

Student 11: I sometimes forget to check. *(not a difficulty)*

Student 12: I do have no answer that's why I didn't look back. (*(had no idea how to evaluate the derived value that ensured the accuracy and facts of the problem)*

Student 13: It was so hard in looking back because I had a hard time devising a plan/strategy the same with carrying out the plan more on looking back. *(had no idea how to evaluate the derived value that ensured the accuracy and facts of the problem)*

Student 14: I was just sometimes forget to check out the solution. *(not a difficulty)*

Student 15: Di po talaga ako nagccheck ng solution Ma'am, kasi okay naman sa tingin ko ang nakuha kong solution. (I usually don't check, coz I guess I derived the correct value). *(not a difficulty)*