

EFFECTS OF MATHEMATICS BIBLIOTHERAPY MODEL AND ABILITY GROUPINGS ON THE ACHIEVEMENT OF COLLEGE FRESHMEN IN PROBLEM SOLVING

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ABSTRACT

This study determined the level of achievement in problem solving among college freshmen in terms of their posttest achievement scores and the effects of mathematics bibliotherapy model and ability groupings on the achievement of college freshmen in problem solving. It was conducted at the Ifugao State College of Agriculture and Forestry, Lamut, Ifugao from December 10, 2007 to January 31, 2008 using 102 college freshmen as the subjects of the study.

The data were analyzed using descriptive and inferential statistics. To describe the profile of the respondents, frequency counts, percentages, means and standard deviations were used while in the analyses of the significant relationships among variables, the Analysis of Covariance was utilized. The Scheffé Method was also used to compare the differences between each pair of ability groupings – the high ability, average ability and low ability groupings.

The 0.05 probability level (level of significance) was used as the critical point of reference.

The findings in the study were as follows:

1. The overall level of achievement of the college freshmen in Plane trigonometry in terms of their posttest scores is “average”.
2. There is a significant difference between the achievement of college freshmen exposed to mathematics bibliotherapy model and the conventional teaching method with mental ability test equivalent grades as covariate.

3. There is a significant difference between the achievement of college freshmen exposed to mathematics bibliotherapy model and the conventional teaching method with reading comprehension ability test scores as covariate.
4. There is a significant difference between the achievement of college freshmen exposed to mathematics bibliotherapy model and the conventional teaching method with final grades in College Algebra as covariate.
5. There is a significant difference between the achievement of college freshmen exposed to math bibliotherapy model and the conventional teaching method with final grades in Study and Thinking Skills as covariate.
6. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement.
7. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with mental ability test equivalent grades as covariate.
8. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with reading comprehension ability test scores as covariate.
9. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with final grades in College Algebra as covariate.
10. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with final grades in Study and Thinking Skills as covariate.
11. The mean difference between the low ability group and the average ability group is significant; between the low ability group and the high ability group is significant and between the average ability group and the high ability group is also significant.

The following conclusions were formulated based on the findings in this study:

1. The students exposed to the mathematics bibliotherapy model tend to achieve better than the students exposed to the conventional method of teaching problem solving.

2. The mathematics bibliotherapy model is better than the conventional method.

3. The mathematics bibliotherapy model is applicable to all ability groupings – the low ability group, average ability group and high ability group.

Based from the conclusions, the researcher offers the following recommendations:

1. Administrators and mathematics teachers should advocate the use of mathematics bibliotherapy model in order to enhance teaching in problem solving and improve students' achievement in mathematics.

2. It is recommended that curriculum designers include problem solving as a part of the mathematics curricula for further improvement of mathematics education.

3. Other researchers are encouraged to conduct similar studies in other fields of Mathematics and other related areas of learning in other year levels in a longer duration of experimentation.

4. A Conduct of Math Clinic is recommended using the mathematics bibliotherapy model as a way of enhancing problem solving.

INTRODUCTION

Background of the Study

Educators today are facing new challenges that go well beyond the traditional expectation of teaching reading, writing and arithmetic. These challenges take many forms. Many students enter the educational system lacking the necessary social, emotional and academic prerequisites to be successful. Educational settings are becoming more diverse with students from varying cultural backgrounds and with disparate learning abilities. In addition, laws are demanding increasingly higher standards and accountability of the teaching profession. With such enormous impediments, it is essential that school personnel today find approaches that are relevant to each student's unique needs (Cook, et al, 2006).

Despite current research efforts in mathematics and science problem solving, in the students' performance on recent tests like the Third International Mathematics and Science Study (TIMSS), Filipino students are not yet meeting the expectations of the mathematics education community. In spite of calls for problem solving approaches to teaching mathematics, the shift from teaching math facts and procedures to teaching with emphasis on mathematical concepts and thinking skills has been slow and difficult. Many teachers are unconvinced that traditional methods should be abandoned. Of those who want to change, many are unsure how to go about it. Further complicating the issue is the lack of consensus about what is meant by problem solving, especially open-ended and story problem solving, and how it is best taught and assessed (Wiest, 2002).

Students tend to deem word problems as among the most distasteful and anxiety-inducing tasks in the mathematics classroom. Because word problems are difficult for students and play a key role in mathematics instruction, it is worthwhile to seek improved ways of constructing them. The result can lead to enhanced thinking and insight into which problem aspect has an impact on students' problem solving performance and in what manner. One aspect of word problems that some researchers have found to have an impact on students' performance is problem context, or non-mathematical meanings present in any problem statement. The influence of problem context is an important area that has not been studied extensively. Carefully

selected problem contexts can increase student interest as well as understanding, and hence problem solving succeeds, through enhanced ability to present problems in computational form and to evaluate reasonableness of answers. The potential benefits provide an important message to designers of mathematics materials. Enhancing instructional materials in terms of their potential for raising intrinsic motivation may lead to increased learning (Boaler, 1994).

The National Council of Teachers of Mathematics (NCTM 1989 and 2000) recognized that technical changes in society demand that students learn to value mathematics more and become more confident in their math ability as well as become more proficient in problem solving. Through teaching methods such as authentic problem solving, cooperative learning, hands-on activities, use of computers and calculators, discussions, authentic assessment, interdisciplinary instruction, reflection and journal writing, teachers can influence students' attitude in a positive manner by helping them deal with their feelings about mathematics because negative feelings and attitudes stand in the way of success.

A learning style is a student's consistent way of responding to and using stimuli in the context of learning. Classically, our learning style is forced upon us through life like this: In grades kindergarten to third, new information is presented to us kinesthetically; grades four to eight are visually presented; while grades nine to college, information is presented to us through auditory means by lectures. The VAK Learning Style uses three main sensory receivers- Vision, Auditory, and Kinesthetic (movement) to determine the dominate learning style. This allows learners, no matter what their preferred style is, the opportunity to become involved. Some hints for recognizing and implementing the three styles are:

- 1) Auditory learners often talk to themselves and may have difficulty with reading and writing tasks. To integrate this style into the learning environment, "tell them what they are going to learn, teach them, and tell them what they have learned". Auditory activities like brainstorming or buzz groups may be employed to learners of this type.

- 2) Visual learners have two sub channels – linguistic and spatial. Visual-linguists like to learn through written language such as reading and writing tasks. They remember what has been written down even if they do not read it more than once. Learners who are visual-spatial usually

have difficulty with written language and do better with charts, demonstrations, videos, and other visual materials. They easily visualize faces and places by using their imagination and seldom get lost in new surroundings. To integrate this style into the learning environment, use graphs, charts, illustrations, outlines, handouts for reading and taking notes; include plenty of content in handouts to reread after the learning session; leave white space in handouts for note taking; invite questions to help them stay alert in auditory environment; emphasize key points to cue when to take notes; supplement textual information with illustrations whenever possible; show diagrams and then explain them; have the learners envision the topic or have them act out the subject matter.

3) Kinesthetic learners do best while touching and moving. It also has two sub channels – kinesthetic (movement) and tactile (touch). They tend to lose concentration if there is little or no external stimulation or movement. When reading, they like to scan the material first, and then focus on the details (get the big picture first). They typically take notes by drawing pictures or diagrams (Conner and Hodgins, 2000).

Teachers need to create supportive environments where their students feel comfortable expressing themselves. One approach in helping young people express themselves is bibliotherapy. Bibliotherapy is the use of reading to produce affective change and to promote personality development. Bibliotherapy can be used as an attempt to help young people understand themselves and cope with problems by providing literature relevant to their personal situations and developmental needs at appropriate times. Classroom teachers using this approach hold a fundamental belief that reading will influence thinking and behavior and that through guided discussions, selected readings can be focused on specific needs of students (Forgan, 2002 and 2003).

Teachers by their very nature are passionate about their trade and compassionate toward the students they educate. Therefore, finding strategies to overcome the societal problem facing the profession is of paramount importance. Bibliotherapy is one approach that holds great promise in helping educators find ways to target the individual learner. When using bibliotherapy,

educators systematically match the reading materials to the unique needs of each learner to facilitate student achievement and development (Johnson, et al, 2000).

Bibliotherapeutic intervention may be undertaken for many reasons: (1) to develop an individual's self-concept; (2) to increase an individual's understanding of human behavior or motivations; (3) to foster an individual's honest self-appraisal; (4) to provide a way for the person to find interest outside of self; (5) to relieve emotional or mental pressure; (6) to show to an individual that he is not the first or only person to encounter such a problem; (7) to show an individual that there is more than one solution to a problem; (8) to help a person discuss a problem more freely; (9) to help an individual plan a constructive course of action to solve a problem (Cook, 2006).

Books can help educators guide the emotional development of students far more than intellectual discussion because stories directly affect human emotions. For bibliotherapy to be successful, a meaningful follow-up discussion is required. To simply read a good book with an entire class is not bibliotherapy. It is very important that young people not only read books, but they should develop their cognitive and metacognitive abilities while undergoing a bibliotherapy (Forgan, 2002).

The researcher used a Mathematics Bibliotherapy Model to improve the problem solving skills of the students together with their study habits which are developed on the process of bibliotherapy. In this fashion, bibliotherapy made use of stories and narratives as pedagogical interventions in the classroom. This model included cognitive and metacognitive thinking embedded in bibliotherapy. In particular, the researcher determined the effects of the mathematics bibliotherapy model and ability groupings to the problem solving achievement of college freshmen of the Institute of Arts and Sciences at the Ifugao State College of Agriculture and Forestry Main Campus, Nayan, Lamut, Ifugao during the second semester of the School Year 2007-2008.

Statement of the Problem

This study intended to determine the effects of mathematics bibliotherapy model and ability groupings on the achievement of college freshmen in problem solving in Plane Trigonometry.

Specifically, it sought to answer the following questions:

1. What is the demographic profile of the college freshmen taking up Plane Trigonometry in terms of
 - 1.1 age
 - 1.2 gender
 - 1.3 civil status
 - 1.4 religious affiliation
 - 1.5 ethnicity
 - 1.6 educational attainment of parents
 - 1.7 occupation of parents
 - 1.8 family income
 - 1.9 nature of residence and
 - 1.10 number of hours devoted in studying Plane Trigonometry?
2. What is the level of achievement of the college freshmen taking up Plane Trigonometry in terms of their pretest and posttest mean scores?
3. Is there a significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with mental ability test equivalent grades as covariate?
4. Is there a significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with reading comprehension ability test scores as covariate?
5. Is there a significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with final grades in College Algebra as covariate?

6. Is there a significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with final grades in Study and Thinking Skills as covariate?
7. Is there a significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement?
8. Is there significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with mental ability test equivalent grades as covariate?
9. Is there a significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with reading comprehension ability test scores as covariate?
10. Is there a significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with final grades in College Algebra as covariate?
11. Is there a significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with final grades in Study and Thinking Skills as covariate?

Objectives of the Study

This study aimed to:

1. identify the characteristics of the college freshmen as to age, gender, civil status, religious affiliation, ethnicity, educational attainment of parents, occupation of parents, family income, nature of residence and number of hours devoted in studying Plane Trigonometry;
2. state whether the differences between the achievement of the college freshmen in the control group and in the experimental group are significant or not with (a) mental ability test equivalent grades, (b) reading comprehension ability test scores, (c) final grades in College Algebra, and (d) final grades in Study and Thinking Skills as covariates;

4. state whether the interaction between the methods of teaching problem solving and the ability groupings on the students' achievement is significant or not without using any covariate;

5. state whether the interaction between the methods of teaching problem solving and the ability groupings on the students' achievement is significant or not with

(a) mental ability test equivalent grades, (b) reading comprehension ability test scores, (c) final grades in College Algebra and (d) final grades in Study and Thinking Skills as covariates.

Hypotheses of the Study

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with mental ability test equivalent grades as covariate.
2. There is no significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with reading comprehension ability test scores as covariate.
3. There is no significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with final grades in College Algebra as covariate.
4. There is no significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with final grades in Study and Thinking Skills as covariate.
5. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement.
6. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with mental ability test equivalent grades as covariate.

7. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with reading comprehension ability test scores as covariate.
8. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with final grades in College Algebra as covariate.
9. There is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with final grades in Study and Thinking Skills as covariate.

Significance of the Study

This study is conceived with the hope that its results and significance would be of help to students, mathematics teachers, administrators, curriculum designers, and other researchers in the following ways:

Students. This study could help students gain new techniques in problem solving which may strengthen their skills, improve their study habits and increase the level of their academic performance.

Mathematics Teachers. Since teachers are in charge of the students' success in Mathematics, new techniques in problem solving may improve their teaching styles and abilities.

Administrators. The results of this study could serve as bases for implementing new measures in improving the level of achievement of students in Mathematics.

Curriculum Designers. This study could encourage inclusion of problem solving as a part of the mathematics curricula for further improvement of mathematics education.

Other Researchers. This study could encourage development of Mathematics Models for better mathematics instruction.

Scope and Limitation of the Study

The study focused on the effects of mathematics bibliotherapy model and ability groupings on the problem solving achievement of the college freshmen of the Institute of Arts and Sciences of the Ifugao State College of Agriculture and Forestry Main Campus, Nayon, Lamut, Ifugao during the second semester of the School Year 2007-2008.

This study involved the study of Plane Trigonometry which was limited to topics on Trigonometric Functions, Solutions of Right Triangles, and Applications (Word Problems) of Solutions of Right Triangles.

Theoretical Framework

Bibliotherapy embraces the theories of cognitivism and metacognition. The theory of cognitivism includes the following concepts: (1) Learning is a change of knowledge state; (2) Knowledge acquisition is described as a mental activity that entails internal coding and structuring by the learner; (3) Learner is viewed as an active participant in the learning process; (4) Emphasis on the building blocks of knowledge; (5) Emphasis on structuring, organizing and sequencing information to facilitate optimal processing; (6) Focus is on how learners remember, retrieve, and store information in memory; (7) Examines the mental structure and processes related to learning; (8) Learning is viewed as an active process that occurs within the learner and which can be influenced by the learner; (9) The outcome of learning is not only dependent on what the teacher presents but also on what the learner does to process this information. The theory of metacognition on the other hand, involves cognitive and reflective thinking where students analyze their thinking processes. It refers to higher order thinking which involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of the task are metacognitive in nature (Forgan, 2002).

Metacognitive experiences involve the use of metacognitive strategies or metacognitive regulation. Metacognitive strategies are sequential processes that one uses to control cognitive activities, and to ensure that a cognitive goal (e.g., understanding a text) has been met. These

processes help to regulate and oversee learning, and consist of planning and monitoring cognitive activities, as well as checking the outcomes of those activities. For example, after reading a paragraph in a text a learner may question herself about the concepts discussed in the paragraph. Her cognitive goal is to understand the text. Self-questioning is a common metacognitive comprehension monitoring strategy. If she finds that she cannot answer her own questions, or that she does not understand the material discussed, she must then determine what needs to be done to ensure that she meets the cognitive goal of understanding the text. She may decide to go back and re-read the paragraph with the goal of being able to answer the questions she had generated. If, after re-reading the text she can now answer the questions, she may determine that she understands the material. Thus, the metacognitive strategy of self-questioning is used to ensure that the cognitive goal of comprehension is met (Brown, 2002).

The use of mathematics bibliotherapy model is a strategy which involves cognitive and metacognitive processes. In its activities, the learner is helped to achieve a particular goal (e.g., understanding a text – a cognitive process) and is ensured that the goal has been reached (e.g., quizzing oneself to evaluate one's understanding of the text – a metacognitive process).

Conceptual Framework

The aspects of word problem context that influence problem solving include readability, verbal structure, story concepts and personal factors:

Readability refers to comprehensibility of problem contexts and relates to such elements as vocabulary and wording, rather than to standardized readability measures. Although students could pronounce the word, they did not know the meaning of the term. Even after discussing its meaning as a class, students used the term inappropriately in making problem solving decisions. Still, in another problem, the concept was abstract but may have been understandable had the wording not been so confusing (Caldwell, 1987).

Many students seemed bothered by the unfamiliarity of names, their inability to pronounce them, or their uncertainty about the gender assignment of the name. Moreover, use of prepositions in mathematical text may differ from the way we use them in everyday language.

This is one reason to doubt use of standard readability formulas to assess text comprehensibility, probably to a greater degree for mathematical than literary text. These measures generally consider word and sentence length to determine the difficulty level of the text. Verbal structure includes visual and physical formatting of text. The physical proximity of numbers to each other and of set names or actions to each other and to related information might affect how well a problem solver associates those items (Macgregor, 2000).

Story concepts involve meaning embedded in the story in a larger sense (e.g., the story line) and a smaller sense (individual terms and phrases) and the way the meaning is presented. Some students said certain stories needed more information. In general, they wanted richer, more developed stories. Students reported liking problems that had a “background”, “details”, or “enough information”, and those that allowed them to “get a whole picture” of what was happening. Students’ general desire for rounded-out stories may highlight a need for an adequate context in which to conceptualize a problem or merely a substantial enough story to draw their interest. Story concepts influence problem solving performance by way of comprehensibility of key terminology and larger ideas. Not only the type but also the number and complexity of different concepts contained in a problem’s context may affect level of understanding (Davis-Dorsey, 1991).

Another story aspect that may influence student problem solving response is the activity level of the story line. Students addressed this factor, unsolicited, by stating that some stories either had a lot of action or needed more action. In his meta-analysis of problem-context studies, Hembree (1992) states that the very young students performed better on problems that included some measure of action. Improved ability to visualize information or invoke imagery has been associated with increased learning.

Personal factors in word problems are those that are personally relevant and therefore vary with the individual. These include interest, personalization, and familiarity. The degree of interest in a problem’s context affects how much they like the problem and how they solve it by affecting them in the following ways: perceived difficulty level of the problem, interest in working

the problem, attentiveness, degree of effort exerted, success in solving the problem, and feeling toward the problem in solving it (Jones, 1999)

Dominant group interests surfaced as well as individual ones. Students expressed interest in both fantasy and real-world contexts. In general, however, story specifics such as story lines and particular story elements outranked general story type or genre in importance. Familiarity of content has been associated with enhanced problem solving performance. Individual response to problem context may vary according to a problem solver's gender, age, community type, and geographical location, family background (including values, preferred activities, race/ethnicity, socio-economic status, and religion), individual personality (interest), and academic ability (Boaler, 1993).

The level of achievement of students in problem solving is dependent on the ways and methods of reinforcing the learning behavior the students possess from the beginning up to the end of the course, hence, the mathematics bibliotherapy model.

Further, the problem solving readiness of the students in terms of their ability level (in this study, the "low ability", "average ability", and "high ability" groupings were employed) affects their achievement level. Thus, these variables were chosen following the paradigm being constructed.

In Figure 1, the independent variables namely treatment 1 (conventional method of teaching) and treatment 2 (mathematics bibliotherapy model) were believed to have direct effects on the students' achievement in problem solving, being the dependent variable. The methods of teaching problem solving (Factor A) and Ability Groupings (Factor B) were believed to have direct effects on the problem solving achievement of students in Plane Trigonometry with Mental Ability Test Equivalent Grades, Reading Comprehension Ability Test Scores, Final Grades in College Algebra and Final Grades in Study and Thinking Skills as covariates. It was also predicted that there is a significant interaction between Factor A and Factor B.

Figure 1 shows the relationships existing among the variables.

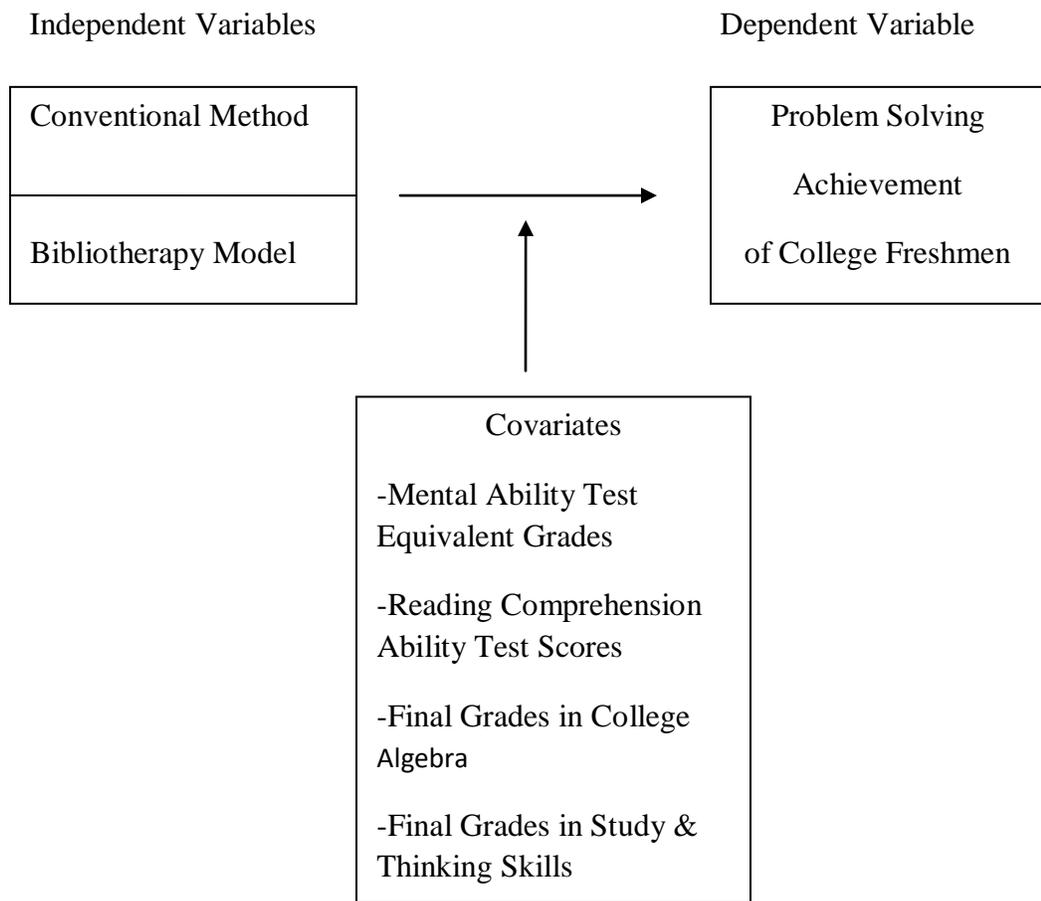


Figure1. Conceptual Paradigm showing the Relationships of Variables

The paradigm shows that this research study recognizes the students as the ultimate objects in the learning process. It also shows that the students have certain limitations in the problem solving achievement level as determined through the ability grouping to which they belong. It also believed that their problem solving achievement could be improved through the use of mathematics bibliotherapy model in teaching problem solving.

Operational Definition of Terms

The following terms are defined to give the readers better understanding of this study:

Ability Groups. This refers to the groups in which students were classified according to their grades in College Algebra and it was based on the grading system of the Ifugao State College of Agriculture and Forestry where the student respondents were enrolled. In this study, three groups were used, and they are as follows:

Low Ability Group. This refers to the group of college freshmen in the study area whose grades in College Algebra fall within the range 75 – 79.

Average Ability Group. This refers to the group of college freshmen in the study area whose grades in College Algebra fall within the range 80 – 85.

High Ability Group. This refers to the group of college freshmen in the study area whose grades in College Algebra fall within the range 86 and above.

Achievement. This refers to the accomplishment of the students in their schoolwork resulting from instruction and learning.

Achievement Level. This refers to the degree of accomplishment the students are able to achieve as measured. It is expressed as: High Achievement (40-50), Above Average Achievement (30-39), Average Achievement (20-29), Below Average Achievement (10-19) and Low Achievement (0-9) (Leaño 1995).

Bibliotherapy. It is the use of stories and narratives to facilitate problem solving skills of the subjects.

Mathematics Bibliotherapy Model. It refers to the main instrument constructed to improve the problem solving achievement of students.

Cognitive Processes. This refers to the processes which emphasize the development of thinking skills as a means to enhance learning.

Metacognitive Processes. This refers to processes of higher order thinking which involve control over the cognitive processes involved in learning.

College Algebra. This refers to the Mathematics subject taken by the college freshmen during the first semester. The lessons in this subject included the following:

(a) Exponents, (b) Polynomials, (c) Factoring, (d) Graphing, (e) Systems of Equations, (f) Radicals, (g) Quadratic Equations and (h) Problem Solving.

College Freshmen. This refers to college students enrolled in the first year level. In this study, it included the first year college students in the Institute of Arts and Sciences.

Conventional Method of Teaching. This refers to the approach employed in teaching problem solving which includes teaching the procedure, providing time for individual student practice and finally presenting the problem that utilize the particular procedure.

Demographic Profile. This refers to the status of the subjects as students. It includes the following:

Age. This refers to the length of time the subject has existed since birth up to the year the study was performed.

Gender. This refers to the classification where the subjects are grouped as male or female.

Civil Status. This refers to the legal condition of the subjects in which they are classified as single, married, widow/widower and annulled.

Religious Affiliation. This refers to the religious sect to which a respondent belongs. The different sects considered are Roman Catholic, Iglesia ni Cristo, Born Again Christians, Pentecost, United Church of Christ of the Philippines.

Ethnicity. This refers to the cultural group to which the respondents belong whether Ilocano, Ifugao, Tagalog, Igorot, Pangasinense and others.

Educational Attainment of Parents. This refers to the highest level of education attained by the parents of the respondents.

Occupation of Parents. This refers to the kind of job the parents of the respondents are engaged in.

Family Income. This refers to the financial status of family to which a respondent belongs.

Nature of Residence. It refers to the kind of residence the respondent is staying in whether it is a boarding house, relative's house or own house.

Number of Hours Devoted in Studying Plane Trigonometry. This refers to the total number of hours per week spent by the respondent in studying Plane Trigonometry.

Difficulty Index. This is an indicator of the percentage of a specified group of students who answered a test item correctly. It is the proportion of the upper 27% and the lower 27% of the students tested who got the item right.

Discrimination Index. The power of a test item to separate the bright ones from the weak ones. It is the difference between the upper 27% and the lower 27% of the students tested who got the item correct.

Final Grade in College Algebra. This refers to the grade in the subject College Algebra obtained by the respondent at the end of the first semester.

Final Grade in Study and Thinking Skills. This refers to the grade in the subject Study and Thinking Skills obtained by the respondent at the end of the first semester.

Item Analysis. A process by which relative difficulty and discriminating ability are determined to verify the validity of items.

Math Clinic. This refers to an activity wherein students are provided assistance for previously learned mathematics lessons. It includes processes such as self-assessment, diagnosing and recording strengths and weaknesses and finally, tutoring lessons.

Mental Ability. This refers to the person's innate intellectual potential as represented by a score measured by the SLU Mental Ability Test (College Qualification Test). It is categorized as follows:

Score Range	Category
0 – 70	Very Poor
71 – 80	Poor
81 – 90	Below Average
91 – 110	Average
111 – 120	Above Average
121 – 130	Very Superior
131 – above	Near Genius

Mental Ability Test. This refers to the test on mental ability administered to a particular individual. In this study, it refers to the test administered by the Guidance Testing Center Personnel of ISCAF to college freshmen every first semester of a school year.

Plane Trigonometry. This refers to the mathematics subject taken by the college freshmen during the second semester. In this study, the lessons included the applications of solutions of right triangles such as Angle of Elevation, Angle of Depression, Geometry Construction, Surveying and Navigation.

Problem. It is a task for which there is no immediate solution.

Problem Solving. It is the process by which a subject attempts to find an answer to a non-routine mathematical question.

Problem Solving Skills. It is the ability of a student to apply his techniques in approaching a mathematical problem and determining its proper solution.

Reading Comprehension Ability. This refers to the person's level of reading achievement. It is categorized as follows:

Range of Score	Category
94 – 99	Very High
70 – 93	High
32 – 69	Average
8 – 31	Low
1 – 7	Very Low

Reading Comprehension Ability Test. This refers to the Nelson Reading Test (NRT) Revised Edition which allows a researcher to compare the student's level of reading achievement with his learning capacity.

Reliability. This refers to the degree of consistency and precision or accuracy that a measuring instrument demonstrates.

Study and Thinking Skills. This refers to the English subject taken by the college freshmen during the first semester. This subject deals with the development of the core communication skills and thinking skills.

Table of Specification. This is a plan or a guide that defines as clearly as possible the scope and emphasis of a test to relate to its contents and objectives.

Validity. This refers to the degree to which a test actually measures what it tries to measure. In this study, the validity of the achievement test administered to the respondents was determined basing from a given set of criteria (Appendix C).

RESEARCH METHODOLOGY

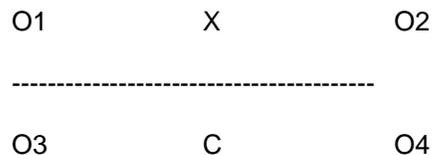
This chapter contains the procedure/processes employed in the conduct of the study.

The Research Design

The study used the Two – Group Pretest - Posttest Design.

The researcher handled two intact classes in Plane Trigonometry during the second semester for the implementation of the study.

The Experimental Design is as illustrated:



Where:

O = observed measures

X = experimental treatment

C = control group

O1, O3 = pretests of the control and experimental groups

O2, O4 = posttests of the control and experimental groups

----- = non-randomization

Research Method

The study was experimental in nature. It was made up of a two by three (2 x 3) factorial design. The two levels of Factor A are the Conventional Method of Teaching Problem Solving and the Use of Mathematics Bibliotherapy Model in Teaching Problem Solving and the three levels of Factor B are the high ability group, average ability group and low ability group. The determination of the ability grouping to which a student would belong was based from his final grade in College Algebra. A student whose final grade in College Algebra ranged from 75 – 79 was assigned to the “low ability group”; a student who had a final grade in College Algebra within the ranges 80 – 85

was assigned to the “average ability group”; and a student whose final grade in College Algebra ranged from 86 and above was assigned to the “high ability group”. This was done to each of the two groups of students-the experimental group and the control group.

Subjects of the Study

The subjects of the study consisted of two intact classes of the Institute of Arts and Sciences at the Ifugao State College of Agriculture and Forestry Main Campus, Nayon, Lamut, Ifugao, during the Second Semester of the School Year 2007-2008. Such classes were chosen since these they were composed of purely First Year Criminology students and there was only one class composing of First Year BS Political Science students.

The experimental group and the control group were randomly assigned to the classes I-A and I-B, respectively via the toss-coin process.

The classes composed of 102 college freshmen of the Institute of Arts and Sciences which were broken down into two classes of 48 and 54 students respectively. The classes were with the same subject matters assigned to the two teaching methods - the conventional method (control group) and the implementation of the Mathematics Bibliotherapy Model (experimental group). The researcher handled the two classes following their respective schedule prepared by the Institute Dean.

The researcher used the prescribed textbook in Plane Trigonometry with the inclusion of some College Plane Trigonometry textbooks as the main sources of the subject matters being tackled in the two classes. Preparations and organizations of lessons and lesson plans were done prior to the start of the experiment.

Before the experiment formally started, the researcher gave the two classes a fifty (50) – item pretest (Appendix P) to measure their level of achievement in terms of the contents Applications (Word Problems) of Solutions of Right triangles. The same test was administered to the two classes at the end of the study. This served as the posttest of the study.

Research Instruments

A questionnaire/checklist was constructed by the researcher to gather information regarding the profile of the subjects of the study in terms of age, gender, civil status, religious affiliation, ethnicity, educational attainment of parents, occupation of parents, family income, nature of residence and number of hours per week devoted in studying Plane Trigonometry (Appendix F).

Likewise, a fifty-item multiple choice type of test was constructed by the researcher to measure the individual achievement in the units of learning covered by the study before and after the experiment. A table of specification was also constructed to show the distribution of test items in accordance to the desired learning competencies and cognitive levels.

The covariates used in the study were the mental ability equivalent grades, reading comprehension ability scores, final grades in College Algebra, and final grades in study and Thinking Skills.

The mental ability equivalent grades of the respondents were obtained through the Saint Louis University, Baguio City College Qualification Test which was administered to both the experimental and the control groups. The Reading Comprehension Ability Scores were obtained through the Nelson Reading Test (NRT) Revised Edition which was administered to the respondents by the personnel of Saint Mary's University Testing Center.

The final grades of the respondents in College Algebra and Study and Thinking Skills were obtained from the registrar's office of the Ifugao State College of Agriculture and Forestry through the grade sheets submitted by their respective instructors during the first semester of School Year 2007-2008.

Preparation and Validation of the Test Items

I. Planning the Test

The researcher examined and determined the coverage of the content areas that can be taken up within the midterm of the second semester as suggested by the Syllabus in Plane Trigonometry.

The content weight of emphasis on each area was determined by formulating a set of criteria wherein each item shall be chosen basing from the following qualities: level of difficulty and content within the range assigned to freshmen, frequency of use by the students, and its significance to the succeeding knowledge of the students.

A. Objectives

1. To measure the students' level of achievement in plane Trigonometry particularly in the content areas on Trigonometric Functions, Solutions of Right Triangles, and Applications (Word Problems) of Solutions of Right Triangles.
2. To determine the effectiveness of the Mathematics Bibliotherapy Model on the problem solving skills of the College Freshmen in Plane Trigonometry.

II. Test Construction Stage

A. Submission of the Preliminary Draft of the Test for Review and Validation

The researcher presented the preliminary draft of the test for review and validation by experts. The reviewers and evaluators included the Vice President for Academic Affairs of the Ifugao State College of Agriculture and Forestry (ISCAF), the Campus Director of ISCAF Alfonso Lista Campus, Dean of the Institute of Business Administration of ISCAF Lagawe Campus, and two (2) Master Teachers in Mathematics at ISCAF Lagawe Campus.

The criteria that were used for the test evaluation are as follows:

1. The test items adequately represent the objectives of the specified units of learning in Plane Trigonometry.
2. The test items are suitable to the comprehension level of the college freshmen.
3. The test items are suitable to the behavioral patterns of the college freshmen.

These are enumerated in Appendix C2. The average rating given by the evaluators is 4.67, an indication that the test is 93.4 % valid.

III. Tryout Stage

A. Administering the Tryout

The test was administered at the Ifugao State College of Agriculture and Forestry Main Campus, on December 3, 2007 to three classes of second year students of the Institute of Computer Science. The test was finished in one hour and thirty minutes.

The purposes of the tryout are as follows:

1. To determine the appropriateness of the vocabulary or symbols used.
2. To determine the time duration of the test.
3. To determine the clarity of directions in the test.
4. To solicit comments from the students regarding the test.
5. To determine the language suitability of the items in the test.
6. To determine the level of difficulty of each item in the test.
7. To determine how many items should constitute the final form of the test.
8. To determine the discriminating power of each item in the test.
9. To discover omissions, ambiguities, or inadequacies of the test as a whole.

B. Item Analysis (Asaad, Abubakar S. and Hailaya, Wilhalm M., 2004)

Steps:

1. Arrange the test scores from the highest to the lowest.
2. Get the upper and the lower 27% of the scores.
3. Count the number of students in the upper and the lower groups, who chose the options.
4. Record the frequency.
5. Estimate the Index of Difficulty

$$\text{Index of Difficulty} = \frac{\sum X}{N} \times 100$$

Where: $\sum X$ sum of scores of correct answers of the upper and lower groups

N the total number of students in both groups
 who belong to the upper and lower 27

A difficulty index ranging from 0.81 to 1.00 belongs to the “very easy” level of difficulty; 0.61 – 0.80 belongs to the “easy” level of difficulty; a difficulty index ranging from 0.41 – 0.60 belongs to the “moderately difficult” level of difficulty; 0.21 – 0.40 belongs to the “difficult” level of difficulty; and a range of 0.00 – 0.20 indicates a “very difficult” level of difficulty.

6. Estimate the discriminating Power

Compare the correct response from the upper group and the lower group.

$$\text{Index of Discrimination} = \frac{RU - RL}{NG}$$

Where: RU right response of the upper group
 RL right response of the lower group
 NG number of students in each group

- The discrimination power of an item should not be more than 1.00
- The maximum positive discriminating power = 1.00, when the upper group students chose the correct answer and not one in the lower group.
- A negative discriminating power is obtained when more students in the lower group got the item right than in the upper group.
- A zero discriminating power is obtained when equal number of students in both groups got the item right.
- Items that are very discriminating and questionable should be discarded in the final draft of the test.

7. Determine the effectiveness of the distracters.

- A good distracter attracts more students in the lower group than in the upper group.

A discrimination index ranging from 0.10 and below indicates a “questionable” item; 0.11 – 0.20 range of discrimination index belongs to “not discriminating” level of discrimination; a range of discrimination index 0.21 – 0.30 indicates a “moderately discriminating” item; 0.31 – 0.40 index range indicates a “discriminating” item and a “very discriminating” item belongs to 0.41 – 1.00 index range..

Categorization of an Item

For the purpose of categorization of an item, the intersection of the difficulty and discriminating levels are utilized. Evaluation Code for an Analysis of an Item presents the 25 possibilities of the items to be retained, revised or rejected in the final draft of the test (Appendix J2).

Data Gathering Procedure

The researcher submitted a request letter to administer achievement tests in Plane trigonometry to the second year college students of the Institute of Computer Science at the Ifugao State College of Agriculture and Forestry Main Campus, Nayon, Lamut, Ifugao to the office of the dean on October 29, 2007.

To guide the researcher, a planned time frame for the study was prepared:

DATE	
November 5-7, 2007	Planning Stage
November 8-9, 2007	Sending of letter of request for permission to conduct an experimental study
November 12, 2007	Sending of letters to the evaluators for content validity
December 3, 2007	Tryout at ISCAF (Institute of Computer Science)
December 4-6, 2007	Item analysis of the tryout and preparation

	for final form of the test
December 10, 2007	Pretest
December 10-20, 2007 to January 3-31, 2008	Conduct of the Study (Implementation of Bibliotherapy)
February 4 to March 19, 2008	Consolidation and interpretation of Data

Statistical Analysis

The Analysis of Covariance was used to analyze the following:

1. Significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method with mental ability test equivalent grades, reading comprehension ability test scores, final grades in College Algebra and final grades in Study and Thinking Skills as covariates.
2. Significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement.
3. Significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement with mental ability test equivalent grades, reading comprehension ability test scores, final grades in College Algebra, and final grades in Study and Thinking Skills as covariates.

The Scheffé Method (S – Method) was also utilized to compare the mean differences of the three ability groupings namely the low ability group, average ability group and high ability group which were subjected to the two methods of teaching problem solving, the conventional method and the use of mathematics bibliotherapy model.

All tests were determined at 0.05 level of significance.

RESULTS AND DISCUSSION

This chapter contains information on the results of the statistical analysis of data and interpretation of research findings. It presents the problem solving achievement in Plane Trigonometry of the college freshmen who were subjected to two methods of teaching problem solving namely the conventional method and the use of the mathematics bibliotherapy model.

The achievement of each of the two groups of students was represented by their posttest scores in the achievement test.

Demographic Profile of College Freshmen

Age

Table 1 Distribution of College Freshmen in terms of Age

Age Group	Frequency (F)	Percentage (%)	Mean (\bar{x})	SD
16 – 17	26	25.49	18.46	1.54
18 – 19	57	55.88		
20 – 21	14	13.73		
22 – 23	5	4.9		
Total	102	100		

Table 1 shows that 57 (55.88 %) had a range of 18 to 19 years old; 26 or 25.49% belong to age bracket 16 to 17 years old; 14 or 13.73% belong to age bracket 20 to 21 years old while only 5 or 4.9% belong to age bracket ranging from 22 to 23 years old.

The mean age of the college freshmen subjected in this study is 18.46 years old which implies that most of the college freshmen entered college at a later age.

Gender

Table 2 Distribution of College Freshmen in terms of Gender

Gender	Frequency (F)	Percentage (%)
Male	75	73.53
Female	27	26.47
Total	102	100

Table 2 shows that out of 102 students, there are 75 (73.53 %) male students while 27 (26.47 %) are female.

These figures indicate that majority of the college freshmen belongs to the male group. This further implies that males dominate the course BS Criminology in the Institute of Arts and Sciences.

Civil Status

Table 3 Distribution of College Freshmen in terms of Civil Status

Civil Status	Frequency (F)	Percentage (%)
Single	101	99.02
Married	1	0.98
Total	102	100

Table 3 shows that 101 (99.02 %) of the students are still single while only 1 or 0.98 % is married.

This is an implication that most of the respondents gave more priority to their studies than to other things that may possibly disturb or totally hinder them from finishing their course.

Religious Affiliation

Table 4 Distribution of College Freshmen in terms of Religious Affiliation

Religious Affiliation	Frequency (F)	Percentage (%)
Roman Catholic	57	55.88
Iglesia ni Cristo	12	11.76
Pentecost	8	7.84
UCCP	2	1.96
Born Again Christian	12	11.76
Others (Baptist, Mormon)	11	10.78
Total	102	100

Table 4 shows the distribution of the students in terms of their religious affiliation. It can be gleaned from the table that majority of the student respondents belongs to the Roman Catholic sect as indicated by the figure 57 (55.88 %), Iglesia ni Cristo and Born Again Christians have 12 (11.76 %) each. Eleven (10.78 %) belongs to other sects represented by Baptists and Mormons, 8 (7.84 %) are Pentecost and 2 (1.96 %) are members of the UCCP.

These figures imply that most of the families of the student respondents are being influenced by the Catholic doctrines.

Ethnicity

Table 5 Distribution of College Freshmen in terms of Ethnicity

Ethnicity	Frequency (F)	Percentage (%)
Ifugao	98	96.08
Ilocano	4	3.92
Total	102	100

Table 5 shows the distribution of the college freshmen in terms of their ethnicity. Ifugao students composed the majority of the subjects of (98 or 96.08%). Only 4 (3.92 %) are Ilocanos and no student belongs to the other ethnic groups representing Igorot, Pangasinense, Tagalog and Gaddang.

This implies that the dominant ethnic group in the college is Ifugao.

Educational Attainment of Parents

Table 6a Distribution of College Freshmen in terms of Educational Attainment of Father

Educational Attainment	Frequency (F)	Percentage (%)
Elementary Level	33	32.35
Elementary Graduate	9	8.82
High school Level	17	16.67
High school Graduate	25	24.51
College Level	14	13.73
College Graduate	4	3.92
Total	102	100

It can be gleaned from the table that 33 (32.35 %) of the fathers of the respondents reached elementary level, (9 8.82 %) graduated in the elementary, 17 (16.67 %) reached high school level, 25 (24.51 %) finished high school, 14 (13.73 %) were able to go to college but did not finish, only 4 (3.92 %) graduated in college and none of these college graduates finished masters or doctorate degrees. Most of them finished up to high school and only a few entered in the college.

This is an indication that only a few obtained higher education.

Table 6b Distribution of College Freshmen in terms of Educational Attainment of Mother

Educational Attainment	Frequency (F)	Percentage (%)
Elementary Level	31	30.39
Elementary Graduate	7	6.86
High school Level	18	17.65
High school Graduate	24	23.53
College Level	13	12.75
College Graduate	7	6.86
Masteral Graduate	2	1.96
Total	102	100

Table 6b shows that most of the mothers of the student respondents reached up to high school only as indicated by the following figures: there are 31 (30.39 %) who entered elementary but did not finish, only 7 (6.86 %) finished elementary, 18 (17.65 %) reached high school but did not graduate, 24 (23.53 %) finished high school, 13 (12.75 %) entered college but did not finish, 7 (6.86 %) graduated in the college, only 2 finished master degree and no one finished doctorate degree.

These findings imply that only a few had obtained higher education.

Occupation of Parents

Table 7a Distribution of College Freshmen in terms of Occupation of Father

Occupation of Father	Frequency (F)	Percentage (%)
Farming	97	95.10
Teaching	2	1.96
Office Work	2	1.96
Others (driving)	1	0.98
Total	102	100

Table 7a shows the distribution of the students involved in this study in terms of the occupation of their fathers. Almost all of the fathers are farmers and only a few is engaged in other kinds of occupation like teaching, office work and driving. This is shown by the following figures: 97 (95.10 %) are engaged in farming, 2 (1.96 %) are teachers, 2 (1.96 %) work in the office and only 1 (0.98 %) works as a driver.

This is an implication that most of the fathers engage in farming as their livelihood.

Table 7b Distribution of College Freshmen in terms of Occupation of Mother

Occupation of Mother	Frequency (F)	Percentage (%)
Farming	94	92.16
Teaching	5	4.9
Office Work	1	0.98
Others (business)	2	1.96
Total	102	100

Table 7b shows that 94 (92.16 %) of the mothers of the respondents work in the farm, 5 (4.9 %) are teaching, 2 (1.96 %) are on business and only 1 (0.98 %) is working in an office.

Such findings indicate that even mothers of the respondents are depending on farming for their source of income.

Family Income

Table 8 Distribution of College Freshmen in terms of Family Income

Family Income	Frequency (F)	Percentage (%)	Mean (\bar{x})	SD
P 31,000 – 50,000	48	46.07	59,751.69	25,107.32
51,000 – 70,000	36	35.29		
71,000 – 90,000	1	0.98		
91,000 – 110,000	8	7.84		
111,000 – 130,000	9	8.82		
Total	102	100		

Table 8 shows the distribution of the college freshmen in terms of family income as indicated by the following figures: 48 (46.07 %) have an income ranging from 31,000.00 to 50,000.00; 36 (35.29 %) have an income ranging from 51,000.00 to 70,000.00; 9 (8.82 %) have income of 91,000.00 to 110,000.00; 8 (7.84 %) from 91,000.00 to 110,000.00 and only 1 (0.98 %) from 71,000.00 to 90,000.00.

These data indicate that almost all of the families of the respondents are poor.

Nature of Residence

Table 9 Distribution of College Freshmen in terms of Nature of Residence

Nature of Residence	Frequency (F)	Percentage (%)
Own House	12	11.76
Relative's House	20	19.61
Boarding House	70	68.63
Total	102	100

Table 9 shows that 70 (68.63 %) of the subjects stay in a boarding house, 20 (19.61 %) in a relative's house and 12 (11.76 %) in their own house while they are studying. This results show that majority of the respondents are far from their home.

Number of Hours per Week Devoted in Studying Plane Trigonometry

Table 10 Distribution of College Freshmen in terms of Number of Hours per Week Devoted in Studying Plane Trigonometry

Number of Hours Devoted to Studying Plane Trigonometry	Frequency (F)	Percentage (%)	Mean (\bar{x})	SD
1 – 2	5	4.90		
3 – 4	88	86.27	3.58	0.73
5 – 6	9	8.82		
Total	102	100		

The average number of hours per week spent by the student respondents in studying Plane trigonometry is ranging from 3 to 4 hours as indicated by the mean 3.58. Out of the total number of respondents, 88 (86.27 %) spend 3 to 4 hours per week, 9 (8.82 %) spend 5 to 6 hours and 5 (4.90 %) spend 1 to 2 hours.

This shows that the students have allotted a very minimal amount of time per week in studying Plane Trigonometry the fact that they may have reserved even only an hour per day to study Plane Trigonometry which would eventually increase the time they should have consumed for such activity thereby increasing also their capability in answering word problems since they have more time to practice solving problems.

Level of Achievement of the College Freshmen

Table 11a Overall Level of Achievement of the College Freshmen in Plane Trigonometry in terms of Pretest (Leaño, 1995)

Group of Respondents	Achievement in Plane Trigonometry	
	Mean	Quantitative Description
Experimental Group	20.38	Below Average
Control Group	18.91	Below Average
Overall Mean	19.65	Below Average

Table 11a shows that the experimental group has obtained a mean score of 20.38 in the pretest. This indicates that it belongs to the “below average” level of achievement, while the control group has obtained a mean score of 18.91 which indicates that it also belongs to the “below average” level of achievement. Thus, the overall achievement level of the two groups is “below average” as shown by the overall mean 19.65.

Table 11b Overall Level of Achievement of College Freshmen in Plane Trigonometry in terms of Posttest (Leaño, 1995)

Group of Respondents	Achievement in Plane Trigonometry	
	Mean	Qualitative Description
Experimental Group	31.04	Above Average
Control Group	24.27	Average
Overall Mean	27.66	Average

Table 11b shows that the experimental group has obtained a mean score of 31.04 in the posttest. This indicates that it belongs to the “above average” level of achievement, while the control group has obtained a mean score of 24.27 which indicates that it belongs to the “average” level of achievement. Thus, the overall achievement level of the two groups is “average” as shown by the overall mean 27.66. The results also show that although there was an improvement in the students’ level of achievement in both groups, it is very evident that the group which was exposed to the mathematics bibliotherapy had obtained a higher percentage of improvement compared to the group of students which was taught using the conventional method of teaching problem solving. Thus, it can be inferred that the use of the mathematics bibliotherapy model as a

new method in teaching problem solving had contributed to the increase of the students' level of achievement in problem solving.

Achievement of the Two Groups of Students

Table 12 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method with Mental Ability Test Equivalent Grades as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Treatment	1	1185.67	1185.67	47.94*	0.0001
Error	99	2447.84	24.73		
Covariate	1	87.49			
Total	101	3721.00			

*significant

The table shows that the probability level 0.05 is higher than the actual probability value which is 0.0001. This means that the null hypothesis stating that there is no significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method using the mental ability test equivalent grades as covariate is rejected.

This implies that the use of the mathematics bibliotherapy model as a new method in teaching problem solving improves the problem solving achievement of the college freshmen even if the effect of mental ability test equivalent grades is removed.

It also infers that the implementation of the mathematics bibliotherapy model as a technique in teaching problem solving enhanced the problem solving capability of the students hence they were able to obtain higher scores than those who were taught using the conventional method of teaching problem solving.

Table 13 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method with Reading Comprehension Ability Test Scores as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Treatment	1	1300.86	1300.86	48.32*	0.0001
Error	99	2665.50	26.92		
Covariate	1	54.64			
Total	101	4021			

*significant

The table shows that the probability level 0.05 is higher compared to the actual probability value of 0.0001. This proves that there is a significant difference between the achievement of college freshmen exposed to the mathematics bibliotherapy model and the conventional teaching method using the reading comprehension ability test score as covariate. This result reveals that the mathematics bibliotherapy model is a more effective method of teaching problem than the conventional method even after removing the effect of reading comprehension ability test scores.

This significant difference also implies that the students' exposure to the mathematics bibliotherapy enabled them to achieve higher scores compared to those students who were exposed to the conventional method of teaching problem solving.

Table 14 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method with Final Grades in College Algebra as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Treatment	1	1092.04	1092.04	53.22*	0.0001
Error	99	2031.81	20.52		
Covariate	1	897.14			
Total	101	4090.99			

*significant

It is shown in the table that the probability level 0.05 is greater than the actual probability value of 0.0001. Hence the null hypothesis stating that there is no significant difference between

the problem solving achievement of college freshmen exposed to the conventional method of teaching and the mathematics bibliotherapy model is rejected. This is an indication that even if the effect of the final grades in College Algebra was removed, mathematics bibliotherapy model was still proven to be the better method of teaching problem solving compared to the conventional method of teaching.

Table 15 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method with Final Grades in Study and Thinking Skills as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Treatment	1	970.25	970.25	43.72*	0.0001
Error	99	2197.07	22.19		
Covariate	1	853.69			
Total	101	4021.01			

*significant

There is a significant difference between the achievement of college freshmen exposed to the math bibliotherapy model and the conventional teaching method using the final grade in Study and Thinking Skills as covariate. This is proven by the 0.05 probability level being greater than the actual probability value which is 0.0001. This implies that the use of the math bibliotherapy model as a new method in teaching problem solving resulted to higher achievement of students in problem solving, an indication that the students who were exposed to the mathematics bibliotherapy performed better than the students who were taught using the conventional method of teaching problem solving.

The results obtained on the analysis of covariance in the foregoing sets of data corroborates with the study conducted by Houtveen (2007) on the "Effects of Metacognitive Strategy Instruction on Reading Comprehension and Achievement in Mathematics". In her study, the learning gains made by the students in the experimental group (metacognitive strategy) turned out to be significantly greater than those made by the students in control group (traditional method).

Table 16 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method Subjected to Ability Groupings

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Factor A (Treatments)	1	1039.84	1039.84	32.41*	0.02
Factor B (Ability Groups)	2	1008.05	504.02	14.27*	0.07
Interaction (A x B)	2	70.62	35.31	1.92 ^{ns}	0.15
Error	96	1768.80	18.43		
Total	101	82041.00			

*significant ^{ns} not significant

The table reveals the there is no significant interaction between the methods of teaching problem solving and the ability groupings on the students' achievement as shown by the 0.05 level of significance being less than the actual probability value of 0.15. This implies that the mathematics bibliotherapy model is applicable to any ability grouping to which the students may belong. This further proves that whether a student belongs to the low ability group, average ability group or high ability group, he would be a better solver than one who may be in the same ability group but was not taught using the mathematics bibliotherapy model as a method in problem solving.

The following data also reveals the mean achievement of each of the ability groups exposed to the two methods of teaching problem solving:

Table 17 Mean Scores of the Ability Groups Exposed to the Two Methods of Teaching Problem Solving

Factor B (Ability Groupings)	Factor A (Treatment)		Overall (column)
	Control	Experimental	
Low Ability Group	23.19	28.06	25.625
Average Ability Group	24.46	32.22	28.34
High Ability Group	30.67	42.33	36.50
Overall (row)	24.43	31.29	27.86

Table 17 shows the mean score of each of the ability groups of the college freshmen exposed to the two methods of teaching problem solving. The low ability group of the students exposed to the mathematics bibliotherapy model has attained a mean score of 28.06 which is higher than that of the low ability group of the students exposed to the conventional method of teaching problem solving which is 23.19. The overall mean score of the low ability groups is 25.625.

The average ability group of students treated with mathematics bibliotherapy model obtained a mean score of 32.22 while the mean score of the students treated with the conventional method of teaching problem solving is only 24.46. These figures resulted to the overall mean score of the average ability group which is 28.34.

The mean score obtained by the high ability group exposed to mathematics bibliotherapy model which is 42.33 is seen to be higher than the mean score obtained by the high ability group of students exposed to the conventional method of teaching problem solving. Hence, the overall mean score of the high ability group of students is found to be 36.50.

The experimental group had obtained an overall mean score of 31.19 while the control group obtained an overall mean score of 24.43.

All of these results indicate that the mathematics bibliotherapy model is a more effective method of teaching problem solving than the conventional method of teaching.

Table 18 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method Subjected to Ability Groupings with Mental Ability Test Equivalent Grades as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Model	6	2125.53	354.26	17.76	0.00
Factor A	1	701.12	701.12	35.14*	0.00
Factor B	2	757.15	378.57	18.97*	0.00
Interaction (A x B)	2	83.37	41.69	2.09 ^{ns}	0.13
Covariate	1	76.79	76.79	3.85	0.05
Error	95	1895.46	19.95		
Total	101	4020.99			

*significant ^{ns} not significant

Table 18 shows that Factor A, the methods of teaching problem solving has the 0.05 level of significance higher than the actual probability value. It means that the null hypothesis stating that there is no significant difference in the achievement in problem solving of students who were exposed to various methods of teaching problem solving is rejected. This implies that the implementation of the mathematics bibliotherapy model to the treatment group has made it obtain higher level of achievement than the group which was treated with the conventional method of teaching.

Likewise, the table shows that there is a significant difference between the three types of ability groupings which are high ability group, average ability group, and low ability group and the students' achievement as shown by 0.05 level of significance being greater than the actual probability value. This implies that the ability groupings have effects on the achievement of students in problem solving, that is, the higher is the ability grouping where a student belongs, the higher is his achievement in problem solving.

The interaction between the methods of teaching problem solving and the ability groupings is not significant as indicated by actual probability value which is greater than 0.05 level of significance. Hence, the null hypothesis stating that there is no significant interaction between the methods of teaching problem solving and the ability groupings with the achievement of students in mathematics is accepted. Thus, they do not have interactive effect on the students' achievement. This means that the performances of the different ability groups are the same. Each group would perform better when treated with mathematics bibliotherapy even if the effect of the covariate mental ability test equivalent grades is removed.

Table 19 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method Subjected to Ability Groupings with Reading Comprehension Ability Test Scores as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Model	6	2094.99	349.16	17.22	0.00
Factor A	1	749.43	749.43	36.97*	0.00
Factor B	2	648.74	324.37	16.00*	0.00
Interaction (A x B)	2	77.70	38.85	1.92 ^{ns}	0.15
Covariate	1	46.24	46.24	2.28	0.13
Error	95	1926.00	20.27		
Total	101	4020.99			

*significant ^{ns} not significant

Table 19 shows that Factor A, the methods of teaching problem solving has the 0.05 level of significance higher than the actual probability value. It means that there is significant difference in the achievement in problem solving of students who were exposed to various methods of teaching problem solving. This implies that the mathematics bibliotherapy model has improved the achievement of students in mathematics, particularly in problem solving.

The table also shows that there is a significant difference between the three types of ability groupings which are high ability group, average ability group, and low ability group and the students' achievement as shown by 0.05 level of significance being greater than the actual probability value. This implies that the ability grouping of a student determines his achievement in problem solving. A student belonging to the high ability group would have a higher achievement than the one who belongs to the average or low ability group.

Further, the interaction between the methods of teaching problem solving and the ability groupings is not significant since the 0.05 level of significance is less than the actual probability value of 0.15. Hence, the null hypothesis stating that there is no significant interaction between the methods of teaching problem solving and the ability groupings with the achievement of students in mathematics is accepted. This means that regardless of the ability group to which a student belongs, he would perform better when he is exposed to the new method of teaching problem solving, the mathematics bibliotherapy.

Table 20 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method Subjected to Ability Groupings with Final Grades in College Algebra as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Model	6	2259.03	376.50	20.30	0.0001
Factor A	1	783.56	783.56	42.25*	0.0001
Factor B	2	138.00	69.00	3.72*	0.0001
Interaction (A x B)	2	65.96	32.98	1.78 ^{ns}	0.1700
Covariate	1	210.28	210.28	11.34	0.0011
Error	95	1761.96	18.55		
Total	101	5218.79			
*significant	^{ns}	not significant			

Table 20 shows that Factor A, the methods of teaching problem solving has 0.05 level of significance higher than the actual probability value, thus, the null hypothesis stating that there is no significant difference in the achievement in problem solving of students who were exposed to various methods of teaching problem solving is rejected. This implies that the mathematics bibliotherapy model helps improve the achievement of students in problem solving.

It is also gleaned from the table that there is a significant difference between the three types of ability groupings which are high ability group, average ability group, and low ability group with the students' achievement as shown by the 0.05 level of significance being greater than the actual probability value. This implies that the higher the ability group to which a student belongs, the better is his performance in problem solving.

The interaction between the methods of teaching problem solving and the ability groupings is not significant as indicated by 0.05 level of significance being less than the actual probability value. Hence, there is no significant interaction between the methods of teaching problem solving and the ability groupings with the achievement of students in problem solving. This is an indication that to whichever ability group the students belong if treated with mathematics bibliotherapy, they will likely to have better achievement or performance in problem

solving than those who had their lessons taught using the conventional method of teaching problem solving.

Table 21 Analysis of Covariance Summary Table on the Achievement of the Two Groups of Students exposed to Mathematics Bibliotherapy Model and the Conventional Teaching Method Subjected to Ability Groupings with Final Grades in Study and Thinking Skills as Covariate

Source of Variation	Degrees of Freedom	Adjusted Sum of Squares	Adjusted Mean of Squares	F-Ratio Value	Actual Probability Value
Model	6	2303.64	383.94	21.24	2.196
Factor A	1	720.87	720.87	39.88*	3.946
Factor B	2	280.44	140.22	7.76*	3.096
Interaction (A x B)	2	69.83	34.91	1.93 ^{ns}	3.096
Covariate	1	254.89	254.89	14.10	3.946
Error	95	1717.35	18.08		
Total	101	4020.99			

*significant

^{ns} not significant

Table 21 shows that Factor A, the methods of teaching problem solving has 0.05 level of significance being higher than the actual probability value. It means that the null hypothesis stating that there is no significant difference in the achievement in problem solving of students who were exposed to various methods of teaching problem solving is rejected. This implies that the mathematics bibliotherapy model helps in improving the achievement of students in mathematics, particularly in problem solving.

Likewise, the table shows that there is a significant difference between the three types of ability groupings which are high ability group, average ability group, and low ability group since 0.05 level of significance is greater than the actual probability value. This implies that the ability groupings also affect the achievement of students in such a way that a student who belongs to the low ability group would have a lower achievement in problem solving than with someone who belongs to either the average ability or the high ability group.

The interaction between the methods of teaching problem solving and the ability groupings is not significant as indicated by the 0.05 level of significance being less than the actual probability value. Hence, the null hypothesis stating that there is no significant interaction

between the use of math bibliotherapy model as a method of teaching problem solving and the ability groupings with the achievement of students in mathematics is accepted, thus, they do not have any interactive effect on the problem solving achievement of the students. Each ability group performs better it is treated with mathematics bibliotherapy.

The Scheffé Method of comparison was also used to determine the mean differences between each pair of ability groupings such as the low ability group, average ability group, and high ability group. The mean difference between the low ability group and the high ability group; between the low ability group and the average ability group and between the average ability group and the high ability group were determined in consideration to the different covariates such as mental ability test equivalent grades, reading comprehension ability test scores and final grades in Study and Thinking Skills.

The results are as shown:

Table 22 Comparison of Adjusted Means by Ability Groupings and Teaching Methods with Mental Ability Test Equivalent Grades as Covariate

Factor B (Ability Groupings)	Mean Difference	Probability
Low – Average	-3.695*	0.035
Low – High	-10.426*	0.001
Average – High	-6.731*	0.030

*significant

Table 22 shows the mean differences in achievement between the low ability group and the average ability group; between the low ability group and the high ability group and between the average ability group and the high ability group. Each difference is found to be greater than the corresponding actual probability value. This means that there is a significant difference between the means of the low ability group and the average ability group; the low ability group and the high ability group and the average ability group and high ability group. Such results imply that the average ability group performed better than the low ability group but not with the high ability group. Likewise, the high ability group performed better than the average ability group and the low ability group.

Table 23 Comparison of Adjusted Means by Ability Groupings and Teaching Methods with Reading Comprehension Ability Test Scores as Covariate

Factor B (Ability Groupings)	Mean Difference	Probability
Low – Average	-3.347*	0.002
Low – High	-10.169*	0.001
Average – High	-6.821*	0.003

*significant

Table 23 shows the mean differences in achievement between the low ability group and the average ability group; between the low ability group and the high ability group and between the average ability group and the high ability group. Each of these differences is found to be greater than the corresponding actual probability value. This means that there is a significant difference between the means of the low ability group and the average ability group; the low ability group and the high ability group and the average ability group and high ability group. Such results imply that the average ability group performed better than the low ability group but not with the high ability group. Likewise, the high ability group performed better than the average ability group and the low ability group.

Table 24 Comparison of Adjusted Means by Ability Groupings and Teaching Methods with Final Grades in Study and Thinking Skills as Covariate

Factor B (Ability Groupings)	Mean Difference	Probability
Low – Average	-2.386*	0.037
Low – High	-7.468*	0.001
Average – High	-5.082*	0.030

*significant

Table 24 shows the mean differences in achievement between the low ability group and the average ability group; between the low ability group and the high ability group and between the average ability group and the high ability group. The actual probability value is found to be less than every corresponding mean difference. This means that there is a significant difference between the means of the low ability group and the average ability group; the low ability group and the high ability group and the average ability group and high ability group. Such results imply that the average ability group performed better than the low ability group but not with the high

ability group. Likewise, the high ability group performed better than the average ability group and the low ability group.

These results have the same bearing with the study conducted by Ireson (2002) in her dissertation entitled "Ability Grouping in English Secondary Schools: Effects on Attainment in English, Science and Mathematics" wherein she found that placement in a high, middle or low ability grouping has a significant effect on mathematics attainment.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study aimed to determine the effects of mathematics bibliotherapy model and ability groupings on the problem solving achievement of college freshmen in Plane Trigonometry within the content areas of Trigonometric Functions, Solutions of Right Triangles and Applications (Solutions of Right Triangles).

The study was conducted at the Ifugao State College of Agriculture and Forestry, Institute of Arts and Sciences, Nayon, Lamut, Ifugao during the second semester of the School Year 2007 – 2008. A total sample of 102 college freshmen served as the respondents of the study. A Personal Information Questionnaire and a fifty-item multiple choice type of Achievement Test constructed by the researcher were the instruments used to gather the pertinent data required in this study.

The data were analyzed using descriptive and inferential statistics. In describing the data gathered regarding the profile of the respondents, the study made use of the frequency counts, percentages, means and standard deviations while in the analyses of the significant relationships among variables, the Analysis of Covariance was utilized.

The Scheffé Method (S – Method) was utilized to compare the mean differences of the three ability groupings namely the low ability group, average ability group and high ability group which were subjected to the two methods of teaching problem solving, the conventional method and the use of mathematics bibliotherapy model.

The 0.05 probability level (level of significance) was used as the critical point of reference. The results were portrayed in tabular forms and presented in narrative reportorial method.

Based on the results of the study, the following findings have been attained:

1. Profile of the Respondents.

The mean age of the college freshmen subjected in this study is 18.46 years old which implies that most of the college freshmen entered college at a later age. The males dominate the

course BS Criminology in the College having a total number of 75 (73.53%) compared to their female counterpart being 27 (26.47%) only.. Only one among the college freshmen is married. Most of the families of the student respondents are predominantly Roman Catholic and the dominant ethnic group in the College is Ifugao. Most of the parents finished their studies up to elementary and high schools and the most common source of their livelihood is farming, the probable reason that led them to be among the poor families of the province. The respondents are far from the school where they have enrolled so that 70 (68.63) were staying in boarding houses. The respondents were spending a very minimal amount of time in studying Plane Trigonometry, about 3 – 4 hours per week.

2. Achievement of the Respondents.

The overall level of achievement of the college freshmen in Plane Trigonometry in terms of their pretest is “Below Average” (mean = 19.65). However, after a particular treatment (conventional method for the control group and mathematics bibliotherapy for the experimental group) was given to each of the two groups, the control group obtained a mean score of 24.27 (Average Level) while the experimental group achieved a higher level equivalent to 31.04 (Above Average Level) in the posttest. Such means resulted to the overall posttest mean score of 27.66 which is described to be “Average” level of achievement.

The analysis of covariance on the achievement of the students who were exposed to the mathematics bibliotherapy model and the conventional method of teaching problem solving with mental ability test equivalent grades, reading comprehension ability test scores, final grades in college algebra and final grades in Study and Thinking Skills as covariates showed that there was a significant difference between the achievement of students who were exposed to the use of the mathematics bibliotherapy model in problem solving and those who were taught using the conventional method of teaching.

The interaction between the methods of teaching and the ability groupings on the students' achievement was also found to be insignificant which means that any ability group when treated with mathematics bibliotherapy will improve in its achievement in problem solving.

When the interaction between the methods of teaching problem solving and the ability groupings with mental ability test equivalent grades, reading comprehension ability test scores, final grades in College Algebra and final grades in Study and Thinking Skills as covariates was tested, the results revealed that there was no significant interaction that has existed between the two factors. This is an indication that the ability groupings did not significantly contribute with the achievement of the intact classes from a given covariate.

In the comparison of adjusted means by ability groupings, results revealed that there was a significant difference between the means of the low ability group and average ability group; the low ability group and high ability group; and the average ability group and high ability group. These results indicate that a higher ability group would always perform better than a lower ability group whether it is exposed neither to the conventional method nor to the mathematics bibliotherapy model.

Conclusions

In view of the findings, the following conclusions were drawn:

1. The mean age of the college freshmen subjected in this study is 18.46 years old which implies that most of the college freshmen entered the college at a later age.
2. The males dominate the course BS Criminology in the College.
3. Most of the college freshmen are single.
4. Most of the families of the respondents are being influenced by Catholic doctrines.
5. The dominant ethnic group in the college is Ifugao.
6. Most of the parents of the respondents are low educated.
7. The most common source of livelihood of the respondents' parents is farming.
8. Most of the families of the respondents are poor.
9. Residences of the respondents are far from the school where they have enrolled.
10. The respondents spend a very minimal amount of time in studying Plane Trigonometry.
11. The achievement level of the control group is "average" while the

achievement level of the experimental group is “above average” and the overall achievement level attained by the two groups is “average”.

12. There was a significant improvement on the achievement of the group of students who were exposed to the use of the mathematics bibliotherapy model in teaching problem solving.
13. The mathematics bibliotherapy model as a new method of teaching problem solving is applicable to all ability groupings - the low ability group, the average ability group and the high ability group.

Recommendations

Based from the foregoing findings and conclusions, the researcher offers the following recommendations:

1. Administrators and mathematics instructors/professors should advocate the use of Mathematics Bibliotherapy Model to enhance teaching in problem solving.
2. Curriculum designers to include Problem Solving as a subject in mathematics curricula.
3. A replication of the study should be conducted in other fields of mathematics like College Algebra, Geometry, and Higher Mathematics and also to related areas of learning like Physics and Chemistry likewise in the other year levels.
4. A conduct of Math Clinic is recommended using the mathematics bibliotherapy model as a way of enhancing problem solving. (A proposed math clinic design is found in Appendix R).

LITERATURE CITED

- Aquino, Gaudencio V. *Effective Teaching*. (2003) National Book Store. Mandaluyong City. Philippines
- Asaad, Abubakar S. and Hailaya, Wilhalm M. (2004). *Measurement and Evaluation: Concepts and Principles*. Rex Book Store. Manila. Philippines.
- Boaler, J. (1993). *The Role of Contexts in the Mathematics Classroom: Do they Make Mathematics More "Real"? For the Learning of Mathematics*.
- Boaler, J. (1994). "When Do Girls Prefer Football to Fashion?" An Analysis of Female Underachievement in Relation to 'realistic' Mathematics Contexts. *British Educational Research Journal*. Volume 20.
- Brown, A. L. (2002). *Metacognition, Executive Control, Self-Regulation and Other More Myterious Mechanisms*. Hillsdale, New Jersey. Lawrence Erlbaum Associates.
- Calderon, Jose F and Gonzales, Expectacion C. (1993). *Measurement and Evaluation*. National Book Store. Mandaluyong City. Ohilippines
- Caldwell, J. H. and Goldin, J. B. (1987). *Variables Affecting Word Problem Difficulty in Secondary School Mathematics*. *Journal for Research in Mathematics Education*.
- Conner, Marcia and Hodgins, Wayne. (2000). *Learning Styles*. <http://www.Learnativity.com/learningstyles.html>
- Cook, Katherine E. (2006). *Bibliotherapy, Intervention in School and Clinic*. Boston. USA
- Cook, Roberta. (1997). "An Exploration of the Relationship Between Mathematics Anxiety Level and Perceptual Learning Style of Adult Learners in a Community College Setting". *Dissertation Research for North America*.
- Davis-Dorsey, J. (1991). *The Role of Rewording the Context Personalization in the Solving of Mathematical Word Problems*. *Journal of Educational Psychology*.
- De Corte, E. (2003). "Fostering Cognitive Growth: A Perspective from Research on Mathematics Learning and Instruction." *Educational Psychologist*.
- Febre, Francisco A. (1987). *Introduction to Statistics*. Phoenix Publishing House, Inc. Quezon City. Philippines.
- Forgan, James W. (2002). *Teaching Problem Solving Through Children Literature*. USA
- Garcia, Evelyn (2004). "Enhancing Problem Solving Skills of Pre service Mathematics Teachers through a Bridging Course". *Dissertation*. De La Salle State University.
- Gardner, Howard. (1993). *Frames of Mind: The Theory of Multiple Intelligences (10th Anniversary Edition)*. New York: Basic Books.
- Hembre, R. (1992). *Individual and Teacher-Related Factors Which Influence Academic Help-Seeking of the Developmental Studies of Mathematics Students. Experiments and Relational Studies in Problem Solving*. Saint Peter's College. Jersey City. New Jersey. USA.
- Houtveen, A. A. (2007) "Effects of Metacognitive Strategy Instruction on Reading Comprehension and Achievement in Mathematics". *Utrecht University of Applied Sciences*. Utrecht. Netherlands.

- Ireson, Judith (2007). "Ability Grouping in English Secondary Schools: Effects on Attainment in English, Science and Mathematics. U London. Institute of Education. United Kingdom.
- Jones, L. G. ((1999). Context, Confidence and the Able Girl. Educational Research.
- Johnson, R. (2000). An analysis of Learner Variables Related to Achievement in an Introductory Graduate Statistics Course. New Jersey. USA.
- Leaño, B. P. (1995). "The Mathematics Achievement of Junior High School Students of NVGCHS, School Year 1994 – 1995. A Basis for Evolving An Instructional Model. PNU. Manila.
- Livingston, J. A. (1996). "Effects of Metacognitive Instruction on Strategy Use of College Students." Unpublished Manuscript. State University of New York. Buffalo.
- Macgregor, S. (2000). Helping Students Become Strategic Learners: Guidelines for Teaching. Cambridge, MA: Brookline Books.
- Mc Intosh, R. (2000). A View of Social Intervention for Students with Learning Disabilities. Journal of Learning Disabilities. California. USA.
- Mohamed, Mohini and Nai, Tan Ten (2005). "The Use of Metacognitive Process in Learning Mathematics". University Teknologi Malaysia.
- Padua, Roberto N.. Santos, Rosita G. 1997. Educational Evaluation & Measurement: Theory, Practice and Application. Katha Publishing Co., Quezon City.
- Peñaranda, Teresita P. (2004). "The Relationship Between Knowledge of Vocabulary and the Comprehension and Solving of Mathematical Word Problems". Dissertation. De La Salle State University.
- Punsalan, T. G. and Uriarte, G. G. (2003). Statistics: A Simplified Approach. Rex Book Store. Manila. Philippines.
- Raña, Perlita A. (1999). "Effect of Cooperative learning Strategy on the Mathematics Achievement of High School Students in Mathematics II". Nueva Vizcaya State Institute of Technology, Bayombong, Nueva Vizcaya.
- Rees and Ress. (1980). Trigonometry. Prentice Hall, Inc. Englewood Cliffs. New Jersey.
- Schoeder, Charles C. (1997). New Students-New Learning Styles. On Line: <http://www.virtualschool.edu/mon/Academia/kierseylearningstyles.html>.
- Schoenfeld, a. H. (1994). "Reflections on Doing and Teaching Mathematics." In "Mathematical Thinking and Problem solving". New Jersey: Lawrence Associated.
- Tall, D. (1994). "Understanding the Processes of Advanced Mathematical Thinking." Zurich: International Congress of Mathematicians.
- Thorndike, Robert and Elizabeth Hagen. 1991. Measurement and Evaluation in Psychology and Education. Macmillian Publishing Co.
- Wiest, Lynda (2002). Using Bibliotherapy to Overcome Math Anxiety. Hillsdale. NJ. Erlbaum.
- Wilson M. and Lloyd, G. M. (2000). Sharing Mathematical Authority with Students: The Challenge for High School Teachers. Journal of Curriculum and Supervision. NY. Macmillian.

Ybañez, Lydia M. (1993). Basic Statistics. Phoenix Publishing House, Inc. Quezon City. Philippines.

Van Zile-Tamsen, C. M. (1996). "Metacognitive Self-Regulation and the Daily Academic Activities of College Students." Unpublished Doctoral Dissertation. State University of New York. Buffalo.

Wiest, Lynda R. (2002). Aspects of Word Problems that Influence Children's Problem Solving Performance. Spring. USA.

Zan, R. (2000). "A Metacognitive Intervention in Mathematics at University Level." International Journal of Mathematical Education in Science and Technology.

Aquino, D. M. (2013). Effects of Mathematics Bibliotherapy Model and Ability Groupings on the Achievements of College Freshmen in Problem Solving. Open Science Repository Mathematics, Online(open-access), e23050452. doi:10.7392/openaccess.23050452