EFFECTIVENESS OF COOPERATIVE AND INDIVIDUALISTIC STUDENT'S ACTIVITIES IN MATHEMATICS III ACHIEVEMENT

A Thesis

Presented to

The Faculty of the Graduate School

Samar State Polytechnic College

Catbalogan, Samar

In Partial Fulfillment

of the Requirements for the Degree of

Master of Arts in Teaching Mathematics

SHERRIE ANN M. CANANUA

March 1998

APPROVAL SHEET

This thesis, entitled "**EFFECTIVENESS OF COOPERATIVE AND INDIVIDUALISTIC STUDENT'S ACTIVITIES IN MATHEMATICS III ACHIEVEMENT,**" has been prepared and submitted by **SHERRIE ANN M. CANANUA**, who, having passed the comprehensive examination, is hereby recommended for oral examination.

March 12, 1998
Date

EUSEBIO T. PACOLOR, Ph.D.
Adviser

Approved by the Committee on Oral Examination on March 12, 1998 with a rating of _____.

RIZALINA M. URBIZTONDO, Ph.D.
Chairman

FLORIDA B. MARCO
Member

ALMA O. UY
Member

MARILYN D. CARDOSO, Ph.D.
Member

Accepted and approved in partial fulfillment of the requirements for the degree of MASTER OF ARTS IN TEACHING (MATHEMATICS).

RIZALINA M. URBIZTONDO, Ph. D.
Dean, Graduate & Post Graduate Studies

Date of Oral Examination:
March 12, 1998

A C K N O W L E D G M E N T

The writer who, cognizant to her human limitations, could not have completed this piece of work alone, wishes to acknowledge with sincere and profound gratitude the following persons:

Dr. Eusebio T. Pacolor, Dean, College of Arts and Sciences, Samar State Polytechnic College, the researcher's adviser for his encouragement, patience and ever-ready assistance in the conduct of this study and for allowing her to use the brand new computer of his college.

Dr. Rizalina M. Urbiztondo, Dean of Graduate and Post Graduate Studies, Chairman of the Panel of Examiners, Prof. Alma O. Uy, Prof. Florida B. Marco, and Dr. Marilyn D. Cardoso, Head of the Research and Development Section, members of the Panel of Examiners, all of Samar State Polytechnic College for their constructive criticisms, pieces of professional advise and invaluable suggestions for the refinement and improvement of this research study.

Dr. Alfredo Dacuro, Superintendent of Eastern Samar Division, member of the Panel of Examiners on Pre-Orals for critically reading the pre-final manuscript and whose suggestions and recommendations were thoughtfully considered in the revision process.

Dr. Dominator Q. Cabanganan, President of Samar State Polytechnic College for constantly encouraging his personnel to pursue higher

A C K N O W L E D G M E N T

The writer who, cognizant to her human limitations, could not have completed this piece of work alone, wishes to acknowledge with sincere and profound gratitude the following persons:

Dr. Eusebio T. Pacolor, Dean, College of Arts and Sciences, Samar State Polytechnic College, the researcher's adviser for his encouragement, patience and ever-ready assistance in the conduct of this study.

Dr. Rizalina M. Urbiztondo, Dean of Graduate and Post Graduate Studies, Chairman of the Panel of Examiners, Prof. Alma O. Uy, Prof. Florida B. Marco, Dr. Marilyn D. Cardoso, Head of the Research and Development Section, members of the Panel of Examiners, all of Samar State Polytechnic College for their constructive criticism, pieces of professional advise and invaluable suggestions for the refinement and improvement of this research.

Dr. Alfredo Dacuro, Asst. Schools Division Superintendent, Division of Eastern Samar, member of the Panel of Examiners on Pre-Orals for critically reading the pre-final manuscript and whose suggestions and recommendations were thoughtfully considered in the revision process.

Dr. Dominador Q. Cabanganan, President of Samar State Polytechnic College for constantly encouraging his personnel the pursue higher

learning, for giving the researcher the chance to avail of the thesis aid, and for permitting her to use some facilities of the college in the conduct of her study.

Dr. Jovita C. Jadloc, Vice President for Academic Affairs, Leyte NormaL University and Prof. Alejandro E. Cananua, Board Secretary, Samar State Polytechnic College for their constant encouragement to the researcher which made herself determined to finish this investigation.

She would like to express her thanks to Prof. Norma Ricafort for patiently editing the manuscript.

This book has profited from the statistical expertise of Dr. Marilyn Cardoso in reviewing and checking the computations of this study.

Special acknowledgment is also due to Ms. Maryjes Grata for patiently assisting the researcher in encoding the tables and other computations; Miss Lolit O. Cugtas for lending her doctoral materials on cooperative learning; and Prof. Phebe R. Nacionales for the encouragement and cheer.

Thanks to her College of Education family composed of Ma'am Tess, Sir Bebot, Ma'am Gie, Ma'am Gigi, Ma'am Colette, Ma'am Vicky, Ma'am Totet, Ma'am Emie, Ma'am Irene, Ma'am Cora, Ma'am Nits, Ma'am Fely, Ma'am Alma, Ma'am Ethel, Ma'am Ida, Ma'am Linda, Ate Madelynn, Inoy, Dondon, and Ate Rose for their moral support, help and cheer.

This acknowledgment is not complete without expressing deep gratitude to her parents, Tex and Sylvia Cananua; brothers, Samuel, Shubert and Socrates, who are her abiding inspiration, and whose unfailing support and encouragement sustained her through the final writing of this book.

Above all, she thanks and praises God for His sustaining mercy, grace and strength which generated extra energy and vigor during the critical moments of her study.

s h e

To my God, who gives grace, mercy and love

To my parents and brothers, who are the pride of my life and the persons who inspire me to continue taking on this writing project and seeing it through to completion

I dedicate this piece of work.

s h e

ABSTRACT

In this context, the researcher was motivated to conduct the study. The researcher employed the experimental method of research using the pretest and posttest control design. This was used on 48 third year high school students of Samar State Polytechnic College through purposive sampling, matching their second year mathematical ratings. There was a significant relationship between mathematics achievement and attitude towards mathematics of the III- Orchids class since the computer r was 0.53. The computed r between the mathematics achievement and attitude towards the subject of the control group yielded to only 0.12. This indicated a very low correlation between variables. This result, therefore, accepted hypothesis number six which states that "There is no significant relationship between mathematics achievement and attitude towards mathematics with respect to the control group." High, average and low ability students using cooperative student activities perform better than their counterparts in the individualistic student activities. Moreover, cooperative student activities that use mixed ability grouping tend to be more effective for low ability and average ability students than for high ability groups. Both cooperative and individualistic student activities are effective strategies in increasing mathematics achievement of high ability students. Students who have a positive attitude towards mathematics tend to have high mathematics achievement in cooperative learning groups

TABLE OF CONTENTS

CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Introduction

Never before in the history of mankind has science been making its greatest impact than it is today. In our society, we all see evidences of tremendous changes brought about by the advancement of science. Science and technology according to UNESCO Report as cited by Oliva (1990) have been and will continue to be at the center of change, causing it, shaping it, and responding to it. Hence, the incessant call for relevance in science and technology education in all developing countries as well as developed countries at all times.

Mathematics is the foundation of science and technology, hence its importance cannot be overemphasized. Rapid technological and scientific advancement demands a greater need for any nation to acquire adequate knowledge and sufficient mathematical proficiency and skills. This can only be achieved through a relevant and effective mathematics instruction in the schools.

The present situation in our schools today shows the need for a more strengthened mathematics instruction and mathematics curriculum. Studies reveal the downward trend in mathematics achievement of learners both in the elementary as well as secondary level. The results of the

PRODED National Evaluation and Impact Survey showed the achievement of grade school pupils in mathematics to be the lowest among the five subjects tested. What was disturbing in the results was that from Grade 2 to Grade 6 there was a consistent decrease in pupils' achievement in mathematics as measured by grade level tests. This consistent downward trend in scores in Mathematics was found in other subjects in elementary schools.

In the Evaluation of the Secondary Evaluation Development Program (Ibe, 1993) the same trend was noted: Students' performance in mathematics continued to be poor. In almost all the studies conducted, mean performance scores were roughly within the range 26 to 34 percent of the number of test items used. This was also consistently the case in studies of performance in National tests like the NSAT, the NEAT, and the DOST-SEI Scholarship tests.

The poor performance of the students in mathematics is reflected in classrooms. To many students mathematics is one of the most disliked subjects. They find the subject hard to understand. Because of its hard nature students cannot easily grasp concepts and ideas. However this is not the only reason. Ibe (1993) in her speech on the Scenario in Mathematics Teacher Education: Issues and Constraints, has this incisive comment: "Much of the dislike for mathematics perhaps could be

traced to teachers who are wanting either in sufficient knowledge in the subject or in ways of teaching- hence are not able to teach it well."

There are many views as there are many researches on students' learning, implying that achievement is related to, or being influenced by some factors. While researches show that student achievement is influenced by factors inherent in individuals, Kelly as cited by Pacolor (1993) contends that students' learning likewise depends on the teacher.

Thus, there is a critical need on the part of the teacher to develop instructional strategies that will promote positive attitude towards the subject being studied and increase students' motivation to study. Cooperative learning has something to offer. According to Anderson (1989), when done correctly, it tends to promote higher achievement, greater motivation, more positive attitude toward the subject area and the teacher, greater self-esteem and psychological health, greater social skills, and many positive instructional outcomes.

In this context, the researcher was motivated to conduct the study as to how effective is the cooperative learning in teaching Mathematics III, with the aim of having it as one of the strategies to be employed in teaching mathematics.

Statement of the Problem

This study attempted to investigate the effectiveness of Ocooperative and individualistic student activities on mathematics

achievement of third year high school students of Samar State Polytechnic College, Catbalogan, Samar, SY 1997-98. Specifically it sought answers to the following questions:

1. What are the pretest and posttest mean scores of the third year high school students in mathematics achievement test in experimental and control class?

2. Is there a significant difference between the mean scores of the experimental and control groups per

2.1 pretest?

2.2 posttest?

3. Is there a significant difference between the pretest and posttest mean scores of:

3.1 experimental group?

3.2 control group?

4. Is there a significant difference in the posttest mean scores between experimental and control groups on

4.1 recall and comprehension?

4.2 application and problem solving?

5. Is there a significant difference in the posttest mean scores of the experimental and control groups among students with high, average, and low-ability?

6. What is the attitude level of the third year high school students toward mathematics?

7. Is there a significant relationship between mathematics achievement and attitude towards mathematics of:

7.1 experimental group?

7.2 control group?

Null Hypotheses

1. There is no significant difference between the experimental and control groups with respect to their pretest and posttest mean scores.

2. There is no significant difference between the pretest and posttest mean

score of the experimental group.

3. There is no significant difference between the pretest and posttest mean score of the control group.

4. There is no significant difference in the posttest mean score between the experimental and control groups on

4.1 recall and comprehension

4.2 application and problem solving

5. There is no significant difference in the posttest mean scores of the experimental and control groups among students with high, average and low-ability.

6. There is no significant relationship between mathematics achievement and attitude towards mathematics of both the experimental and control groups.

Theoretical and Conceptual Framework

This study is based on Piaget's Theory of Cognitive Development. Piaget identified social interaction as necessary for cognitive development. Children and adolescents, in their interaction with peers, directly learn attitudes, values and skills and information unobtainable from adults, such as how to deal with conflict or temptation. In their interaction with each other, children and adolescents imitate each other's behavior and identify with friends possessing admired competencies. By way of providing models, enforcement, and direct learning, peer shape a wide variety of social behaviors, attitude and perspectives. Kamii (1984:89) support the idea by stating that exchanging points of view contributes to students' social effective moral and political development.

Piaget stressed that peer group also provides a standard by which individuals can measure themselves during the process of identity formation. Within the peer group, a young person can try out a variety of roles. The values and norms of the group permit adolescents to acquire a perspective on their own values and attitudes. A peer group

can also help them to make the transition from reliance on the family to relative independence (Groiler Encyclopedia for Knowledge,1995;97).

Cooperative social situation is one in which the goals of the separate individuals are so linked together that there is a positive correlation among their goal attainment. An individual can reach his/her goal only if the other participants can obtain their goals. Thus students seek outcomes that are beneficial to all those with whom they are cooperatively linked.

Piaget's theory is further bolstered by Dewey's theory of Experiential Learning as cited by Johnson & Johnson (1987;17). According to him, experiential learning affects the learners in three ways: (1) the learner's cognitive structures are altered, (2) the learner'' attitude are modified, and (3) the learner's repertoire of behavior is expanded. To be affected in these three ways, learner must pay attention to their actions, theories, knowledge, attitudes, perceptions, of self and social environment and behavior patterns.

Learning is best when it is made a social process, integrating itself with environment, (Gregorio, 1976;144). In varying degrees each person influence others, and vice versa as cited by him. This principle is based on the philosophy of Spencer who said "that education is a social process and should therefore aim toward individual development and social efficiency. Each individual is a part of a larger organic

whole, and in his functioning it is the good of the whole which is paramount importance. The aim of education must be broad enough to include both the welfare of the individual and the good of society. In a democratic country like ours, each individual must refer his own actions to those of others. He must consider the actions of others to give meaning and direction to his own. The more we enter into the meaning and purposes of others the more meaningful life becomes. We cannot separate the individual's mental life from social life.

The schema that follows on page 9 (Figure 1) shows the conceptual framework of the study. The first frame at the bottom contains the 48 third year high school students of Samar State Polytechnic College who served as the subjects of the study. These subjects were divided into two groups: the control group on the left side of the schema and the experimental group on the right side. Students of these groups were categorized according to ability levels as high, average and low. Both groups were given a pretest to determine the entry behavior of the students on the subject. For the instruction, the control group was exposed to individualistic student activities while the experimental group was exposed to cooperative student activities. At the end of the grading period both groups were given the Attitudinaire and Posttest. The results of the pretests and posttests were evaluated using the appropriate statistical tool to find out any significant improvement.

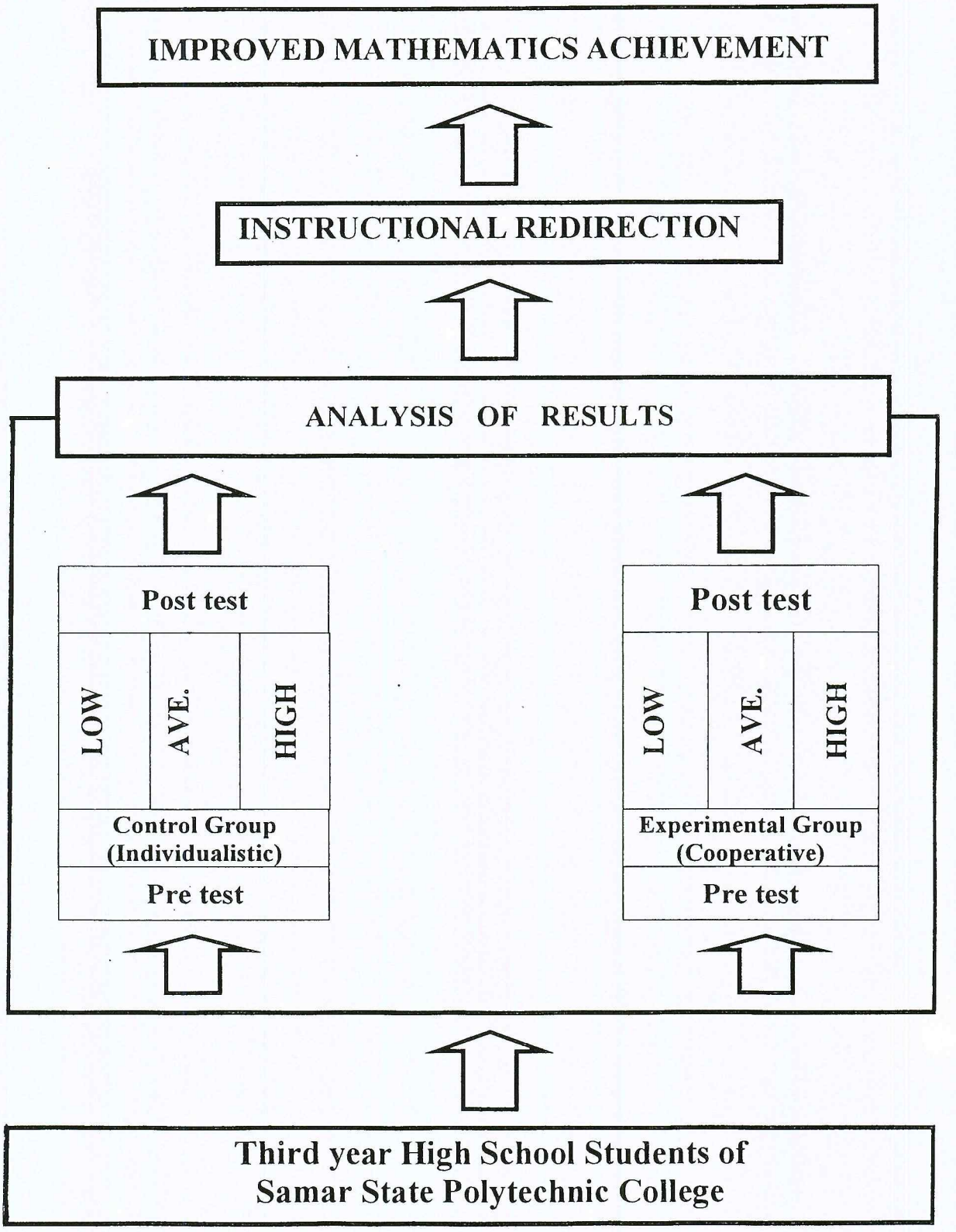

Fig. 1 *Schema of the Conceptual Framework showing the research environment and Program of the study.*

The findings and their implications would serve as feedback mechanisms to the concerned students for instructional redirection in order to attain the ultimate goal of the study which is improved mathematics achievement.

Significance of the Study

Modern mathematics education does not only call for the upgrading of mathematics competencies of teachers, development of instructional materials also the changing of instructional strategies by considering how a student learns best rather than how an instructor teaches best. This change has led to a shift from teacher-centered activities such as lectures and teacher-led discussions to student-centered activities such as problem-based and cooperative learning.

This study on the effectiveness of cooperative learning and individualistic strategies will be beneficial to various groups of individuals because of its relevance in our times.

To the Students. They are the motivating force in the conduct of this study. Policies that will be formulated by the administrators are intended to improve the quality of instruction that they are exposed with. Moreover, their understanding and learning will be further facilitated with their teachers being knowledgeable of the different innovations and techniques that can be used in teaching. Cooperative learning strategy will help them improve and develop higher level of

cognitive skills, increase their achievement and self-esteem, and improve their problem-solving and communications skills (McEnerney, 1994:166).

To the Teachers. The result of this study will encourage them to try other effective strategies and approaches in teaching mathematics. It will motivate them to use cooperative learning in their classes, thus changing their role of being strictly as content expert to an instructor who will serve as facilitator, observer and encourager. An additional benefit is that the instructor can observe how students learn from each other and diagnose learning difficulties or identify those who need additional help.

To the Administrators and Officials. The findings of the study will provide insights of improving mathematics instruction by means of upgrading teacher competencies and mastery of instructional strategies through in-service training.

To the Curriculum Planners. The result of the study will be used to help evaluate the strengths and weaknesses of the existing curriculum in school, conceive better strategies/techniques that could contribute further to the development of positive and interest towards mathematics.

To the Parents. The primary concern of parents in sending their children to school is for them to learn. Support from them can easily

solicited if they realize that their children are exposed to teachers using effective strategies and approaches of teaching.

To the Future Researchers. The result of this study may be utilized by interested researchers in conceptualizing researchable problems of similar nature. Moreover, future researchers may be able to elicit an idea in terms of arriving at the design of their experiment if they are interested in delving into comparison of techniques or approaches in teaching mathematics.

Ultimately, the study will motivate the students, teachers, and administrators in striving for the attainment of quality education.

Scope and Delimitation of the Study

This study concerns mainly on the effectiveness of cooperative and individualistic student activities on mathematics achievement of third year high school students of Samar State Polytechnic College, Catbalogan, Samar, during the school year 1997-98.

The intervention was conducted for one grading period, i.e. from the second week of November to the second week of January or approximately 10 weeks covering the topics on Exponents and Radicals. It utilized a 60-item teacher made and validated pretest and posttest as basic sources of data.

An experimental method of research using the Pretest -Posttest Control Group Design was employed to 48 third year high school students

which was divided into two groups; 24 for the experimental group and 24 for the control group. Each group was composed of six high-ability students, 12 average-ability students and 6 low-ability students.

Definition of Terms

For the purposes of this study, the following terms are hereby defined:

Achievement. This refers to the accomplishment or proficiency of performance in a given skill or body (Good, 1973;7). In this study, achievement refers to the scores of the third year high school students in the pretest and posttest.

Control Group. A group of subjects matched with the experimental group, but not subject to treatment under investigation. The control group of an experimentation involving human beings is usually unaware of its status (Webster, 1995;212). In this study, this term refers to the 24 third year high school students enrolled in SSPC during SY 1997-98 who were taught using the individualistic student activities.

Cooperative Goal Structure. A learning environment in which students perceive they can obtain their goal if, and only if, the other students with whom they work can obtain their goals (Arends, 1997;285). In this study it refers to a learning environment in which all the members of the group have mastered the material given or the topic studied.

Cooperative Learning. A student-centered instructional strategy in which heterogeneous groups of students work toward achievement of common academic goal (McEnerney, 1994;166). In this study, the students in this situation are given three tasks: to learn to solve each assigned problem, to make sure that the other members of the group know how to solve each problems, and to make sure that everyone in the class knows how to solve each problem.

Experimental Group. A group of subjects matched with a control group, and is subjected to treatment under investigation (Webster, 1995:523). In this study, this term refers to the 24 third year high school students enrolled in SSPC during SY 1997-98 who were using cooperative student activities.

Evaluation. The process of making a judgment, assigning value; or deciding on the worth of a particular program, approaches, or a student's work (Arends, 1997;286).

Individual Goal Structure. A goal structure in which achievement of a goal by one student is unrelated to the achievement of the goal by other students (Arends, 1997;286).

Individual Learning. A situation wherein there is no cooperation among the goal attainments of the participants. Group members perceive that obtaining their goal is unrelated to the goal achievements of the group members (Johnson & Johnson, 1983;265).

Jigsaw. An approach to cooperative learning where students work in mixed ability group and each student is responsible for a portion of the material (Arends, 1997;287).

High-Ability. In this study this refers to the third year high school students whose second year Mathematics rating fall within the upper 25% of the sample arranged in descending order.

Low-Ability. In this study, this refers to the third year high school students whose second year Mathematics rating fall within the lower 25% of the sample arranged in descending order.

Average-Ability. Third year high school students whose second year Mathematics rating fall within the middle 50% of the sample arranged in descending order.

Mathematics III. A subject of the third year high school students that deals with the concepts, principles, processes and skills in Exponents, Radicals, Special Products and Factoring, Rational Expressions, Quadratic Equations and Functions, Variations, Similarity, Sequences and Series, Quartiles and Percentiles.

Pretest. This refers to the 60-item multiple type of test given to both control and experimental groups before the lesson. The test covers lessons on exponents and radicals.

Posttest. This refers to the 60-item multiple type of test given to both control and experimental groups after exposing them to

treatments. The test covers lessons on exponents and radicals. It has the same items with the Pretest but the item numbers have been disarranged.

Student Teams Achievement Divisions (STAD). An approach to cooperative learning in which students work in mixed-ability groups and rewards are administered and recognized for both individual and group effort (Arends, 1997;289).

Groups of Four. This model does not focus on achieving group goals, nor are individuals in the group accountable for group achievements. Rather, it simply involves having four students work together on some task.

Group Investigation/Small-Group Teaching. In this approach, the teacher assigns an area of study and a group of students select a topic related to the area that interests them. Through cooperative planning, the teacher and students decide how to investigate the topic and group tasks are assigned.

Student Team Learning. This method of cooperative learning involve competition among teams matched by ability. The emphasis is on achieving team goals, but individual accountability in terms of improving one's own performance is also important. Individual accountability encourages peer tutoring so that each student is prepared for an assessment.

Co-op Co-op. Co-op co-op is designed to provide conditions in which students' natural curiosity, intelligence, and expressiveness will emerge and develop. It is structured around a series of team-building exercises requiring students to interact with each other.

CHAPTER II

RELATED LITERATURE AND STUDIES

This chapter presents a review of various literature and studies which have relation to the present study.

Related Literature

Educators preparing for the twenty-first century are changing their instructional strategies by considering how a student learns best rather than how an instructor teaches best. This change has led to a shift from a teacher led-discussions to student-centered activities such as problem-based and cooperative learning.

In recent years, Joyce and Well (1986;12) pointed out that there has been a great deal of development work on cooperative learning and great progress has been made in developing strategies that help students work effectively together. The contributions of three teams led respectively by Roger and David Johnson, Robert Slavin and Shlomo Sharan- have been particularly notable, and the entire cooperative learning community has been active in exchanging information and techniques and in conducting and analyzing research.

McEnerney (1994;166) has defined cooperative learning as a student-centered instructional strategy in which heterogeneous groups of students work toward the achievement of a common goal.

Johnson and Johnson as cited by Anderson (1989;177) said that there are many ways in which cooperative learning may be used in a class. Learning basic facts, understanding concepts, higher level reasoning, problem solving and applying may all be best done in cooperative groups. The more conceptual the task, the more problem solving that is required and the more creative the answers need to be, the greater the superiority of cooperative over competition and individualistic learning. Cooperative learning is indicated whenever the learning goals are highly important, the task is complex or conceptual, problem solving is desired, divergent thinking or creativity is desired, quality of performance is expected, higher level reasoning strategies and critical thinking is needed, long-term retention is desired, or when social development of students is one of the major instructional goals.

According to him, there are five basic elements of cooperative learning. They are: positive interdependence, face-to-face interaction, individual accountability, collaborative skills, and group processing.

Positive interdependence is the perception that one is linked with others in a way that one cannot succeed unless the other members of the group succeed and vice versa. Face-to-face interaction exists when each students orally explain to each other how to solve problems, discuss with each other the nature of the concepts being learned.

Individual accountability, on the other hand, exists when the performance of each individual student is assessed and the results given back to the group and individual. It is important that the group knows who needs more assistance in completing the assignment. It is also important that group members know that they cannot "hitch-hike" on the work of others, that is, they must personally learn the assigned material. Collaborative skills include leadership, decision-making, trust-building, communication and conflict-management skills required for the students to work together productively. Groups cannot function effectively if students do not have and use the needed collaborative skills. These skills have to be taught just as purposely and precisely as academic skills.

Lastly, group processing occurs when groups discuss how well they are achieving their goals and maintaining effective working relationships among members. Group needs to describe what member actions are helpful and unhelpful and make decisions about what behaviors to continue or change. Such processing (a) enables learning groups to focus or group maintenance, (b) facilitates the learning of collaborative skills, (c) ensures that members receive feedback on their participation, and (d) reminds students to practice collaborative skills consistently.

There are three ways by which a teacher can structure students learning goals; competitively, individualistically, and cooperatively (Anderson, 1989;276). By structuring positive, negative or no interdependence, teachers can influence the pattern of interaction among students and the instructional outcome that results. Each time teachers prepare for a lesson, they must make decisions about the teaching strategies they will use. Teacher may structure academic lesson so that students are (a) in a win-lose struggle to see who is best, (b) learning individually on their own without interacting with classmates, or (c) learning in pairs or small groups helping each other master the assigned material. When lessons are structured competitively, students work against each other to achieve a goal that not only one or a few students can attain. Students are graded on a curve, which requires them to work faster and more accurately than their peers. In a competitive learning situations, students goal achievements are negatively correlated; when one student achieves his or her goal, all others with whom he or she is competitively linked fail to achieve their goals. Students seek outcomes that are personally beneficial but also are detrimental to the others with whom they are competitively linked. They either study hard to do better than their classmates or they take it easy because they do not believe they have the chance to win. In a competitively structured class, students would be given the task of completing the assignments

faster and more accurately than the other students in the class. They would be warned to work by themselves, without discussing the assignments with other students, and to seek help from the teacher if they needed it.

Teachers can also structure their lessons individualistically so that students work by themselves to accomplish learning goals unrelated to those of their classmates. Individual goals are assigned each day, students' efforts are evaluated on a fixed set of standards, and rewards are given accordingly. Each of a student has a set of materials and works at his or her own speed, ignoring the other students in the class. In an individualistic learning situations, students' goal achievement are independent; the goal achievement of one student is unrelated to the goal achievement of others. Students seek outcomes that are personally beneficial and they ignore as irrelevant the goal achievement of their classmates. In a class structured individualistically, students would be given the task of completing the assignments correctly to reach a preset criteria of excellence. Students would be told to work by themselves, without disturbing their neighbors, and to seek help and assistance from the teacher.

There is a third option. Teacher can structure lessons cooperatively so that students work together to accomplish shared goals (Anderson, 1989;278). Students are assigned to small groups and

instructed to learn the assigned material to make sure that the other members of the group also master the assignment. Individual performance is checked regularly to ensure all students are learning. A criteria-reference evaluation system is used. In a cooperative learning situation, students' goal achievements are positively correlated; students perceive that they can reach their goals if and only if the other students seek outcomes that are beneficial to all those with whom they are cooperatively linked. Students discuss material with each other, help one another understand it, and encourage each other to work hard. In a cooperatively structured class, heterogeneous small groups made up of one high, one medium, and one low-ability students would be formed. The students are given the three tasks: to learn the assigned material, to make sure that the other members of the group have learned the assigned material, and to make sure that everyone in the class has learned the assigned material. While students work on assignments, they discuss the material with other members of the group, explaining how to complete the work, listening to each other's explanation, encouraging each other to try to understand the solutions, and providing academic help and assistance. When everyone in the group has mastered the material, they go look for another group to help until everyone in the class understands how to complete the assignments.

Arends (1997:408) in his Syntax of the Cooperative Learning Model enumerates six major phases with the corresponding teacher behavior: Phase 1, provide objectives and goals. In this phase the teacher goes over objectives for lesson and establishes learning set; Phase 2, Present Information. The teacher presents information to students either through verbal presentation or text; Phase 3, Organize students in learning teams. Teacher explains to the students how to form learning teams and helps groups make efficient transition; Phase 4, Assist team work and study. In this phase the teacher assists learning teams as they do their work. Phase 5, Test. The teacher tests knowledge of learning materials of group's present result of their work. Lastly, Phase 6, Recognize achievement. The teacher finds ways to recognize both individual and group efforts and achievements.

Individualistic learning, on the other hand, has its own advantage. The philosophy behind the special kind of individualized instruction according to Toralba, (1983;24) hinges on the generally accepted fact that each child is a unique individual with background experience, inborn qualities, habits and learning styles different from those of other individuals, and as such he should be able to grow and develop his potential at his own pace. This instructional material possesses the qualities that will make an individual an independent learner, self-pacing or progressing at his own rate. The approach

allows measures to meet the needs of an individual differences and contribute to a feeling of success no matter how humble it maybe, until finally, the feeling of self-satisfaction is attained.

In support to Toralba, Gregorio (1976:422-423) pointed out that the thrust towards attempting to meet the needs of an individual pupils has been largely an outgrowth of investigation of individual difference among pupils. The nature and scope of individual growth under varying conditions of present-day life in which no two pupils have the same experiences, would make it necessary in learning. Today there is a growing demand for individualized teaching. He also added that there are general suggestions to be observed in individualized instruction which are the following:

1. The promotion should be according to the work or subject completed. It should be individual rather than general.

2. The pupils should have accurate and well kept records of his accomplishments or achievements.

3. The pupils should be allowed to work at his own rate of speed and ability.

4. The pupils should be given enough time for completion of the unit. unit.

5. The curriculum should be graded into units of increasing difficulty each measured by achievement test.

6. Every pupil should be furnished with complete instructional materials which can be accomplished individually, and with corresponding administering test.

Just what instructional aids a teacher uses depends on his or her knowledge and experiences, the availability of the materials, the lesson assignment, the subject and the students. Instructional aids are made for situations in general. It is the teacher's job to tailor them to the needs of the students.

In relation to instructional materials, Gailan (1983:3) stressed that modules are very effective tools of learning for they have the following features: (1) the subject matter is presented in an organized manner and follows a logical sequence; (2) the objectives are specific and are congruent with the content and evaluation; (3) they assure constant effectiveness; (4) learning depends on the qualities of materials like accuracy and adequacy of information.

From the above context, it can be gleaned that instruction may take place in small group and individual settings. The teacher, being the facilitator of learning, is given the task to vary these groupings according to the needs of the students, objectives of the lesson and the kind of learning that he or she wants to place in a class.

Related Studies

This section summarizes a review of related studies on cooperative learning which provides understanding and insights necessary for the development of the logical literature of this research.

Nichols (1994) had a study entitled "The Effects of Cooperative Learning on Student Achievement and Motivation in High School Geometry Class." Eighty-one students were randomly assigned to one of the cooperative learning geometry classes or a traditional geometry class with lecture instruction. Student Team Assisted Division (STAD) was used in two treatment situations; (1) as instruction for the first nine weeks of school . These two experimental groups were compared with the control group receiving traditional lecture instruction. Five dependent variables were measured; achievement, goal orientation, self-efficacy, intrinsic, and extrinsic valuing of the learning task, and the use of cognitive strategies.

The results of the study were as follows:

1. Both treatment groups experienced significantly higher achievement scores and increases in learning goal orientation, self-efficacy, intrinsic valuing, and reported uses of deep.

2. Processing cognitive strategies than did the control group.

3. A decline in these effects was also noted when cooperative group instruction was replaced by traditional lecture instruction.

The study of Nichols has a similarity to the present study. Both studies explored the effectiveness of cooperative learning as a strategy. The two studies, however were different in terms of the subjects handled. Nichols' study was on Geometry in a foreign setting while the study on hand was on algebra specifically on Exponents and Radicals in local setting.

In the study of Hopp (1994) with the title "Cooperative Learning in a Mathematics Class and the Influence of Task on Peer Interactions," the author described and examined the influence of task spent in cooperative episodes and on cognitive and meta-cognitive behaviors of 32 eight-grade students as they worked cooperatively in groups of four on two routine and two non-routine mathematics class over a three-week period.

The findings of the study are:

1. Time spent in cooperative episodes is related to the type of task;

2. Task may influence the quality of interactions as evidenced by problem solving behaviors.

3. Differences in time spent in cooperative episodes and in meta-cognitive and cognitive behavior were found between routine and non-routine tasks, and there were differences within the two task types.

4. Results offer strong support that; for a task to be truly desirable as a group task, it needs to be non-routine for everyone in the group.

5. Tasks which require multiple abilities results in more and larger cooperative episodes.

The study of Hopp has similarity to the present study in the sense that it used Cooperative Learning in mathematics class. Two studies are different since Hopp's study dealt with the influence of task spent in cooperative episodes on cognitive and meta-cognitive behaviors while the present study was on the effectiveness of cooperative and individualistic learning. Its setting is also different because the former is foreign while the other is local.

Javier (1980) had a study on the "Relative Effect of Small-Group-Within Large Group Instruction Versus One-Large-Group Instruction in Teaching Mathematics." The researcher's subjects consisted of 40 matched pairs of grade four pupils enrolled in Urious College, Butuan City, for the school year 1980-1981. The subjects of the study were matched on the basis of their I.Q. and average grades in Grade 3 mathematics. The toss-a-coin technique was used to assign each member of the pair of either group and to differentiate the experimental group from the control group. Both groups were taught for two weeks. Pupils in the experimental group were divided into smaller groups where seat

works, exercises, and activities were given. There was no regrouping of pupils in the control group.

An achievement test was then given as a posttest to both groups. Two weeks later, another test was administered to determine the extent of retention of each group.

The results of the study show that pupils taught using the small-group-within the large group approach learn better and retain concepts longer than pupils taught using the one-large-group approach.

Javier's study is similar to the study of the researcher. It aimed to determine the effect of peer teaching, one of the components under cooperative learning on the learning of mathematics. It also made use of the previous mathematical rating of students as basis in matching samples for each group. The present study, however, differed in the subjects, strategies compared. Javier compared small-group-within the large group and one-large-group approach while the present study compared cooperative and individualistic approaches. He also used elementary pupils while the present study used high school students.

Cohen's study (1986) on "Educational Analysis of Tutoring: A Meta-Analysis of Findings." His findings revealed that tutoring programs was the most effective method both for tutors and tutees having the following characteristics: 1) formal organization with procedural rules established better teacher, 2) instruction in basic skills and contents,

3) explanatory rather than terminal health given, 4) no more than 3 tutees per tutor and ideally one tutee per tutor, 5) short duration about four weeks. Also he recommended that a tutorial program with the given listed characteristics combine with regular classroom instruction. "The students being tutored not only learned more than they did without tutoring."

This study is similar to the present study with regards to the conduct of the experiment. It can be seen from the literature reviewed that in conducting cooperative learning students within each groups act as tutees and tutors. However, the two studies are different in terms of research environment and the subject area considered. Likewise Cohen's study was conducted in a foreign setting.

Hwong (1986) investigated the effects of the cooperative learning condition (CLC) and the individualistic learning condition (ILC) on the college students' achievement in method course. The study revealed that compared in the ILC, the students in the CLC had:

1. Perceived significantly greater goal interdependence, resource interdependence, and academic support from the instructor.

2. Perceived significantly more "helpfulness of feedback" give by instructor about their performance.

3. Produced significantly better-quality written assignments.

4. Significantly fewer observed off-task behaviors than students in the ILC, and they were observed to be on-task significantly more often during planning lessons.

The above study has similarity to the present study. Both studies explored the effectiveness of cooperative and individualistic learning as strategies. The two studies however, differed in the subject handled. Hwong's study was on music while the study on hand was on mathematics. He used college students as subjects while the present study used high school students.

Catacutan (1989) conducted a study entitled "Effects of Cooperative Learning Strategy on the Academic Achievement and Attitude in Mathematics of selected Grade Four Pupils." The subject of the study involved 96 grade four pupils from the two sections, Grade IV-A and Grade IV- B out of 13 grade sections at the Killjoy San Agustin. Each group was taught by the researcher in the morning with 40 minutes a day and on the same days. This was done to control the teacher variable and to eliminate the possibility of the time element becoming as variable that might affect the results of the study.

The study featured the following:

1. The cooperative effort extended by all members in each group in the completion of the tasks and other learning activities.

2. The interaction between the group where all the members shared their ideas during discussions.

3. The motivating effects of the competition among groups which motivated the pupils to give their best in every learning sessions.

The present study is similar to that of Catacutan's study. Both tested effect of cooperative cooperative learning. It also considered the attitude. The difference is focused on the research environment and the educational level of the subjects involved.

"A Comparison of Cooperative Mastery Learning and Traditional Approach in Teaching Mathematics" was explored by Licup (1988). The study revealed that students taught under the Cooperative Mastery Learning (CML) strategies had an overall higher academic achievement level in mathematics than their peers taught under the traditional (large-group and none-mastery) approach. The superiority of the experimental treatment group was evident both in the immediate and the retention tests on the two units of multiplication and division. Either the non-DDU experimental and control groups whose difference in the division retention test did not reach statistical significance. There was only a marginal superiority in favor of the experimental group.

Another significant finding of Licup's study is that CML groups outperformed the control groups. This was on both the low-level (recall and computational) and the high-level (estimation and problem solving)

cognitive operations in mathematics. Her findings suggest that generally, the students did better on the computational test items than on the word problems.

The present study is similar to that of Licup's in the sense that both studies compared strategies in teaching mathematics, one of which is cooperative learning. It also considered the achievement of students in terms of recall and comprehension and application and problem solving skills. However, the two studies differed on the research environment, the target population, and the topics considered.

A study on the "Relative Effectiveness of Cooperative, Competitive, Individualistic, and Traditional Strategies on Students' Mathematics Achievement" was undertaken by Arañador (1992). In her study, she attempted to find out the relative effectiveness of the four strategies on mathematics achievement, attitude towards mathematics, and perception of classroom life. She also determined the relationship of mathematics achievement towards mathematics and perception of classroom life.

Arañador subjected her experiment with 334 first year students enrolled in first mathematics. Students came from developed and developing public secondary schools in Division of Iloilo City, in region VI during the school year 1989-1990.

The findings of the study are as follows:

1. On the average, the cooperative strategy came out as best strategy for affecting cognitive achievement in mathematics. The effect of the cooperative learning strategy was very much more in the developing than in the developed school.

2. Cooperative learning was found to have more gainful effects in terms of recall and comprehension abilities than the competitive, individualistic, and traditional strategies. In terms of application and problem solving skills, the cooperative learning strategy on the average came out as most effective strategy.

3. The cooperative learning strategy brought about a significant change in the performance of students in the developing school. In the developed school, although the competitive groups' score was higher than the cooperative groups' score by 0.65, the difference was not significant.

4. In terms of ability level, students with high, medium, and low ability using the cooperative learning strategy, on the average performed better than their counterparts in the competitive, individualistic, and traditional strategies on comprehension and problem solving skills. The increase was very evident in the developing school.

5. The cooperative learning strategy affected a better attitude towards mathematics compared with the three other strategies. The ranking of the competitive, individualistic, and traditional strategies

in the developed school on mathematics attitude are second, third, and fourth respectively. In the developing school, the ranking of the four strategies was in this order: cooperative, traditional, individualistic, and competitive, respectively. On the average, the attitude of students towards mathematics in the developed school is better than that of students in the developing schools. On the other hand, the attitudes of the students in the traditional group of the developing school was better than that of their counterparts in the developed school. This is a deviation from the normal trend.

6. In terms of ability level, the high-, medium-, and low- ability groups in the developed school had a more favorable attitude towards mathematics than those in the developing school. In like manner, high-, medium-, and low- ability groups ranked first, second and third, respectively, in terms of their attitude towards mathematics.

7. It is apparent that the competitive strategy had a negative effect on the mathematics attitude of the students in the developing school. It was the individualistic strategy which was effective in fostering in the students a favorable attitude towards mathematics. For the developed school it was the traditional strategy which had the least effect on the mathematics attitude of the student.

8. Students in the developed school had more favorable [perception of classroom life than in the developing school. The competitive

strategy had a better effect on the perception of classroom life compared with the cooperative, traditional and individualistic strategies in that descending order, however, the differences across strategies were not significant.

9. The rating of classroom life is significantly correlated (p/_.001) with retention test scores in mathematics and mathematics attitude and post-posttest ratings of classroom life as well as with quiz scores.

10. There were also significant positive relationships between mathematics achievement on one hand and the following variables on the other hand, cooperation, extrinsic motivation, cohesion, goal interdependence, resource interdependence, teacher academic self-esteem. Scores on mathematics posttest were negatively correlated with alienation; that is, students who felt less alienated performed in the mathematics posttest.

The aforementioned study of Arañador is related to the present study because it is concerned with relative effectiveness of four strategies in teaching mathematics. Likewise, it attempted to find which strategies have useful effects on student's cognitive outcomes in terms of recall and comprehension, and application and problem solving. It also considered the ability and the relationship between mathematics achievement and attitude towards mathematics. The two studies however,

differed in terms of scope, content, samples, sampling procedures, research design and learning environment. Concerning content the former covered fraction and decimal while the other in exponents and radicals. The scope of her study was wide covering 334 first year high school students. It extended to developed and developing public secondary schools in the Division of Iloilo City, Region VI

Avelino (1995) in his study entitled "Effectiveness of Cooperative Learning" had the primary objective of finding out the effect of cooperative learning and the traditional approach in learning mathematics. The study utilized the pretest-posttest control group design with 40 first year high school students of Tinablan National High School.

He recorded down the following findings:

1. There was significant gain of knowledge of the students in both groups. This significant gain of knowledge was determined using the t-value computation for significant difference between the pretest and the posttest scores in both groups.

2. There was no significant difference in the posttest scores between the control group and the experimental group. The performance of the students in both groups are the same.

3. There was no significant difference in the means of the weekly evaluation test. This suggest that as far as short quizzes are

concerned, the experimental group can perform comparatively to the control group.

He further made the following conclusions, namely:

1. Cooperative learning as an approach to teaching mathematics is as effective as the traditional lecture approach of teaching mathematics.

2. Cooperative learning can also be utilized in the performance of the weekly activities of the students in mathematics. They may include exercises and short quizzes.

The study of Avelino is similar with the study on hand because both studies compared strategies in teaching mathematics, cooperative and traditional. It also utilized pretest and posttest control group design. The two studies, however, differed on subjects used and setting of the study.

CHAPTER III

METHODOLOGY

This chapter presents the research methodology that were used in conducting the study. It includes the subjects, research design, instrumentation, sampling procedure, data gathering and statistical instruments used.

Research Design

The experimental method of research was used in this study. Experimental method of research as defined by Good (1972:216) is a method or procedure involving the control or the manipulation of conditions for the purpose of study of the relative effects of various treatment applied to members of different samples. Since the present study is concerned about the effectiveness of cooperative and individualistic student's activities on mathematics achievement of third year high school students of Samar State Polytechnic College, the said method of research was used.

This study employed the Pretest-Posttest Control Group Design. In this design, two groups were matched in sex, and mental ability. One group called the experimental group was exposed to the cooperative method of teaching while the other group, called the control group, was

exposed to the individualistic approach. The research design is shown in the table presented below:

Eg	T_1	X	T_2
Cg	T_1		T_2

wherein:

Eg - Experimental Group

Cg - Control Group

T_1 - Pretest

T_2 - Posttest

X - Experimental Treatment (independent variable)

More specifically, the chart of design is shown below involving these variables: treatment (cooperative and individualistic) and ability level (high, average and low).

ABILITY (B)

TREATMENT (A)	Low Ability	Average Ability	High Ability
Cooperative	A_1B_1	A_1B_2	A_1B_3
Individualistic	A_2B_1	A_2B_2	A_2B_3

Forty-eight third year students were the subjects of the study chosen through purposive sampling. Two groups were formed out of this composition, the experimental and the control group.

The study progressed as follows: A pretest was designed to determine the entry behavior of the two groups. A table of specification was prepared for this purpose. Lessons were developed afterwards.

During the period of experimentation, the experimental group was taught using the cooperative learning while the control used the individualistic learning using the modules.

A posttest was given after all the lessons were covered. The result of the pretest-posttest was evaluated using the t-test.

Instrumentation

The main sources of data were pretest, posttest and attitudinaire. The research also used the documentary analysis.

Pretest. This was one of the main instruments in gathering data. To ensure the content validity of the test, a table of specification was constructed based on the specific objectives of Exponents and Radicals. The items were objective-type in nature using multiple choice with four options and were classified as recall, comprehension, application and problem solving skills. There were 12 items for recall, 18 items for comprehension, 23 items for applications and 7 items for problem

solving. Problem solving items were those items that demanded two or three of operations for the answers. The result of the test served as basis to determine which item would be improved and revised for the pretest and posttest.

Attitudinaire. The study made use of Student's Rating Scale designed to measure attitudes towards mathematics. The Attitudinaire adopted from Pacolor (1993) consisted of items describing students' feelings and attitudes towards mathematics. It was composed of 17 positive statements and 7 negative statements. The students were given 5 alternatives indicating their reactions to each statement in the scale. The Likert type of summative rating was adopted. For positive statements, the following point assignments to 5 different types of responses were used: strongly agree (5), agree (4), neutral (3), disagree (2), strongly disagree (1). These points were reversed for the negatively oriented statements. The score for mathematics attitude was based on the mean of the scale points of all the students.

Posttest. This was the same test as the pretest but the order of the items was rearranged, and given to each group after the experimentation to evaluate the achievement of the students.

Documentary Analysis. Mathematics II ratings of III-Orchids were taken from Form 138-A and were used in selecting the members of the

experimental and control groups. The subjects were matched correspondingly on the basis of their sex and mathematical ability.

Validation of Instrument

The 90-item teacher-made test was constructed after making a table of specifications. The draft was presented to the mathematics experts of the college for comments and suggestions. Incorporating their suggestions the researcher made another draft and was presented to the adviser for refinement. The researcher finally came up with 80 items which were tried among Fourth Year High School Students of SSPC. After the try out, the items were subjected to item analysis to determine the index of discrimination and the facility value and therefore was revised based on the analysis (see Appendix K).

A test consisted of items revised and modified on the basis of item analysis.

The formula for calculating the facility value (F.V.) is:

$$F.V. = \frac{\text{Total number making the correct choice}}{\text{Total number of examinees}}$$

The following facility values are suggested as general guide to the difficulty of items by Bright as cited by Españo (1994:33):

Very easy = Above 0.9

Medium easy = 0.7 - 0.9

Medium Difficult = 0.3 - 0.69

Very difficult = below 0.3

In the item analysis of the test instrument, the indices of difficulty ranged from 0.10 to 0.98 providing a wide range of difficulty. Of the original 80 items, 16 items were considered to be difficult, 17 were medium difficult, 28 were medium easy, and 19 were very easy.

In the context of item discrimination analysis, it provided an indication of how well an item sorts out the good students from the poor ones. The total scores on the examination being considered were taken as the measure by which to judge the discriminating power of each item within the examination.

The formula for calculating the index of discrimination (I.D.) is:

$$\text{I.D.} = \frac{\text{No. of Upper Group Correct} - \text{No. of Lower Group Correct}}{\text{Number of Students in One Group}}$$

The following table is suggested as a guide to the interpretation of the numerical value of I.D. by Bright as cited by Español (1994:34):

Value of I.D	Acceptability of Item
0.4 and above	A high level of discrimination Retain the item.
0.30 - 0.39	Item discriminate reasonably well. Retain the item.
0.20 - 0.29	Marginal level of discrimination. Retain the item.
Below 0.20	Items does not contribute to the overall Pattern of the examination result. Reject the item.
Negative Values	Reject the item.

The discrimination indices of the item analysis of the test instrument ranged from 0.04 to 0.48. Out of the original item, 16 items were identified as high level of discrimination, 34 items discriminate reasonably well, and 10 items were marginal level of discrimination and 20 items did not contribute to the overall pattern of examination. These 20 items were rejected thus forming the final draft of the test consisting of 60 items.

The reliability of the achievement was determined using the modified Kuder-Richardson Formula 20 given by Stanley and Hopskin as cited by Espano (1994:35) as:

$$r = \frac{k}{k-1}\left[1 - \frac{6\,\Sigma pq}{(KD)^2}\right]$$

where:

r = reliability coefficient

Σ = summation

P = proportion of students who answered the particular item correctly

q = proportion of the students not getting the correct answer for a particular item (1-P)

k = total number of test items

D = mean of discrimination indices

The interpretation of the computed r (reliability coefficient) was based on the interpretation given by Ebel (1965:212) shown below:

Reliability Coefficient	Degree of Reliability
0.95 - 0.99	Very high, rarely found among teacher made test
0.90 - 0.94	High, equaled by few tests
0.80 - 0.89	Fairly high, adequate for individual measurement
0.70 - 0.79	Rather low, adequate for group measurement but not very satisfactory for individual measurement.
Below 0.70	Low, entirely inadequate for individual measurement although useful for group average and school survey.

The test reliability coefficient (r) was computed to be 0.803 which interpreted as fairly high, adequate for individual measurement.

Sampling Procedure

The study was participated in by junior high school students of Samar State Polytechnic College, Catbalogan, Samar. The technique used was purposive sampling.

A total of forty-eight (48) III-Orchids students were made as subjects of the study. This figure is fifty-percent of the total third year high school students of the college. The class composed of high, average, and low ability students was divided into two groups matching their mathematical ability using their previous mathematical grades and sex. The two groups became the experimental and control groups of the study.

The researcher gathered the previous mathematical ratings of the students from Form 138. Mathematics II ratings served as the basis of selecting the subjects into two groups. Student's ratings were arranged from highest to lowest. The upper 25% was categorized as high ability, middle 50% as average ability and the lower 25% as low ability. Students with the same or almost similar mathematical ratings and sex were matched correspondingly to avoid bias in the result. At the end of the pairing, each group consisted of 6 high ability, 12 average ability and 6 low ability students.

To see if the cases or cooperative groups were balanced means and variances were computed. Values were found to be more or less the same.

Data Gathering Procedure

The gathering of data was divided into three phases namely:

Pre-Experimental Phase. An approval from the Chairman of the SSPC Laboratory High School and the Dean of the College of Education was sought to conduct the research study to the third year high school students especially III-Orchids. The researcher also sought permission for the creation of the new time schedule for the experimental class since the control class was held in its regular time schedule. The schedule was then changed after 5 weeks.

A pretest was given to both experimental and control groups to determine the initial knowledge of the respondents on the subject. The researcher saw to it that the factors that may affect the result such as seating arrangement, lighting, ventilation and honesty were controlled. Afterwards the test papers were collected, scored and recorded for subsequent statistical analysis and interpretation.

Students under the experimental group were assigned to cooperative groups. Each of which consisted of one high ability, two average ability and one low ability students. The said group was given the orientation concerning Cooperative Learning, its basic elements and

features, techniques commonly used and responsibilities of each members of the group including the instructor.

Students under the control group exposed to individualistic learning, were likewise oriented concerning its elements and features and the use of modules.

Experimental Phase. The researcher handled the class of the experimental and control groups. Before any instruction was given to both groups, the researcher planned the activities to be undertaken to avoid bias. For the experimental group, the researcher prepared the instructional materials, worksheets and activity sheets. She made use of different approaches and variations depending on the instructional objectives of the lesson. Some of the approaches used were as follows: Student Team Teaching, Student Team Achievement Divisions (STAD), Team-Games-Tournaments (TGT), Jigsaw, Group of Four and Co-op co-op.

The control group, on the other hand, was exposed to individualistic learning using the validated modules of Alandino (1996).

Variables that could affect the result were controlled. For the time element, the experimental group was recited 3:00 - 4:00 every Monday and Wednesday and 10:00 - 11:30 every Thursday while the control group was met every 10:00 - 11:30 every Wednesday and 3:00 - 4:00 every Tuesday and Thursday. The schedule was reversed after 5 weeks. Both groups also used the same room.

Post-Experimental Phase. After covering the topics as prescribed on Exponents and Radicals, a posttest was administered to both groups using the same test as the pretest which was rearranged. This is to evaluate the performance of the students after the experimentation. Again, the factors that may affect the result during the pre-testing were also controlled during the post-testing.

Statistical Treatment of Data

To arrive at the solutions to the problems in the study, all responses were processed and computed. The sets of data gathered from the different research instruments were statistically organized, analyzed, and interpreted. The statistical tools used were the mean, standard deviation, t-test for dependent and independent samples, two-way ANOVA analysis of variance, pearson correlation coefficient, Fisher's t-test and frequency counts.

To determine the mean scores of the experimental and the control groups both in the pretest and posttest, the mean was used. The formula is:

$$\bar{X} = \frac{\Sigma X}{N}$$

where:

X = pretest/posttest scores of the Experimental and control groups

ΣX = The sum of the pretest/posttest scores

N = Number of samples in each group

To determine if the two groups are of balanced cases, the variations that existed in each group, the standard deviation (Walpole, 1986:31) was computed as follows:.

$$SD = \sqrt{\frac{N(\Sigma X^2) - (\Sigma X)^2}{N\ (N - 1)}}$$

Where: X = pretest/posttest scores of the experimental/ Control group

ΣX = sum of the X column

ΣX^2 = sum of the X^2

N = number of respondents in each group

T-test for dependent samples (Walpole, 1986: 311) was used to analyze the significant difference between the pretest and posttest mean score of the experimental and control groups. The formula is as follows:

$$t = \frac{\bar{D}}{SD/\sqrt{N}}$$

Where:

t = computed t-value for the dependent sample

$\bar{D}$ = average difference between the posttest and pretest of the experimental and control group

SD = standard deviation

N = number of respondents in each group

To determine if there is a significant difference between the mean scores of experimental and control groups per pretest and posttest in cognitive levels, t-test for independent samples was used. The formula is shown below:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left[\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}\right]\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

where:

t = computed student t-value

X_1 = mean of the experimental group

X_2 = mean of the control group

n_1 = number of students in the experimental group

n_2 = number of students in the control group

SD_1 = standard deviation of the experimental group

SD_2 = standard deviation of the control group

To determine if there was a significant difference in the posttest mean score of the experimental and control groups among

students with high, average, and low ability, the two-way analysis of variance was employed as follows:

COMPUTATIONAL FORMULA FOR TWO-WAY ANOVA

Source of Variation (SV)	Degrees Of Freedom	Sum of Squares (SS)	Mean Square (MS)	Computed f
Row means	r - 1	$SSR = \frac{\Sigma T_i^2}{c} - \frac{T^2...}{rc}$	$S_1^2 = \frac{SSR}{r-1}$	$f_1 = \frac{S_1^2}{S_2^2}$
Column Means	c - 1	$SSC = \frac{\Sigma T_j^2}{r} - \frac{T^2...,}{rc}$	$S_2^2 = \frac{SSR}{r-1}$	$f_1 = \frac{S_1^2}{S_2^2}$
Error	(r-1) (c-1)	SSE = SST-SSR-SSC	$S_3^2 = \frac{SSE}{(r-1)(c-1)}$	
Total	rc - 1	$SST = \frac{\Sigma \Sigma T_{ij}^2}{c} - \frac{T^2...}{rc}$		

Where:

Xij = an observation in the ith row and jth column

Ti. = the total of all observations in the ith row

Xi. = the mean of all observations in the ith row

T.j = the total of all observations in the jth column

X.i = the mean of all observations in the jth column

T.. = the total of all rc observations

X.. = the mean of all rc observations

For the hypothesis rejected with the use of two-way ANOVA, further test was administered in comparing the group means and identify where the significant difference(s) lie(s) with the use of t-test for independent samples pairing 3 ability-levels of two groups.

On the other hand, frequency counts and weighted point were used to analyze the student attitude towards mathematics. The range of mean weighted score of students' responses to their attitude was interpreted was follows:

Mean Weighted Point Scores	Interpretation
4.2 - 5.0	strongly favor
3.4 - 4.1	favor
2.6 - 3.3	neutral
1.8 - 2.5	against
1.0 - 1.7	strongly against

In finding the significant relationship between mathematics achievement and attitude towards mathematics of both groups, Pearson Correlation Coefficient formula of Pagoso (1978: 262) was employed:

$$r = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{[N(\Sigma X^2) - (\Sigma X)^2][N(\Sigma Y^2) - (\Sigma Y)^2]}}$$

where: N = total number of students under study

ΣX = sum of the X column

ΣY = sum of the Y column

r = correlation between X and Y

To test for the significance of the coefficient of correlation between a set of paired variables, the Fisher's t-test formula was used:

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

where; r = coefficient of correlation between two variables

N = total number of paired variables

CHAPTER IV

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter presents the data gathered, their analyses and interpretation of results. The data consist of pretest results of the experimental and control groups, posttest results of experimental and control groups, pretest and posttest results of the control group, pretest and posttest results of the experimental group, comparative posttest results on recall and comprehension, comparative posttest results on application and problem solving, posttest mean scores of the cooperative and individualistic treatment by ability level, attitude of the third year high school students and relationship between mathematics achievement and attitude toward the subject of the experimental and control groups.

Pretest Results of the Experimental and Control Groups

Table 1 shows the distribution of scores of the two groups in the pretest administered. In the case of the experimental group, the highest score obtained was 28 with a lowest score of 9. The total scores of the experimental group was 418 with a mean of 17.412. On the other hand, the highest score obtained by the control group was 25 and

Table 1

Pretest Results of Experimental and Control Groups

Students	Experimental Group (X_1)	Control Group (X_2)	d	X_1^2	X_2^2
A	26	22	4	676	484
B	28	25	3	784	625
C	18	24	-6	324	576
D	9	23	-14	91	529
E	15	22	-7	225	484
F	19	21	-2	361	441
G	16	11	5	256	121
H	16	20	-4	256	400
I	14	19	-5	196	361
J	18	18	0	324	324
K	20	17	3	400	289
L	12	23	-11	144	529
M	16	17	-1	256	289
N	16	15	1	256	225
O	22	14	8	484	196
P	16	15	1	256	225
Q	23	25	-2	529	625
R	15	15	0	225	225
S	16	15	1	256	225
T	16	14	2	256	196
U	16	13	3	256	169
V	17	15	2	289	225
W	16	12	4	256	144
X	18	12	6	324	144
Total	418	427	-9	7680	8051
Mean:	17.42	17.79			
Computed t:	0.298				
Tabular t:	1.960 @ a = .05, df = 46				
Interpretation:	Not Significant				

the lowest score was 11. The total score of the control group reached to 427 with a mean of 17.79

Comparing the mean scores obtained by the two groups, the control group turned out to be higher than the experimental group by 0.37. To find out whether this difference is significant, t-test for independent samples was applied. The computed t-value of 0.298 turned out to be lesser than the tabular t-value of 2.0126 at a = .05 and degrees of freedom of 46. The hypothesis which states that there is no significant difference between the experimental and control groups with respect to their pretest mean scores therefore was accepted. The observed difference between the pretest mean scores was not significant. This findings imply that the entry behavior of the two groups are more or less the same with respect to their mathematical ratings prior to the experimentation.

Posttest Results of the Experimental and Control Groups

Reflected in Table 2 is the statistical treatment result of the posttest scores of the experimental and control groups. The experimental group's mean was 37.54 while the control group was 32.79. Evidently, it can be observed that the mean score of the experimental group in the posttest was higher than the control group by 4.75.

Table 2

Posttest Results of the Experimental and Control Group

Students	Experimental Group (X_1)	Control Group (X_2)	d	X_1^2	X_1^2
A	45	54	-9	2025	2916
B	54	43	11	2916	1849
C	41	33	8	1681	1089
D	41	38	3	1681	1444
E	39	42	-3	1521	1764
F	35	39	-4	1225	1521
G	35	42	-7	1225	1764
H	34	34	0	1156	1156
I	40	42	-2	1600	1764
J	38	30	8	1444	900
K	37	26	11	1369	676
L	37	35	2	1369	1225
M	35	29	6	1225	841
N	41	30	11	1681	900
O	48	24	24	2304	576
P	43	35	8	1849	1225
Q	40	32	8	1600	1024
R	38	28	10	1444	786
S	31	27	4	961	729
T	37	26	11	1369	676
U	28	19	9	784	361
V	22	34	-12	484	1156
W	31	26	5	961	676
X	31	19	12	961	361
Total	901	787		34835	27377
Mean	37.54	32.79			
Computed t : 2.197					
Tabular t : 1.960 @ a = .05, df = 46					
Interpretation: Significant					

To test the significance of the aforementioned difference, t-test for independent samples was employed. Inasmuch as the computed t-value of 2.197 proved to be greater than the tabular t-value of 2.0168 at .05 level of significance and 46 degrees of freedom, the hypothesis that states that "There is no significant difference between the experimental and control groups with respect to their posttest mean scores" was rejected. This implies that the cooperative students' activities are better than the individualistic students' activities in teaching Mathematics III. Hence, cooperative learning is more effective as an approach in mathematics teaching.

Pretest and Posttest Results of the Experimental Group

Shown in Table 3 are the pretest and posttest results of the experimental group. The highest score in the pretest of the said group was 28 and the lowest was 9 with the resulting mean of 17.42. For the posttest, the table shows that all 24 respondents of the experimental group obtained higher scores, with the highest value pegged at 54 and the lowest value at 22. The computed mean score was 37.54. In analyzing the data, each individual's pretest score was subtracted from his/her posttest score, thus permitting analysis of the gains in the scores. The data gave a total difference of 483 and a mean difference of 20.12. Initially, it can be observed that there was a change an

Table 3

Pretest and Posttest Results of the Experimental Group

Students	Pretest	Posttest	d	d^2
A	26	45	-19	361
B	28	54	-26	676
C	18	41	-23	529
D	9	41	-32	1024
E	15	39	-24	576
F	19	35	-16	256
G	16	35	-19	361
H	16	34	-18	324
I	14	40	-26	676
J	18	38	-20	400
K	20	37	-17	289
L	12	37	-25	625
M	16	35	-19	361
N	16	41	-25	625
O	22	48	-26	676
P	16	43	-27	729
Q	23	40	-17	289
R	15	38	-23	529
S	16	31	-15	225
T	16	37	-21	441
U	16	28	-12	144
V	17	22	-5	25
W	16	31	-15	225
X	18	31	-13	169
Total	418	901	-483	10535
Mean:	17.42	37.54	-20.125	
Computed t:	16.57			
Tabular t:	2.069 @ a = .05, df = 23			
Interpretation:	Highly Significant			

improvement in the performance of the experimental group after the experimentation.

Subjecting these scores to t-test for dependent samples, the analysis revealed that the computed t-value of 16.57 was greater than the tabular t-value of 2.069 at a = .05 and degrees of freedom of 23.

Hence, the hypothesis which states that "there is no significant difference between the pretest and posttest mean scores of the experimental group" was rejected. This result led to the implication that the experimental group showed a marked improvement in the posttest in the use of the cooperative student activities.

Pretest and Posttest Results of the Control Group

The results of the pretest and posttest of the control group are reflected in Table 4. For the pretest, the highest score obtained by this group was 25 and the lowest score was 10. This resulted to a total of 412 and a mean of 17.17. For the posttest, the highest score obtained by the group was 54 while the lowest score was 19. Consequently, the total of the scores of the control in the posttest was 787 with a mean of 32.79. The resulting mean difference between the pretest and posttest scores of the control group was 15.62. To test whether the numerical difference is significant, t-test for dependent samples was utilized. The hypothesis that "there is no significant

Table 4

Pretest and Posttest Results of the Control Group

Students	Pretest	Posttest	d	d^2
A	22	54	-32	1024
B	25	43	-18	324
C	24	33	-9	81
D	23	38	-15	225
E	22	42	-20	400
F	21	39	-18	324
G	11	42	-31	961
H	20	34	-14	196
I	19	42	-23	529
J	18	30	-12	144
K	17	26	-9	81
L	23	35	-12	144
M	17	29	-12	144
N	15	30	-15	225
O	14	24	-10	100
P	15	35	-20	400
Q	10	32	-22	484
R	15	28	-13	169
S	15	27	-12	144
T	14	26	-12	144
U	13	19	-6	36
V	15	34	-19	361
W	12	26	-14	196
X	12	19	-7	49
Total	412	787	-375	6885
Mean:	17.17	32.79		
Computed t:	11.46			
Tabular t:	2.069 @ a = .05, df = 23			
Interpretation:	Significant			

difference between the pretest and posttest mean scores of the control group" was rejected as evidenced by the fact that the computed t-value of 11.46 was greater than the tabular t-value of 2.069 at .05 level of significance and 23 degrees of freedom. Like the experimental group, the control group showed marked improvement after it was taught using the individualistic approach.

Comparative Posttest Results on Recall and Comprehension

Table 5 indicates the posttest mean scores and standard deviations of the experimental and control groups on recall and comprehension. The experimental group's mean score was 18.54 while the control group was 17.5. It can be seen that experimental group emerged with higher mean than the control group. But when subjected to t-test for independent samples the computed t-value of 1.088 came out to be lesser than the tabular t-value of 1.960. This led to the acceptance of the hypothesis that "there is no significant difference in the posttest mean score between the two groups on recall and comprehension. Therefore, it can be implied that cooperative and individualistic approaches are equally effective in teaching concepts requiring recall and comprehension.

Table 5

Comparative Posttest Result on Recall and Comprehension And Application and Problem Solving

Group (Treatment)	N	POSTTEST: Recall & Comprehension Mean	SD	Application & Problem Solving Mean	SD
Experimental (Cooperative)	24	18.54	2.69	18.63	4.57
Control (Individualistic)	24	17.50	3.83	15.29	3.82
Overall	48	18.02	3.26	16.96	4.195
Computed t		1.088		2.695	
Tabular t		1.960 @ a = .05 , df = 46			
Interpretation:		Not Significant		Significant	

Comparative Posttest Results on Application and Problem Solving

The right side of Table 5 shows the mean and standard deviations of the scores on application and problem solving between the two groups of respondents. A standard deviation of 4.57 of the cooperative group indicates that scores were more scattered than the individualistic group wherein the standard deviation was only 3.82. The mean of the experimental group which is 18.63 was still higher than the mean of the control group which was 15.29. It has a mean difference of 3.34.

When subjected to t-test for independent samples, the computed t-value came out to be 2.695. This value is greater than the tabular t-value of 2.069 at .05 level of significance and 46 degrees of freedom. This led to the rejection of the hypothesis number 4 which states that "there is no significant difference in the posttest mean score between the experimental and control group on application and problem solving." Students therefore, performed better in application and problem solving using the cooperative learning. This could be attributed to the treatment given to the experimental group.

Posttest Mean Scores of Cooperative and Individualistic Treatment by Ability Level

Posttest mean scores of cooperative and individualistic treatments by ability level is shown in Table 6. It indicates that the mean scores

Table 6

Posttest Mean Scores of Cooperative and Individualistic Treatments by Ability Levels

Treatment \ Ability Level	Low-Ability	Average-Ability	High-Ability
Cooperative	30.00	38.17	42.50
Individualistic	25.17	32.25	42.00
Difference in Means:	4.83	5.92	0.50
Overall	27.58	36.46	42.25

in each treatment increased from low-ability to the high-ability categories. It is worth noting that the high-ability students performed better than the average and low-ability students. Furthermore, the students' mean score in cooperative group emerged higher than individualistic group in all ability levels. Greater mean difference can be seen in low and average ability groups.

A two-way analysis of variance in Table 7 shows that in between treatments, the F-computed value of 7.598 proved to be greater than the critical F-ratio of 4.06. The null hypothesis was rejected. This means that the treatments given affect students achievement in favor of cooperative learning. In between ability-groups, the computed F-ratio of 22.201 is greater than the tabular value of 3.47. Therefore, the corresponding null hypothesis is rejected. This implies that ability-grouping also affects learning. Specifically, it is concluded that the high, average and low-ability groups differ significantly with respect to their mathematics achievement.

To determine whether the difference among high, average and low-abilities between experimental and control groups is significant, a t-test for independent samples was applied.

It can be gleaned from the Summary Table 8 that there exist no significant difference between the high ability group exposed to cooperative and individualistic student activities. It can be said that

Table 7

Two-Way ANOVA of Mathematics Achievement In the Posttest

Sources of Variations	df	SS	MS	F	Tabular
Treatment (Row)	1	221.02	221.02	7.598	>4.06
Ability (Column)	2	1291.68	645.84	22.201	>3.21
Within	2	1280.11	640.06		
Total	5	2792.81			

Table 8

Mean, Standard Deviation, Computed t and Interpretation of Two Treatments by Ability Level

Ability Level / Treatment	Mean	SD	Computed t	Interpretation
Low Ability				
Cooperative	30.00	4.89	3.17	Significant
Individualistic	25.17	5.64		
Average Ability				
Cooperative	38.17	3.83		
Individualistic	32.25	5.67	2.997	Significant
High Ability				
Cooperative	4.25	2.66		
Individualistic	42.00	6.44	0.174	Not Significant

both treatment were effective in increasing mathematics achievement of high ability students. In average ability and low ability students, cooperative learning was more effective than individualistic student activities.

Attitude of Third Year HS Students

Table 9 presents the mean weighted ratings of the students' perception of their attitudes towards mathematics.

The data obtained clearly revealed that the highest ratings of 4.1 was on the attitude; "I feel mathematics is an important subject like any other subjects." This was followed by rating of 4.0 in "In Math, I am not satisfied with the grade of 75," "I find Math very useful in one's life" and "I am interested to obtain further knowledge in math." The rating of 3.6 was obtained on two attitudes, and 3.4 on one attitude, respectively.

There are however, eleven attitudes rated from 2.6 to 3.3 which implying that the subjects were neutral on the following statements: "I enjoy studying a mathematics subject," "My favorite subject is mathematics," "I feel I have a good foundation in mathematics," "I need assistance in doing mathematics problems because it confuses me," "I feel uncomfortable working with numbers, symbols, and worded problems," "I would like to spend more time working with mathematics," "I consider mathematics as a difficult subject," " I easily give up when I cannot

Table 9

Attitude of Third Year HS Students Towards Mathematics

Attitude	Mean Weighted Rating N=48	Interpretation
1. I fell mathematics is a important Subject just like any other subject.	4.1	Agree
2. In mathematics, I am not satisfied With the grade of 75.	4.0	Agree
3. I find math very useful in one's life.	3.9	Agree
4. I am interested to obtain further knowledge in math.	3.9	Agree
5. I enjoy attending my math class.	3.6	Agree
6. I enjoy solving math problems only if I know how to work well.	3.6	Agree
7. I enjoy doing exercises and assignment in my own.	3.5	Agree
8. Math can help a student to think logically.	3.4	Agree
9. I enjoy studying mathematics subject.	3.3	Undecided
10. My favorite subject is math	3.2	Undecided
11. I feel I have a good foundation in Mathematics.	3.2	Undecided
12. I need assistance in doing math problems because it confuses me.	3.1	Undecided
13. I feel uncomfortable working with numbers, symbols and worded problems.	3.1	Undecided
14.I would like to spend more time working with mathematics.	3.1	Undecided
15.I consider mathematics as a difficult subject.	3.0	Undecided
16.I easily give up when I cannot solve A problem in mathematics.	2.9	Undecided
17.I do not feel sure of myself in working with mathematics problems.	2.8	Undecided
18. I never get tired working with math.	2.6	Undecided
19. I feel nervous and uncomfortable in a mathematics class.	2.3	Disagree
20. I am unable to think clearly when working with mathematics.	2.3	Disagree
21. I have a feeling of dislike in math.	1.8	Disagree
22. If math is an elective subject I would avoid taking it.	1.8	Disagree
23. I wish I have no mathematics subjects.	1.8	Disagree
24. I don not listen during math class.	1.8	Disagree

LEGEND:		
	4.51 – 5.00	Strongly Agree (SA)
	3.10 – 4.50	Agree (A)
	2.51 – 3.50	Undecided (U)
	1.51 – 2.50	Disagree (D)
	1.00 – 1.50	Strongly Disagree (SD)

solve a problem in mathematics," "I do not feel sure of myself in working with mathematics problems," "I never get tired working with mathematics," and "I am unable to think clearly when working with mathematics."

On the other hand, five attitudes were rated from 1.8 to 2.3. The results imply that the subjects were against on the following statements: "I feel nervous and uncomfortable in a mathematics class," "I have a feeling of dislike in mathematics," " If mathematics is an elective subject in college, I would avoid taking it," "I wish I have no mathematics subject," and "I do not listen during mathematics class."

When constructed positively and reversing the rating system as described in the instrumentation (Chapter 3), the mean of the attitudes indicates that students rated favorably the five attitudes.

The data revealed that 13 statements or 54% of all the items were rated favorably and 11 or 46% of all the items were rated neutral by the subjects. This implied that majority of the subjects have positive attitudes towards mathematics subject.

The means and standard deviations of mathematics attitude are also shown in Table 10. The cooperative group got the highest mean of 3.6 and 3.3 for the individualistic. The values of the standard deviation indicate that there was a variation in mathematics attitude among two

Table 10

Means and Standard Deviation of the Experimental and Control Group on Attitudinaire

Group	:	N	:	Mean	:	SD
Experimental Group		24		3.6		0.367
Control Group		24		3.3		0.410
Computed t : 2.671						
Tabular t : 1.960 @ a = .05, df = 46						
Evaluation: Reject Ho						

groups. However, results of t-test for independent samples did not yield significant difference. It means that the groups have more or less the same attitude towards mathematics.

Relationship Between Mathematics Achievement and Attitude Towards the Subject of the Experimental Group

The computed coefficient of correlation between students' achievements and their attitudes towards mathematics of the cooperative group is 0.53 as shown in Table 11. This denotes a moderate relationship between the two variables. It can be implied that students' attitudes towards mathematics affect their achievement. This implies further, that positive attitude towards mathematics contribute meaningfully to higher achievement. Moreover, students with positive attitude towards mathematics tend to be achievers than those with negative attitude.

When subjected to Fisher's t-test, the computed t was 2.932. This value is greater than the tabular t-value of 2.074. Hence, the null hypothesis which states that "There is no significant relationship between the mathematics achievement and attitude towards mathematics of the experimental group" was rejected.

Table 11

Relationship Between Mathematics Achievement and Attitude Towards the Subject

Group	:Computed r	: Interpretation	: Computed t	: Interpretation
Experimental	0.53	Moderate Correlation	2.932	Significant
Control	0.12	Low Correlation	0.567	Not Significant

Relationship Between Mathematics Achievement and Attitude Towards the Subject of the Control Group

In the individualistic group, the computed r only yielded 0.12. This denotes a negligible relationship between the two variables. It means that the increase of one may not mean the increase of the other. Thus, students with low achievement in mathematics does not mean that they have negative attitude towards the subject or students with high achievement does not mean they have favorable attitude towards the subject.

Likewise, the null hypothesis which states "There is no significant relationship between the mathematics achievements and attitude towards mathematics of the control group was accepted, since the computed t of 0.567 is lesser than 2.074 at .05 level of significance and 22 degrees of freedom.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary, conclusion and recommendations based on the study.

Summary of Findings

Based on the data gathered, the following results were obtained:

1. The t-test for independent means yielded a computed t-value of 0.298 which is significantly lower than the tabular t-value of 2.0168, indicating the acceptance of the null hypothesis number one which states that "There is no significant difference between the experimental and control groups with respect to their pretest mean scores."

2. The computed t-value of 2.197 was significantly higher than the tabular t-value of 2.0168 in favor of the experimental group. This led to the rejection of the hypothesis which states that "There is no significant difference between the experimental and control groups with respect to their posttest mean scores.

3. The t-test for dependent means yielded a computed t-value of 16.57 which is very much greater than the tabular t-value of 2.069. With this result, null hypothesis number two was rejected. There was a significant difference between the pretest and posttest mean scores of the experimental group.

4. The computed t-value of 11.46 was greater than the tabular t-value of 2.069. This result indicates the rejection of the null hypothesis number three. The findings implied that there was a significant difference between the pretest and posttest mean scores of the control group.

5. The null hypothesis which states that "There is no significant difference in the posttest mean scores between the experimental and control groups on recall and comprehension" was rejected since the computed t-value of 1.088 is lesser than the tabular t-value of 2.069.

6. The computed t-value of 2.740 was significantly higher than the tabular t-value of 2.069 in favor of the experimental group, hence the null hypothesis which states that "There is no significant difference in the posttest mean score between the experimental and control groups on application and problem solving" was rejected.

7. The computed F-ratio of 7.598 was significantly higher than the tabular F-ratio of 4.06 in favor of the cooperative group. The null hypothesis which state that "There is no significant difference in the posttest mean scores of the experimental and control group among students with high, average, and low ability" was rejected.

8. The computed t-value of 3.17 was significantly higher than its tabular t-value in favor of cooperative learning on students with ability. This is true with the average ability group whose computed t-

value was 4.239. With high ability group, the computed t-value was lesser than the tabular value hence, the hypothesis which states that "There is no significant difference in the posttest mean scores of the experimental and control groups among students with high ability" was accepted.

9. There was a significant relationship between mathematics achievement and attitude towards mathematics of the III-Orchids class since the computer r was 0.53.

10. The computed r between the mathematics achievement and attitude towards the subject of the control group was 0.12. This indicated a very low correlation between two variables. This result led to the acceptance of the hypothesis number six which states that "There is no significant relationship between mathematics achievement and attitude towards mathematics with respect to the control group."

Conclusions

Based on the findings of the study, the following conclusions were derived:

1. The mathematical abilities of the experimental and control groups at the start of the experimentation were the same as reflected in their pretest results.

2. Cooperative student activities is more effective than individualistic student activities in teaching mathematics.

3. On cognitive achievement in mathematics in terms of recall and comprehension, cooperative learning is equally effective as individualistic student activities. However, in terms of application and problem solving, the former is more effective than the later.

4. High, average, and low ability students using cooperative student activities perform better than their counterparts in the individualistic student activities. Moreover, cooperative student activities that use mixed ability grouping tend to be more effective for low ability and average ability students than for high ability groups.

5. Both cooperative and individualistic student activities are effective strategies in increasing mathematics achievement of high ability students.

6. Students who have positive attitude towards mathematics tend to have high mathematics achievement in cooperative learning group.

Recommendations

Based on the foregoing conclusions, the following recommendations are made:

1. Teachers should employ cooperative learning in teaching mathematics.

2. Cooperative learning should be integrated in the subject "Methods of Teaching" for education students.

3. To attain more significant effect it is recommended that the experiment be conducted for a longer period of time to determine the time series effects on the performance of the students.

4. Even though the data support that the use of cooperative student's activities could improve mathematics performance than individualistic student's activities, future research should be conducted to show how and when cooperation can maximize learning.

5. Future research in other topics of mathematics and other areas of learning such as Chemistry, Physics, Biology should be conducted.

6. It is recommended that a similar study should be conducted to determine whether similar cognitive outcomes will be obtained in other levels and schools.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Anderson, Lorin. The Effective Teacher. McGraw-Hill Book Co., U.S.A.: 1989.

Arend, Richard L. Learning to Teach. New York: Random House Inc., 1988.

Dewey, John, Experience in Education. New York: McMillan, 1938.

Ebel, R.L. Measuring Educational Achievement. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1965.

Good, Carter V. Dictionary of Education. University of Cincinnati: McGraw-Hill Book Company, 1973.

Howes, Peter, Elementary Mathematics and Methods of Teaching. Michigan, U.S.A.: Edwards Brothers, Inc., 1971.

Joyce, B. & Weil, M. Models of Teaching. Third Ed. Englewood Cliffs, New Jersey: Prentice-Hall, 1986.

Onsteirn, Allan C. Strategies for Effective Teaching. New York, U.S.A.: Haupers Collins Publishing, Inc., 1990.

Piaget, Jean. Psychology of Intelligence. Patterson, New Jersey: Little Fields Adams, 1963.

Popham, James W. Educational Evaluation. New Jersey: Prentice-Hall, Inc., 1975.

McEnerney, Kathleen. Cooperative Learning in Clinical Laboratory Science Education. American Society to Statistics. New York: McMillan Publishing Company, Inc., 1982.

UNPUBLISHED MATERIALS

Alandino, Danilo R. "Development and Validation of Modules on Exponents and Radicals in Mathematics III," Samar State Polytechnic College, 1996.

Aranador, Lourdes. "Relative Effectiveness of Cooperative, Competitive, Individualistic, and Traditional Teaching Strategies on Mathematics Achievement" Unpublished Dissertation, UP Diliman, 1992.

Avelino, Armando L. Effectiveness of Cooperative Learning Strategy in Teaching Mathematics," Unpublished Master's Thesis, PIT, Palompon,, Leyte, 1995.

Catacutan, Prescila M. "Effectiveness of Cooperative Learning Strategy on the Academic Achievement and Attitude in Mathematics off Selected Grade Four Pupils" Unpublished Master's Thesis, Colegio San Agustin, Makati, M,M,m 1989.

Cohen, Peter A. James A. Kulik & Chen Lin C. Kulik. "Educational Analysis of Tutoring: Meta-Analysis of Findings" American research Journal, 1986.

Espano, Gina U. "Effectiveness of Teacher-Made/Workbook in Teaching Basic Mathematics" Unpublished Master's Thesis, Samar State Polytechnic College, 1994.

Hopp, Carolyn Mae. "Cooperative Learning in Mathematics Class and the Influence of Tasks on Peer Interactions" Unpublished Doctoral Dissertation, University of Wisconsin, Madison, 1994.

Javier, Dolores. "Relative Effects of Small-Group-Within-A-Large-Group Instruction Versus One-Large-Group Instruction in Teaching Mathematics," Unpublished Master's Thesis, UP Diliman, 1980.

Licup, Nora. "Comparison of Cooperative Mastery Learning and the Traditional Approach in Teaching Mathematics," Unpublished Doctoral Dissertation, University of the Philippines, 1988.

Nichols, Joey D. "The Effects of Cooperative Learning on Students Achievements in High School Geometry Class" Unpublished Doctoral Dissertation University of Oklahoma, 1994.

Pacolor, Eusebio T. "Determinants of Achievement of Mathematics of Fourth YEar Secondary Students in Samar Island: An Input to a

Model Training Design" Unpublished Doctoral Dissertation, Samar State Polytechnic College, 1993.

Campbell, D. & Stanley J. "Experimental and Quasi-Experimental Designs for Research on Teaching" In Gage, N.L. (Ed.) Handbook for Research on Teaching. Chicago: Round McNally, 1963.

Deutsch, M. Cooperation and Trust: Some Theoretical Note. Lincoln, N.E. University of Nebraska Press, 1962.

Ibe, MIlagros D. "Teacher Education in the Philippines: State of the Arts and State of Practice." UP College of Education, Diliman, Quezon City, 1991.

Ibe, Milagros D. "A Survey of Teacher Training Institutions Offering Bachelor of Secondary Education (BSE Programs)." Department of Science and Technology-Science Education Institute DOST-SEI, Bicutan, Taguig, M,M., April 1993.

Gailan, Tarlochan Kaur. "Self-Instructional Module" World Health Organization Module Bank, 1982.

Jacobs, George. "Cooperative Goal Structure: A Way to Improve Group Activities, ELT Journal. Vol. 42, 97-201, 1988.

Johnson, D. & Johnson R. “Learning Together and Alone: Cooperation and Competition and Individualization”, New Jersey: Prentice-Hall, Inc., 1984.

Johnson, D.W., & Johnson F. “Joining Together: Group Theory and Group Skills.” Englewoods Cliffs, New Jersey: Prentice-Hall, Inc., 1987.

Johnson, D. & Johnson, R. “The Socialization and Achievement Crisis: Cooperative Learning Experiences Are the Solution.” Applied Social Psychology Annual 4, Beverly Hills, CA: Sage Publ., 1983.

Oliva, Cosette C. “Understanding of Electrochemical Concepts Related to the Lead Storage Battery by Automotive Technology Students in Samar State Polytechnic College, Philippines,” A Research paper for the Diploma Course, SEAMEO-RECSAM, Penang, Malaysia, June, 1989.

Slavin, Robert. “Staff Development and Student Learning: A Synthesis of Research on Models of Teaching,” Educational Leadership. Vol. 45, 1987.

Torralba, Constantino M. “Learning Modules as Instructional Materials,” Education and Development. PHL Review. Volume 5, Numbers 2 and 3, 1983.

APPENDICES

APPENDIX A

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

June 20, 1996

Dr. Rizalina M. Urbiztondo
Dean, Graduate & Post Graduate Studies
Samar State Polytechnic College
Catbalogan, Samar

Madam:

In my desire to start writing my thesis proposal, I have the honor to submit for your approval one of the following research problems, preferably number one:

1. EFFECTIVENESS OF COOPERATIVE AND INDIVIDUALISTIC STUDENT'S ACTIVITIES IN MATHEMATICS III ACHIEVEMENT

2. DEVELOPMENT AND VALIDATION OF MODULES ON SELECTED TOPICS IN ALGEBRA FOR BSE STUDENTS

3. EFFECTIVENESS OF MODULAR INSTRUCTION IN TEACHING MATH III

I hope for your kind and favorable action on this matter.

Very truly yours,

(SGD.) SHERRIE ANN M. CANANUA
Researcher

APPROVED:

(SGD.) RIZALINA M. URBIZTONDO, Ph.D.
Dean, Graduate and Post Graduate Studies

APPENDIX B

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

SCHOOL OF GRADUATE STUDIES

APPLICATION FOR ASSIGNMENT OF ADVISER

Name: SHERRIE ANN M. CANANUA

CANDIDATE FOR DEGREE: Master of Arts in Teaching (MAT)

AREA OF SPECIALIZATION: Mathematics

TITLE OF PROPOSED THESIS/DISSERTATION: Effectiveness of Cooperative and Individualistic Student's Activities on Mathematics III Achievement

(SGD.) SHERRIE ANN M. CANANUA
Applicant

EUSEBIO T. PACOLOR, Ph.D.
Name of Designated adviser

CONFORME:

(SGD.) EUSEBIO T. PACOLOR, Ph.D.
Adviser

APPROVED:

(SGD.) RIZALINA M. URBIZTONDO, Ph.D.
Dean, Graduate & Post Graduate Studies

APPENDIX C

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

June 20, 1997

Dr. Rizalina M. Urbiztondo
Dean, Graduate and Post Graduate Studies
Samar State Polytechnic College
Catbalogan, Samar

MADAM:

I hereby respectfully request that I be scheduled for a pre-oral defense of my thesis proposal entitled " EFFECTIVENESS OF COOPERATIVE AND INDIVIDUALISTIC STUDENT'S ACTIVITIES ON MATHEMATICS III ACHIEVEMENT", on the 28th of June, 1997.

I hope for your kind and favorable action concerning this matter.

Very truly yours,

(SGD.) SHERRIE ANN M. CANANUA
MAT Applicant

Recommending Approval:

(SGD.) EUSEBIO T. PACOLOR
Adviser

APPROVED:

(SGD.) RIZALINA M. URBIZTONDO, Ph.D.
Dean, Graduate and Post Graduate Studies

Dean, Graduate and Post Graduate Studies

APPENDIX D

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

October 13, 1997

Pres. Dominador Q. Cabanganan
Samar State Polytechnic College
Catbalogan, Samar

S i r :

I have the honor to request permission to conduct an experimental study on the "EFFECTIVENESS OF COOPERATIVE AND INDIVIDUALISTIC STUDENT'S ACTIVITIES ON MATHEMATICS III ACHIEVEMENT " among the III-Orchids of the Laboratory High School for the second grading period, SY 1997-1998.

I hope for your kind and favorable consideration on this matter.

Very truly yours,

(SGD.) SHERRIE ANN M. CANANUA
Researcher

Recommending Approval:

(SGD.) ENGR. ESTEBAN M. MALINDOG, Jr.
Chairman, Laboratory High School

(SGD.) TERESITA T. NEYPES, D.A.
Dean, College of Education

APPROVED:

(SGD.) DOMINADOR Q. CABANGANAN, Ed.D

APPENDIX E

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

March 4, 1998

Dr. Rizalina M. Urbiztondo
Dean, Graduate and Post Graduate Studies
Samar State Polytechnic College
Catbalogan, Samar

Madam:

I hereby respectfully request that I be scheduled for a final oral defense of my thesis entitled "Effectiveness of Cooperative and Individualistic Student's Activities on Mathematics III Achievement," on March 12, 1998.

I hope for your kind and favorable action on this matter.

Very truly yours,

(SGD.) SHERRIE ANN M. CANANUA
MAT Applicant

Recommending approval:

(SGD.) EUSEBIO T. PACOLOR, Ph. D.
Adviser

APPROVED:

(SGD.) RIZALINA M. URBIZTONDO, Ph.D.
Dean, Graduate and Post Graduate Studies

APPENDIX F

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

October 14,1997

Mr. Danilo Alandino
Secondary School Teacher
La Milagrosa Academy

Sir:

I have the honor to request permission to utilize your modules n Exponents and Radicals. This will be used as an instructional material on the control of the study entitled "EFFECTIVENESS OF COOPERATIVE AND INDIVIDUALISTIC STUDENT'S ACTIVITIES ON MATHEMATICS III ACHIEVEMENT."

It is hoped that this request will merit your favorable action.

Very truly yours,

(SGD.) SHERRIE ANN M. CANANUA
Researcher

APPROVED:

(SGD.) DANILO ALANDINO
Author

APPENDIX G

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

October 14, 1997

Dr. Eusebio T. Pacolor
Dean, College of Arts and Sciences
Samar State Polytechnic College
Catbalogan, Samar

Sir:

I have the honor to request permission to utilize your Attitudinaire. This will be used as one of the main instruments in gathering the data in connection with my study entitled "EFFECTIVENESS OF COOPERATIVE AND INDIVIDUALISTIC STUDENT'S ACTIVITIES ON MATHEMATICS III ACHIEVEMENT."

It is hoped that this request will merit your favorable action.

Very truly yours,

(SGD.) SHERRIE ANN M. CANANUA
Researcher

APPROVED:

EUSEBIO T. PACOLOR
Dean, College of Arts and Sciences

APPENDIX H

TABLE OF SPECIFICATION FOR TEST CONSTRUCTION IN MATH III

Topics	Recall	Comprehension	Application	Problem Solving	TOTAL
1.0 EXPONENTS					
Concepts of Exponents	1				1
Laws of Exponents	1	3	1		5
Zero and Negative Exponents	1	2	2		5
Simplifying and Evaluating Expression		1	2		3
Scientific Notation	1	1	4	2	8
Equations Involving Exponents	1	1	4		6
2.0 RADICALS					
Roots of Numbers	3	1	1	1	6
Fractional Exponents	1	3			4
Simplifying Radicals	2	2	1		5
Addition and Subtraction of Radicals	1	1	1	1	4
Multiplication and Division of Radicals	1	1	4	1	7
Equations Involving Radicals	1	3	2	6	
TOTAL	13	17	23	7	60

APPENDIX I

PRETEST/POSTTEST ITEMS

Multiple Choice: Write the letter of the correct answer in the space provided for before each number.

_____ 1. Which of the following expressions below is equal to $8^{1/4}$?
a. 2 b. 84 c. 4 8 d. 8 4

_____ 2. When no index is indicated in a radicand, then it is understood that the index is
a. 1 b. 2 c. 3 d. 4

_____ 3. Which of the following is the term used to a number inside the radical sign or the number whose root is being considered?
a. base b. radicand c. radical d. root

_____ 4. It is the product of a rational number in a decimal form which is lesser than ten and greater than or equal to one and a power of 10.
a. convenient notation c. mathematical notation
b. experimental notation d. scientific notation

_____ 5. Radicals are similar if they have the same
a. base and exponent c. index and base
b. radicand and index d. index and radicand

_____ 6. Which one is the process of eliminating the radicals in the denominator of a fraction?
a. evolution c. multiplication
b. involution d. rationalization

_____ 7. Three statements below are conditions for a simplified radical. Which one is not?
a. The radicand has no factor that is a perfect nth root.
b. The radicand does not contain a fraction.
c. The index of the radicand is in the highest possible index.
d. The denominator of the expression does not contain a radicand.

_____ 8. Which of the following has only one square root?
a. 0 b. 1 c. 4 d. -64

_____ 9. What is the index of the expression $\sqrt{3ab^5}$?
a. 1 b. 2 c. 3 d. 5

_____ 10. What value of x would make the expression $(2ab)^x$ equal to 1?
a. 0 b. 1 c. -1 d. 2ab

_____ 11. Which of the following operations is used to exponents when powers of the same base is multiplied?
a. addition
b. division
c. multiplication
d. subtraction

_____ 12. Which of the following is the base of the expression $(x+y)^{2n}$?
a. x b. y c. x+y D. 2n

_____ 13. The product 5.5.5.5.a.a.a.b.b in exponential form is equal to
a. 4 (5) (3) (a) (2) (b)
b. $4^5 3^a 2^b$
c. $5^4a^3b^2$
d. $(5ab)^9$

_____ 14. What value of k will have if $(x^k.x^k.y^k.y^k)^2 = (xy)^2$?
a. 0 b. ¼ c. ½ d. 2

_____ 15. Which law of exponent makes the statement $(3y)3 = 27y3$?
a. $x^m.x^n = x^{m+n}$
b. $\frac{x^m}{x^n} = x^{m-n}$
c. $(x^m)^n = x^{mn}$
d. $(xy)^n = x^n y^n$

_____ 16. What value of x will make the statement $\frac{(a)^{-5}}{(ab)^x} = \frac{1}{a^5b^5}$
a. 0 b. 1 c. -1 d. 5

_____ 17. Suppose that neither x nor y is zero. Which of these statements is not true?
a. $\frac{x^m}{x^n} = \frac{x^{-n}}{x^{-m}}$
b. $y^{k-1} = \frac{y^k}{y^1}$
c. $y^{k-1} = \frac{y^k}{y^{-1}}$
d. $(x^m)^{-1} = \frac{x^{-m}}{y^{-n}}$

_____ 18. Which is the $\sqrt[n]{xy}$ is not equal to?

a. $\sqrt[n]{x} \cdot \sqrt[n]{y}$ c. $(xy)^{1/n}$

b. $xy^{1/2}$ d. $x^{1/n}y^{1/n}$

_____ 19. The expression $(2x-3y)^{-2}$ written with positive exponent equals

a. $\frac{1}{(2x-3y)^2}$ c. $\frac{2}{x^6y^2}$

b. $\frac{x^6}{4y^2}$ d. $\frac{x^5}{(4y)^5}$

_____ 20. Which is the equivalent exponential form of $(\sqrt[5]{32})^2$?

a. $-(32)^{2/5}$ c. $-(32)^{5/2}$

b. $(-32)^{2/5}$ d. $(-32)^{5/2}$

_____ 21. Which of the following equations cannot be satisfied by any real numbers?

a. $x = 2$ c. $x + 8 = 0$

b. $-x = -7$ d. $3x - 12 = 0$

_____ 22. Which is equal to $(x^7y^7)^7$?

a. $[(xy)^{14}]^2$ c. $(x^7y^7)^7$

b. x^7y^7 d. x^7y^7

_____ 23. Three of the radicals below can be expressed as like radicals. Which one is the unlike radical?

a. 44 c. 110

b. 99 d. 176

_____ 24. Which of the following should be done first in finding the product of the expression $2 \cdot 3\ 4$?

a. multiply the radicals c. multiply the powers by applying $x^m \cdot x^n = x^{m+n}$

b. transform the radicals to powers with fractional exponents d. rewrite the product as a single radical?

_____ 25. Which radical is in simplest form?

a. $\frac{2+5}{3}$ c. $18 + 6$

b. $\frac{10 + 15}{5}$ d. 45

_____ 26. Which of the following cannot be combined into a single radical?

a. $5\ 7 - \sqrt[3]{28} + \sqrt[4]{63}$ c. $5\ 2 - 3\ 32$

b. $x\ 2 - 3x\ 2 + 5x\ 2$ d. $3\ 16 + 3\ 54$

_____ 27. Which of the following expressions is expressed in scientific notation?

a. 4.623×10^{-9} c. 0.99×10^{4}

b. 46.23×10^{8} d. $2.63 \times 10^{1/2}$

_____ 28. Two powers are equal if and only if

a. the bases are equal c. bases & exponents are equal

b. exponents are equal d. products are equal

_____ 29. Which of the following expressions below is in simplest form?

a. $\frac{4x^3y}{8}$ c. $\frac{3n^2b}{4}$

b. x^2y^2 d. $3n^2b^{-2}$

_____ 30. Given $4x = \frac{1}{256}$, which of the following is equal to 256, so that x may be solved?

a. 16^2 c. 128^2

b. 4^4 d. 2^8

_____ 31. $-(2x)^0 + (-2x)^0$ is equal to

a. $-4x$ c. $4x$

b. 0 d. $8x$

_____ 32. Which is equal to $-(-3x2y)^3$?

a. $27x^6y^3$ c. $9x^5y^4$

b. $-27x^6y^3$ d. $-9x^5y^4$

_____ 33. $\frac{a^2b^4}{a^{-3}b^6}$ is equal to

a. $a^{-1}b^4$ c. b^3/a

b. b^4/a d. a^5/b^2

_____ 34. The reduced form of $(4/5)^{-3}$ is

a. 64/125 c. -64/125

b. 125/64 d. -125/64

_____ 35. $(x^3 + y^3)^{-4}$ is equal to

a. $x^{-4} + y^{-4}$

b. $\frac{1}{x^{-4} + y^{-4}}$

c. $\left(\frac{1}{x^3}\right)^{1/4} + \left(\frac{1}{y^3}\right)^{1/4}$

d. $\frac{1}{(x^3 + y^3)^4}$

_____ 36. Which is a simplified form of the expression $\frac{(z^0x^{-3}z^{-10})}{x^2z^5}$?

a. $\frac{x^{-3}z^{-10}}{x^2z^5}$

b. $x^{-5}\ z^{-15}$

c. $\frac{z^0}{x^2y^{15}}$

d. $\frac{1}{x^5z^{15}}$

_____ 37. What is x if $\frac{5^{3x}}{5^{x-2}} = 625$

a. 1
b. 2
c. 4
d. 8

_____ 38. What is the value of a if $x^{2a-1} = x^3$?

a. 2
b. 8
c. ½
d. ¼

_____ 39. What is the value of x if $b^{-4} \cdot b^x = b^8$/

a. -4
b. 4
c. 8
d. 12

_____ 40. In scientific notation, 58 000 000 000 is equal to

a. 58×10^9
b. 5.8×10^{10}
c. 5.8×10^{-9}
d. 5.8×10^{-10}

_____ 41. In scientific notation, 0.000043 is equal to

a. 3.4×10^{-5}
b. 43×10^{-5}
c. 3.4×10^{-4}
d. 3.4×10^5

_____ 42. If x and y are nonnegative real numbers, what is $25x^4y^6$?

a. 5xy
b. -5xy
c. $5x^2y^3$
d. $-5x^2y^3$

_____ 43. 2.8×10^{-6} is equal to

a. 28 000 000 c. 0.0000028
b. 2 800 000 d. 0.000028

_____ 44. What is the product of $(5\sqrt{11})(3\sqrt{11})$?

a. $15\sqrt{11}$ c. 165
b. $11\sqrt{15}$ d. $18\sqrt{115}$

_____ 45. What is the product of 2 3(3 9 + 15 + 5 21) in simplest form?

a. 18 3 + 6 5 + 30 7 c. 6 3 + 2 5 + 10 7
b. 6 27 + 2 45 + 10 63 d. 18 + 6 5 + 30 7

_____ 46. Which is equal to $(\sqrt[3]{72})^4$?

a. $(2.3)^4$ c. $(2^0.3)^4$
b. $(2\sqrt[3]{9})^4$ d. $2\ ^3 9\ ^4$

_____ 47. What is the product of (7 3)(9 15)?

a. 63 5 c. 13 15
b. 189 5 d. 9 35

_____ 48. What is $\dfrac{x\ ?}{x - y}$

a. $\dfrac{x\ x + x\ y}{x^2 - y}$ c. $\dfrac{x + y}{x - y}$
b. $\dfrac{x\ x + x\ y}{x - y}$ d. $\dfrac{x - y}{x}$

_____ 49. What is the $\dfrac{x\ y}{y\ x}$?

a. $\dfrac{x\ \ xy}{y}$ c. $\dfrac{xy}{y}$
b. $\dfrac{x\ \ xy}{y^2}$ d. $\dfrac{x\ y}{x^2}$

_____ 50. What is the value of x if x + 1 = 7?

a. 36 c. 18
b. 48 d. 24

_____ 51. What is the sum of 3 28 - 63 - 5 112 + 2 980 in simplest form?

a. 28 - 63 - 112 + 2 98 c. -17 7 + 28 5
b. 6 7 - 23 7 + 14 2 d. -3 7

_____ 52. What is x if $6x + 9 + 9 = 6$?
a. no real root
b. 6
c. -6
d. -3

_____ 53. What is the value of a if $5a + 3 - 2a + 3 = 0$?
a. 0
b. 2
c. 4
d. 5

_____ 54. The area of a square table is 36 square feet. What is the measure of its sides?
a. 4 ft.
b. 6 ft.
c. 9 ft.
d. 18 ft.

_____ 55. A ladder 7 meters long leans against the side of a building. The bottom of the ladder is 5 meters from the wall of the building. What is the distance from the floor to the building to the top of the ladder?
a. 2.00 m
b. 4.889 m
c. 8.06 m
d. 12 m

_____ 56. What is the area of a rectangle whose length is 5 meters and whose width is 3 5 - 5 meters?
a. 10 sq. m.
b. 75 sq. m.
c. 15 15 - 25 sg. m.
d. 15 5 + 5 sq. m.

_____ 57. The length of a rectangle is 7 162 m and its width is 2 8. What is its perimeter?
a. 4 8 + 14 162
b. 134 2
c. 13 2
d. 67 2

_____ 58. The square root of twice a umber decreased by 10 is equal to 2. What is the number?
a. 72
b. 32
c. 6
d. no solution

_____ 59. The speed of the sound in water is 146 000 cm/s. If it takes sound 0.02 seconds to travel from the surface of a body of water to the bottom and back, how many cm deep is the water?

a. 2920×10^2
b. 29.20×10^2
c. 2.9220×10^3
d. 20.920×10^4

_____ 60. If the micron equals 0.001 mm, then one micron equals 0.000001 m, what is the length of a cell in meters if it is 47 microns long?

a. 4.7×10^{-6}
b. 4.7×10^{6}
c. 4.7×10^{-5}
d. 4.7×10^{5}

APPENDIX J

SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

STUDENTS' ATTITUDE TOWARDS MATHEMATICS

INSTRUCTION:

Below is presented a variety of statements pertaining to your attitude towards mathematics. Please express your feelings toward the subject. There are no right or wrong responses or answers. Rate yourself on each of these attitudes by encircling a number on the scale. The meaning of each of the numbers in the scale is as follows:

1. if you strongly disagree (SD)
2. if you disagree (D)
3. if you are neutral (N)
4. if you agree (A)
5. if you strongly agree (SA)

ATIITUDE	SCALE				
	SD	D	N	A	SA
1. My favorite subject is mathematics	1	2	3	4	5
2. I enjoy attending my mathematics class	1	2	3	4	5
3. I consider math as a difficult subject	1	2	3	4	5
4. I feel nervous and uncomfortable in mathematics class	1	2	3	4	5
5. Mathematics can help a student think logically	1	2	3	4	5
6. I feel I have a good foundation in mathematics	1	2	3	4	5

7. I enjoy solving math problems only if I know how to work well.	1	2	3	4	5
8. I enjoy doing exercises and assign-ments in my own	1	2	3	4	5
9. I find mathematics very useful in one's life .	1	2	3	4	5
10. I enjoy studying a math subject	1	2	3	4	5
11. I would like to spend more time working with mathematics	1	2	3	4	5
12. I am interested to obtain further knowledge in mathematics	1	2	3	4	5
13. I feel math is an important subject Just like any other subjects	1	2	3	4	5
14. In math I am not satisfied with a grade of 75. I want a grade of 85	1	2	3	4	5
15. I easily give up when I cannot solve	1	2	3	4	5
16. If math is an elective subject in College, I would avoid taking it	1	2	3	4	5
17. I need assistance in doing math problems because it confuses me	1	2	3	4	5
18. I am unable to think clearly when working in math	1	2	3	4	5
19. I feel uncomfortable working with Numbers, symbols and worded problems	1	2	3	4	5
20. I have a feeling of dislike in math	1	2	3	4	5
21. I wish I have no math subject	1	2	3	4	5
22. I do not feel sure of myself when working with math problems	1	2	3	4	5
23. I never get tired working with math	1	2	3	4	5
24. I do not listen during math class	1	2	3	4	5

APPENDIX K

ITEM ANALYSIS OF TEST INSTRUMENT

Item No.	Upper 50%	Lower 50%	ID	Int.	FV	INT	q	pg
1.	18	19	.24	MLD	.42	MD	.58	.2436
2.	24	16	.32	DRW	.80	ME	.20	.1600
3.	17	11	.24	MLD	.56	MD	.44	.2464
4.	15	6	.36	DRW	.42	MD	.58	.2436
5.	24	16	.32	DRW	.80	ME	.20	.1600
6.	24	22	.08	NCE	.92	VE		
7.	25	22	.12	NCE	.94	VE		
8.	19	10	.36	DRW	.58	MD	.42	.2436
9.	9	5	.16	NCE	.28	VD		
10.	17	9	.32	DRW	.52	ME	.48	.2496
11.	23	14	.362	DRW	.74	ME	.26	.1924
12.	25	24	.04	NCE	.98	VE		
13.	23	14	.36	DRW	.74	ME	.26	.1224
14.	24	22	.08	NCE	.92	VE		
15.	23	14	.36	DRW	.74	ME	.26	.1924
16.	24	23	.04	NCE	.94	VE		
17.	25	24	.04	NCE	.98	VE		
18.	15	6	.36	DRW	.42	MD	.58	.2436
19.	9	5	.16	NCE	.28	VD		
20.	17	9	.32	DRW	.52	ME	.48	.2496
21.	23	14	.36	DRW	.74	ME	.26	.1924
22.	24	16	.32	DRW	.80	ME	.20	.1600
23.	17	11	.24	MLD	.56	MD	.44	.2464
24.	25	21	.16	NCE	.92	VE		
25.	7	3	.16	NCE	.20	VD		
26.	23	12	.44	MLD	.90	ME	.10	.0900
27.	24	22	.08	NCE	.96	VE		
28.	9	5	.12	NCE	.26	VD		
29.	28	14	.32	DRW	.72	ME	.28	.2016
30.	19	10	.36	DRW	.58	MD	.42	.2436

tem No.	Upper 50%	Lower 50%	ID	Int.	FV	INT	q	pg
31.	7	4	.12	NCE	.22	VD		
32.	23	13	.40	HLD	.72	ME	.28	.2016
33.	24	22	.09	NCE	.92	VE		
34.	8	6	.03	NCE	.28	VD		
35.	20	11	.36	DRW	.62	MD	.38	.2356
36.	25	23	.08	NCE	.96	VE		
37.	24	16	.32	DRW	.80	ME	.20	.16
38.	23	15	.32	DRW	.76	ME	.24	.1824
39.	21	14	.28	MWD	.76	ME	.30	.21
40.	23	12	.44	HLD	.70	ME	.30	.21
41.	18	13	.24	MLD	.42	MD	.58	.2436
42.	14	6	.32	DRW	.40	MD	.60	.24
43.	21	14	.28	MLD	.70	ME	.30	.21
44.	23	14	.32	DRW	.76	ME	.24	.1824
45.	5	2	.12	DRW	.14	VD		
46.	16	9	.28	NCE	.50	MD	.50	.25
47.	13	7	.24	MLD	.40	MD	.60	.24
48.	9	5	.16	NCE	.28	VD		
49.	23	12	.44	HLD	.70	ME	.30	.21
50.	6	2	.16	NCE	.16	VD		
51.	24	12	.48	HLD	.72	ME	.28	.2016
52.	15	6	.36	DRW	.42	MD	.58	.2436
53.	23	15	.32	DRW	.76	ME	.24	.1824
54.	22	14	.32	DRW	.72	ME	.28	.2016
55.	23	12	.44	HLD	.70	ME	.30	.21
56.	21	14	.28	MLD	.70	ME	.30	.21
57.	24	15	.36	DRW	.78	ME	.22	.1716
58.	23	12	.44	HLD	.70	ME	.30	.21
59.	24	14	.40	HLD	.76	ME	.24	.1824
60.	22	13	.36	DRW	.70	ME	.30	.21
61.	21	9	.48	HLD	.60	MD	.40	.24
62.	24	14	.40	HLD	.70	ME	.30	.21
63.	23	13	.40	HLD	.72	ME	.28	.2016
64.	15	4	.44	HLD	.38	MD	.62	.2356
65.	22	13	.36	DRW	.70	ME	.30	.21
66.	23	16	.28	HLD	.78	ME	.22	.1716
67.	24	15	.36	DRW	.78	ME	.22	.1716
68.	21	13	.32	DRW	.68	MD	.32	.2176
69.	22	16	.24	MLD	.76	ME	.24	.1824

Item No.	Upper 50%	Lower 50%	ID	Int.	FV	INT	q	pg
70.	24	14	.40	HLD	.76	ME	.24	.1824
71.	19	10	.36	DRW	.58	MD	.42	.2436
72.	20	11	.36	DRW	.62	MD	.38	.2356
73.	22	14	.32	DRW	.72	ME	.28	.2016
74.	19	10	.36	DRW	.58	MD	.42	.2436
75.	23	12	.44	HLD	.70	ME	.30	.21
76.	16	4	.48	HLD	.40	MD	.60	.24
77.	19	10	.36	DRW	.58	MD	.42	.2436
78.	14	5	.36	DRW	.38	MD	.62	.2356
79.	6	4	.08	NCE	.20	VD		
80.	12	4	.32	DRW	.32	MD	.68	.2176
Total			21.00					9.2192
Mean			0.35					

Note:

HLD - High Level of Discrimination
DRW - Discriminates Reasonably Well
NCE - No Contribution to Examination

VE - Very Easy
ME - Medium Easy
MD - Medium Difficult
VD - Very Difficult

APPENDIX L

Computation of Reliability Coefficient (r)

$$r = \frac{k}{k-1}\left[1 - \frac{6\Sigma pg}{(KD)^2}\right]$$

$$r = \frac{60}{59}\left[1 - \frac{6(12.8876)}{441}\right]$$

$$r = \frac{60}{59}\,(0.8247)$$

$$r = 0.839$$

APPENDIX M

Computation of SD of Experimental and Control Groups

$$SD = \sqrt{\frac{N(\Sigma X^2) - (\Sigma X)^2}{N(N-1)}}$$

175915.64

$$SD_1 = \sqrt{\frac{24(17599115.64) - (2053.8)^2}{24(23)}}$$

$$= \sqrt{\frac{4221975.36 - 4218094.44}{552}}$$

$$= \sqrt{7.03065217391}$$

$$SD_1 = 2.65$$

$$SD_2 = \sqrt{\frac{24(17598.29 - (2052.9)^2}{24(23)}}$$

$$= \sqrt{\frac{4218438.96 - 4214398.41}{552}}$$

$$= \sqrt{7.3198369565}$$

$$SD_2 = 2.71$$

APPENDIX N

Computation of t-value of Pretest Results
Between Experimental and Control Groups

Students	Experimental Group (X_1)	Control Group (X_2)	d	X_1^2	X_2^2
A	26	22	4	676	484
B	28	25	3	784	625
C	18	24	-6	324	576
D	9	23	-14	91	529
E	15	22	-7	225	484
F	19	21	-2	361	441
G	16	11	5	256	121
H	16	20	-4	256	400
I	14	19	-5	196	361
J	18	18	0	324	324
K	20	17	3	400	289
L	12	23	-11	144	529
M	16	17	-1	256	289
N	16	15	1	256	225
O	22	14	8	484	196
P	16	15	1	256	225
Q	23	25	-2	529	625
R	15	15	0	225	225
S	16	15	1	256	225
T	16	14	2	256	196
U	16	13	3	256	169
V	17	15	2	289	225
W	16	12	4	256	144
X	18	12	6	324	144
Total	418	427	-9	7680	8051
Mean:	17.42	17.79			
Computed t:	0.298				
Tabular t:	1.960 @ a = .05, df = 46				
Interpretation:	Not Significant				

$$SD = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{n(n-1)}}$$

$$SD_1 = \sqrt{\frac{24(7680 - (418)^2}{24(23)}}$$

$$= \sqrt{\frac{9596}{552}}$$

$$= \sqrt{17.384057}$$

$$= 4.1694193$$

$$= 4.16942$$

$$SD_2 = \sqrt{\frac{24(8051) - (427)^2}{24(23)}}$$

$$= \sqrt{\frac{10895}{552}}$$

$$= \sqrt{19.737318}$$

$$= 4.4426701$$

$$= 4.44267$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left[\frac{(n_1-1)SD_1^2 + (n_2-1)SD_2^2}{n_1 + n_2 - 2}\right]\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

$$t = \frac{17.42 - 17.79}{\sqrt{\left[\frac{(24-1)(4.16942)^2 + (24-1)(4.44276)^2}{24 + 24 - 2}\right]\left[\frac{1}{24} + \frac{1}{24}\right]}}$$

$$t = \frac{0.37}{\sqrt{\left[\frac{(23)(17.384063) + (23)(19.737316)}{46}\right]\left[\frac{2}{24}\right]}}$$

$$t = \frac{0.37}{\sqrt{\left[\frac{399.83344 + 453.95826}{46}\right]\left[\frac{1}{12}\right]}}$$

$$t = \frac{0.37}{\sqrt{[18.560689][0.08333]}}$$

$$= \frac{0.37}{\sqrt{1.5467234}}$$

$$= \frac{0.37}{1.2436733}$$

$$= 0.2975$$

APPENDIX O

Computation of t-value of Posttest Results
Between Experimental and Control Groups

Students	Experimental Group (X_1)	Control Group (X_2)	d	X_1^2	X_1^2
A	45	54	-9	2025	2916
B	54	43	11	2916	1849
C	41	33	8	1681	1089
D	41	38	3	1681	1444
E	39	42	-3	1521	1764
F	35	39	-4	1225	1521
G	35	42	-7	1225	1764
H	34	34	0	1156	1156
I	40	42	-2	1600	1764
J	38	30	8	1444	900
K	37	26	11	1369	676
L	37	35	2	1369	1225
M	35	29	6	1225	841
N	41	30	11	1681	900
O	48	24	24	2304	576
P	43	35	8	1849	1225
Q	40	32	8	1600	1024
R	38	28	10	1444	786
S	31	27	4	961	729
T	37	26	11	1369	676
U	28	19	9	784	361
V	22	34	-12	484	1156
W	31	26	5	961	676
X	31	19	12	961	361
Total	901	787		34835	27377
Mean	37.54	32.79			

Computed t : 2.197

Tabular t : 1.960 @ a = .05, df = 46

Interpretation: Significant

$$SD = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{n(n-1)}}$$

$$SD_1 = \sqrt{\frac{24(34835) - (901)^2}{24(23)}}$$

$$= \sqrt{\frac{24239}{552}}$$

$$= \sqrt{43.9112318841}$$

$$= 6.63$$

$$SD_2 = \sqrt{\frac{24(22737) - (787)^2}{24(23)}}$$

$$= \sqrt{\frac{37679}{552}}$$

$$= \sqrt{68.259057971}$$

$$= 8.26$$

$$t = \frac{X_1 - X_2}{\sqrt{\left[\frac{(n_1-1)SD_1^2 + (n_2-1)SD_2^2}{n_1 + n_2 - 2}\right]\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

$$t = \frac{37.54 - 132.79}{\sqrt{\left[\frac{(23)(43.91) + (23)(68.23)}{46}\right]\left[\frac{1}{12}\right]}}$$

$$t = \frac{4.75}{\sqrt{\left[\frac{1009.23 + 1569.29}{46}\right]\left[\frac{1}{12}\right]}}$$

$$= \frac{4.75}{\sqrt{4.67123}}$$

$$= \frac{4.75}{2.16159}$$

$$= 2.197$$

tabular t-value : 1.960 @ α = 0.05, df = 46

APPENDIX P

Computation of t-value Between Pretest
And Posttest Scores of Experimental Group

Students	Pretest	Posttest	d	d^2
A	26	45	-19	361
B	28	54	-26	676
C	18	41	-23	529
D	9	41	-32	1024
E	15	39	-24	576
F	19	35	-16	256
G	16	35	-19	361
H	16	34	-18	324
I	14	40	-26	676
J	18	38	-20	400
K	20	37	-17	289
L	12	37	-25	625
M	16	35	-19	361
N	16	41	-25	625
O	22	48	-26	676
P	16	43	-27	729
Q	23	40	-17	289
R	15	38	-23	529
S	16	31	-15	225
T	16	37	-21	441
U	16	28	-12	144
V	17	22	-5	25
W	16	31	-15	225
X	18	31	-13	169
Total	418	901	-483	10535
Mean:	17.42	37.54	-20.125	
Computed t:	16.57			
Tabular t:	2.069 @ a = .05, df = 23			
Interpretation:	Highly Significant			

$$SD = \sqrt{\frac{n(\Sigma d^2) - (\Sigma d)^2}{n(n-1)}}$$

$$= \sqrt{\frac{24(10535) - (-483)^2}{24(24-1)}}$$

$$= \sqrt{\frac{252840 - 233289}{552}}$$

$$= \sqrt{\frac{19551}{552}}$$

$$= 35.418782609$$

$$= 5.95$$

$$t = \frac{d\sqrt{n}}{SD}$$

$$= \frac{20.125\sqrt{24}}{5.95}$$

$$= 16.57$$

tabular t: 22.069 @ $\alpha = 0.05$, df = 23

APPENDIX Q

Computation of t-value Between the Pretest And Posttest Scores of the Control Group

Students	Pretest	Posttest	d	d^2
A	22	54	-32	1024
B	25	43	-18	324
C	24	33	-9	81
D	23	38	-15	225
E	22	42	-20	400
F	21	39	-18	324
G	11	42	-31	961
H	20	34	-14	196
I	19	42	-23	529
J	18	30	-12	144
K	17	26	-9	81
L	23	35	-12	144
M	17	29	-12	144
N	15	30	-15	225
O	14	24	-10	100
P	15	35	-20	400
Q	10	32	-22	484
R	15	28	-13	169
S	15	27	-12	144
T	14	26	-12	144
U	13	19	-6	36
V	15	34	-19	361
W	12	26	-14	196
X	12	19	-7	49
Total	412	787	-375	6885
Mean:	17.17	32.79		
Computed t:	11.46			
Tabular t:	2.069 @ a = .05, df = 23			
Interpretation:	Significant			

$$SD = \sqrt{\frac{n(\Sigma d^2) - (\Sigma d)^2}{n(n-1)}}$$

$$= \sqrt{\frac{24(6885) - (375)^2}{24(24-1)}}$$

$$= \sqrt{\frac{165240 - 140.625}{552}}$$

$$= \sqrt{\frac{24615}{552}}$$

$$= \sqrt{44.5923913043}$$

$$= 6.68$$

$$t = \frac{d\sqrt{n}}{SD}$$

$$= \frac{-15.62\sqrt{24}}{6.68}$$

$$= 11.46$$

tabular t: 22.069 @ $\alpha = 0.05$, df = 23

APPENDIX R

Computation of t-value Between Experimental and Control Groups On Recall and Comprehension

Students	Experimental Group (X_1)	Control Group (X_2)	d	X_1^2	X_1^2
A	21	27	-6	441	729
B	25	23	2	625	529
C	21	16	5	441	256
D	21	20	1	441	400
E	18	21	-3	324	441
F	22	19	3	484	361
G	16	21	-5	256	441
H	17	17	0	289	289
I	22	22	0	484	484
J	16	18	-2	256	324
K	17	16	1	289	256
L	16	19	-3	256	361
M	16	16	0	256	256
N	19	6	13	361	36
O	21	21	0	441	441
P	21	19	2	441	361
Q	20	17	3	400	289
R	20	18	2	400	324
S	19	13	6	361	169
T	17	16	1	289	256
U	12	12	0	144	144
V	11	19	-8	121	361
W	18	12	6	324	144
X	19	12	7	361	144
Total	445	420		8085	7688
Mean	18.54	17.50			
Computed t: 2.695					
Tabular t : 1.960 @ a = .05, df = 46					
Interpretation: Significant					

$$SD = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{n(n-1)}}$$

$$SD_1 = \sqrt{\frac{24(8085) - (445)^2}{24(23)}}$$

$$= \sqrt{\frac{3985}{552}}$$

$$= \sqrt{7.2192}$$

$$= 2.69$$

$$SD_2 = \sqrt{\frac{24(7688) - (420)^2}{24(23)}}$$

$$= \sqrt{\frac{184512 - 176400}{552}}$$

$$= \sqrt{14.6957}$$

$$= 3.83$$

$$t = \frac{X_1 - X_2}{\sqrt{\frac{(n_1-1)SD_1^2 + (n_2-1)SD_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$t = \frac{18.4 - 17.50}{\sqrt{\frac{(23)(7.21920) + (23)(14.6957)}{46}\left(\frac{1}{24} + \frac{1}{24}\right)}}$$

$$t = \frac{1.04}{\sqrt{\frac{504.0427}{46}\left(\frac{1}{12}\right)}}$$

$$= \frac{1.04}{\sqrt{0.913120833}}$$

$$= \frac{1.04}{0.9555735}$$

$$= 1.08835$$

tabular t-value : 1.960 @ α = 0.05, df = 46

APPENDIX S

Computation of t-value Between Experimental and Control Groups On Application and Problem Solving

Students	Experimental Group (X_1)	Control Group (X_2)	d	X_1^2	X_1^2
A	24	27	-3	576	729
B	21	21	0	441	441
C	29	18	11	841	324
D	13	17	-4	169	289
E	20	20	0	400	400
F	20	20	0	400	400
G	19	21	-2	361	441
H	17	17	0	289	289
I	18	20	-2	324	200
J	22	12	10	484	144
K	15	10	-5	225	100
L	21	16	5	441	256
M	18	13	5	324	169
N	19	15	4	361	225
O	27	12	15	729	144
P	22	16	6	484	256
Q	20	15	5	400	225
R	18	10	8	324	100
S	12	14	-2	144	196
T	20	10	10	400	100
U	16	7	9	256	49
V	11	15	-4	121	225
W	13	14	-1	169	196
X	12	7	5	144	49
Total	447	367		8807	5947
Mean	18.63	15.29			
Computed t: 2.695					
Tabular t : 1.960 @ a = .05, df = 46					
Interpretation: Significant					

$$SD = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{n(n-1)}}$$

$$SD_1 = \sqrt{\frac{24(8807) - (447)^2}{24(23)}}$$

$$= \sqrt{\frac{11559}{552}}$$

$$= \sqrt{20.940217}$$

$$= 4.58$$

$$SD_2 = \sqrt{\frac{24(5947) - (367)^2}{24(23)}}$$

$$= \sqrt{\frac{142728 - 134689}{552}}$$

$$= \sqrt{14.563406}$$

$$= 3.82$$

$$t = \frac{X_1 - X_2}{\sqrt{\frac{(n_1-1)SD_1^2 + (n_2-1)SD_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$t = \frac{18.62 - 15.29}{\sqrt{\frac{(23)(20.88) + (23)(14.59)}{46}\left(\frac{1}{24} + \frac{1}{24}\right)}}$$

$$t = \frac{3.33}{\sqrt{\frac{480.24 + 335.57}{46}\left(\frac{1}{12}\right)}}$$

$$= \frac{3.33}{\sqrt{1.476666667}}$$

$$= 2.7403$$

tabular t-value : 1.960 @ α = 0.05, df = 46

APPENDIX T

Computation of Two-Way ANOVA of Posttest Results of Experimental and Control Groups by Ability Levels

TREATMENT	LA	AA	HA	
Cooperative	31	35	45	
	37	35	54	
	28	34	41	
	22	40	41	
	31	38	39	
	31	37	35	
		37		
		35		
		41		
		48		
		40		
		38		
	180	158	255	893
Individualistic	19	42	54	
	26	28	43	
	34	32	35	
	19	35	38	
	26	24	42	
	27	30	40	
		29		
		35		
		26		
		30		
		42		
		34		
	151	387	252	790
	331	845	507	1683

$$\Sigma X^2 = 61\ 803$$

$$N = 48$$

$$\Sigma X = 1\ 683$$

$$C = \frac{\Sigma X^2}{N} = \frac{(1\ 683)^2}{48}$$

$$= 59\ 010.19$$

$$TSS = \Sigma X^2 - C = 61\ 803 - 59\ 010.19$$

$$= 2\ 792.81$$

$$SSC = \frac{109\ 561}{12} + \frac{765\ 625}{24} + \frac{257\ 049}{12}$$

$$= 1\ 291.68$$

$$SSR = \frac{\Sigma (RowT)^2}{ck} - C$$

$$= 221.02$$

$$SSW = TSS - SSC - SSR$$

$$= 2\ 792.8 - 1\ 292.68 - 211.02$$

$$= 1\ 280.11$$

APPENDIX U

Computation of t-test of Posttest Result of Low-Ability Group Exposed to Cooperative and Individualistic Learning

$$SD = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{n(n-1)}}$$

$$SD_1 = \sqrt{\frac{6(5520) - (180)^2}{6(5)}}$$

$$= \sqrt{\frac{720}{30}}$$

$$= \sqrt{2.4}$$

$$= 3.83$$

$$SD_2 = \sqrt{\frac{6(3959) - (151)^2}{6(5)}}$$

$$= \sqrt{\frac{23754 - 22801}{30}}$$

$$= \sqrt{31.7666667}$$

$$= 5.64$$

APPENDIX V

Computation of t-test of Posttest Result of Average-Ability Group Exposed to Cooperative and Individualistic Learning

$$SD = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{n(n-1)}}$$

$$SD_1 = \sqrt{\frac{12(17642) - (458)^2}{12(11)}}$$

$$= \sqrt{\frac{1940}{132}}$$

$$= 3.83$$

$$SD_2 = \sqrt{\frac{12(12835) - (387)^2}{12(11)}}$$

$$= \sqrt{\frac{154020 - 149769}{132}}$$

$$= \sqrt{32.204545}$$

$$= 5.67$$

$$t = \frac{X_1 - X_2}{\sqrt{\frac{(n_1-1)SD_1^2 + (n_2-1)SD_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$t = \frac{38.17 - 32.25}{\sqrt{\frac{(11)(14.6689) + (11)(32.1489)}{22}\left(\frac{1}{12} + \frac{1}{12}\right)}}$$

$$= \frac{5.92}{\sqrt{3.90148333}}$$

$$= 2.997$$

APPENDIX W

Computation of t-value of Posttest of High-Ability Exposed to Cooperative and Individualistic Learning

	N	Mean	SD
Experimental Group	6	42.5	7.1
Control Group	6	42	6.54

$$t = \frac{X_1 - X_2}{\sqrt{\frac{(n_1-1)SD_1^2 + (n_2-1)SD_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$= \frac{42.5 - 42}{\sqrt{\frac{5(7.1) + 5(6.54)}{10}\left(\frac{1}{6} + \frac{1}{6}\right)}}$$

$$= \frac{0.5}{\sqrt{\frac{35.5 + 32.7}{10}\left(\frac{1}{6} + \frac{1}{6}\right)}}$$

$$= \frac{0.5}{\sqrt{(38.77)(1/3)}}$$

$$= 0.139$$

APPENDIX X

Computation of r Between Math Achievement and Attitude Towards Mathematics of the Experimental Group

$$\Sigma X = 87.2$$

$$\Sigma Y = 901$$

$$\Sigma XY = 3\ 303.92$$

$$\Sigma X^2 = 87.2$$

$$\Sigma Y^2 = 34\ 835$$

$$r = \frac{N\Sigma XY - \Sigma X\,(\Sigma XY)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma X^2 - (\Sigma X)^2]}}$$

$$r = \frac{24(3\ 303.1) - 87.2(901)}{\sqrt{[24(319.92) - (87.2)^2]\,[24(34\ 835) - (901)^2]}}$$

$$= \frac{707.2}{\sqrt{(74.24)(24\ 239)}}$$

$$= 0.53$$

APPENDIX Y

Computation of r Between Math Achievement and Attitude Towards Mathematics of the Control Group

$$\Sigma X = 80.2$$

$$\Sigma Y = 787$$

$$\Sigma XY = 2\ 660.5$$

$$\Sigma X^2 = 271.24$$

$$\Sigma Y^2 = 27\ 377$$

$$r = \frac{N\Sigma XY - \Sigma X\,(\Sigma XY)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\ [N\Sigma X^2 - (\Sigma X)^2]}}$$

$$r = \frac{24(2\ 660.5) - 80.1(787)}{\sqrt{[24(271.24) - (80.1)^2]\ [27\ 377) - (271.24)^2]}}$$

$$= \frac{813.3}{\sqrt{(93.75)\ (583\ 476.86)}}$$

$$= 0.12$$

APPENDIX Z

Computation of the Fisher's t-test Between Achievement And Attitude Towards Math of the Experimental and Control Groups

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

$$t_1 = \frac{0.53\sqrt{22}}{\sqrt{1-(0.53)^2}}$$

$$= \frac{2.4859}{\sqrt{0.7191}}$$

$$= 2.9315$$

$$t_2 = \frac{0.12\sqrt{24.2}}{\sqrt{1-(0.12)^2}}$$

$$= \frac{0.5628}{\sqrt{0.9856}}$$

$$= 0.5669$$

CURRICULUM VITAE

NAME	:	SHERRIE ANN M. CANANUA
BIRTHDAY	:	April 7
PLACE OF BIRTH	:	Basey, Samar
ADDRESS	:	184 Mckinley Ave. Brgy. 10 Catbalogan, Samar
PRESENT POSITION	:	Instructor II
STATION	:	Samar State Polytechnic College Catbalogan, Samar
CIVIL STATUS	:	Single

EDUCATIONAL BACKGROUND

Elementary	Catbalogan I Central Elem. School Catbalogan, Samar SY 1978-1984
Secondary	Samar State Polytechnic College Catbalogan, Samar SY 1984-1988
Tertiary	Samar State Polytechnic College Catbalogan, Samar SY 1988-1992
Graduate Studies	Samar State Polytechnic College Catbalogan, Samar

CURRICULUM PURSUED: Master of Arts in Teaching

MAJOR : Mathematics

CIVIL SERVICE ELIGIBILITIES

Career Service Sub-professional Examination, August 5, 1990, Catbalogan, Samar

Career Service Professional Examination, July 26, 1992, Catbalogan, Samar

Professional Board Examination For Teachers, October 25, 1992, Catbalogan, Samar

SEMINARS AND TRAININGS ATTENDED

Evaluation Seminar Workshop in Secondary Mathematics, March 2-4, 1994, Catbalogan, Samar

15th Joint FFP-FAHP Regional Work Conference, December 7-9, 1994, UEP, Catarman, Northern Samar

First Joint Annual Convention-Workshop of PASMEPGAI and MTAP, January 18-20, 1996, Palo, Leyte

Orientation Seminar for Accreditation, February 16, 1994, Catbalogan, Samar

Strengthening curricular Offerings Through Action Research, February 28-March 1, 1994, Catbalogan, Samar

5th National Assembly of High School Students, November 27-30, 1993, Baguio, City

2nd Samar Youth Congress, February 25-27, 1994, Catbalogan, Samar

Seminar Workshop on Research Proposal Preparation, July 29-July 2, 1992, Catbalogan, Samar

Seminar Workshop on Secondary Mathematics, June 28-30, 1993, Catbalogan, Samar

Division Seminar Workshop on Curriculum Writing in Math I and II, August 26-28, 1992, Catbalogan, Samar

Seminar Workshop on Teacher Wellness Through Attitudes and Value Exploration and Test construction for Classroom Use, June 3-5, 1993, Catbalogan, Samar

First Samar Youth Congress, March 6-7, 1993, Catbalogan, Samar

LIST OF FIGURES AND TABLES

Figure

Tables