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Modular Approach in Teaching Intermediate Algebra Among Grade 8 Students in Astorga National High School

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Abstract: This study aimed to determine the effectiveness of the modular approach in teaching mathematics, most particularly radicals to the grade 8 high school students at Astorga National High School, Alang- Alang, Leyte. It lasted for 4 weeks from November 9 to December 7, 2019, utilizing the 54 grade 8 junior high school students enrolled during the school year 2019-2020. The 54 students were divided into a comparable group of 27 students each, the conventional group and experimental group. To find the effectiveness of modular approach in teaching radicals in high school the true experimental design was used, employing the pre-posttest control group design. Since the experiment aimed to investigate the effectiveness of the modular approach in teaching mathematics in comparison with the conventional approach most particularly radicals, there was a need to measure achievement through 40 items pretest and posttest. Mean ratings of the students in both groups in the achievement test were analyzed. On the bases of the findings, the achievement of the conventional group and experimental group was the same in the pretest: simplifying radicals was good, adding and subtracting radicals was fair, multiplying, and dividing radicals was fair, while the combination was good. The computed t-values were all not significant. The performance of both groups in the 3 evaluations was all very good but experimental group showed better performance than the conventional group. The achievement of the conventional group in the posttest: simplifying radicals was very good, adding and subtracting radicals was good, multiplying, and dividing radicals was good, while the combination was very good. In the experimental group: simplifying radicals was very good, adding and subtracting radicals was very good, multiplying, and dividing radicals was very good and the combination was also very good. The performance of both groups in the pre-posttest along the three mathematical skills tested is found to be "significant". Based on the findings and conclusions of this study, the researcher recommends the following: Since modular approach of teaching is more effective than the conventional method, the researcher recommends the use of modules in teaching algebra. Teachers are expected to discuss with the students and parents the need or importance of modular method of teaching not only in mathematics but in other subject areas. Further studies in the use of module in another areas in mathematics should be undertaken to determine what other areas can be taught effectively through modular approach.

Keywords: Modular Approach, Intermediate Algebra, Teaching Radicals

1. Introduction

Any innovative undertaking towards quality education entails varied activities and factors to affect its purpose; that of achieving an effective educational system. Such endeavor includes all disciplines in the school curriculum like Mathematics, whose importance is beyond doubt. It is the brightest jewel in the intellectual crown of mankind; it is not easily owned and acquired.

Teaching and learning come in different styles and forms. Educators are now experimenting on the new methods on teaching and learning which aim at improving the quality of education and the quality of citizens produced by schools.

Mathematics is a foundation of practically everything that men and women do. It is involved in almost all fields of human activity and endeavor. This could easily be seen in the kind of transaction people encounter in their work wherein simple Mathematical equation and computation are used. In this regard, Mathematics becomes indispensable.

Much thought has been given to Mathematics. Cornelius, as cited by Lorenzo, said that the progress of science and technology was often measured by the extent to which it was

successful in the use of Mathematics.

Intermediate Algebra Curriculum was arranged by strands or units, which were content organizers. Those strands build on the concepts and skills developed by students in the First Year. It was expected that in developing the detailed units of study, teachers would weave together related expectations from different strands, in order to create an overall program that integrates and balance concept development, skill acquisition, and applications [18].

The grade 8 high school curriculum aims to achieve the goals set by the Department of Education (DepEd) such as: 1) Developing proficiency in Mathematical skills; 2) Enhancing understanding of mathematical concepts and principles; 3) Improving higher order thinking skills; and 4) Promoting an effective, self-reliant and productive citizenry.

This intermediate algebra for grade 8 uses the previously acquired knowledge and skills covered in the elementary course. The discussion covers systems of linear equations and inequalities, quadratic equations and their algebra solutions, rational algebraic expressions, variations, integral exponents, radical expressions, and patterns in sequences (arithmetic, geometric and others) as applied in real life situations.

Today, Mathematics continues to be one of the basic subjects in the school curricula in both private and public educational institutions. However, it has become a Waterloo to many students such that they would prefer courses with few Mathematics subjects. This study focuses on Intermediate Algebra specifically on radical which is prescribed in all grade 8 high school mathematics under basic education.

Historically, radicals were used long before fractional exponents were found to be more convenient to work with; hence, they were gradually used more often. Perhaps few of us learn and understand what a radical expression is.

Supposed a carpenter wants to construct a square table whose top is to be 16 square feet in area, how long must be the sides of the square table in order that its area will be 16 square feet? The carpenter is looking for a number that when multiplied by itself will give 16 because the area of square can be found by multiplying its length by itself or by squaring it. With a little guess work, we know that the length of the side of the square is 4 feet since $4^2 = 16$ [9].

Like this carpenter many other persons like scientists, architects, navigators, draftsmen, and surveyors have encountered similar problems that are, finding the square root of a number [9]. When we raise a number to the second power, we have squared the number. However, if we need to find the number that was squared as in the problem of the carpenter, we call this process, finding the square root of a number.

Any fractional exponents represent is a radical expression. When working with radicals, remember these are numbers. They are not counting numbers like 1, 2, 3… but they are numbers. The difficulty is that they are usually decimals that do not repeat and do not terminate. These irrational numbers cannot be written in decimal form. That is why the radical symbol $\sqrt{\ }$ was created, so that we could write them in exact form [18].

In the Teacher's Guide 2, the lesson deals with basic arithmetic operations: addition, subtraction, multiplication, and division of its radicals. This provides students with concrete examples to help them realize that the study of radicals can help them extend their understanding of irrational numbers. The concepts of radical expressions can be applied in Astronomy, Geography, Physics and Landscaping [18].

There are specific and general competencies in radical expressions [15] such as (1) demonstrating the acquisition of knowledge and skills related to radical expressions and being able to apply / relate them, (1.1) identifying algebraic expressions which are perfect nth powers, algebraic expressions with rational exponents, (1.2) determining the roots of number of monomials. (2) expressing each radical in simplest form, (2.1) identifying the radicand and index in a given radical expressions (2.2) identifying perfect with power factors in the radicand (2.3) extracting the root/s of these perfect powers out of the radical (2.4) rationalizing a fraction whose denomination contains radicals. (3) performing the fundamental operations on radicals, (3.1) adding and subtracting radicals (3.2) multiplying and dividing radicals.

One of the new methods in teaching and learning today is the modular approach wherein teacher intervention is very minimal or limited [14]. This style of teaching and learning is student-centered since the student must learn everything in the module by his own effort and phase. This method deviates from the traditional classroom situation wherein a teacher presents the lesson, and the students just listen to learn the concepts presented.

By using the module, learners gain access to several instructions. They know exactly what to learn. They can test themselves on their knowledge of the module content. They use their time more efficiently in a threat-free-environment. They achieve self-direction, and the module supplements the formal courses. With modules, the role of the instructor changes from that of an information provider to that of a facilitator, thus giving him/her time to discuss with the learners and identifying their learning difficulties, guiding both fast and slow learners and bringing about the application of knowledge instead of just merely dealing with facts [10].

Table 1. *National Achievement Test for the Last Five Years Year II.*

Subject Area	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Mathematics	80.25	65.84	80.36	75.28	74.73

(ANHS Profile, 2019).

It was evident in the National Achievement Test division level, Leyte Division, SY 2016-2017, showed the highest performance while SY 2015-2016 showed the lowest performance.

In the Leyte Division Achievement Test – Secondary SY 2018-2019 (DAT, 2019), Astorga National High School yielded a very low MPS in Mathematics which was 32.12 as compared to the national targeted MPS which was 75. Based on the test results, 71% of the secondary schools in the Leyte Division were low performing during the school year 2018-2019. In the light of these findings, one of the recommendations by the Department of Education Region

VIII Division of Leyte; all public secondary schools should plan and implement instructional interventions to improve academic performance.

To address these deficiencies, the teacher and the students must be able to understand the aim of teaching Mathematics, that it is not only to follow processes but to understand principles [3]. It is then a wise move to come up with a methodology or approach to facilitate the easy and desirable teaching of Mathematics in the classroom for the students.

It is imperative that Mathematics teachers recognize that the suitability of teaching methods has much to do with the deteriorating students' achievement in Mathematics, as well as other disciplines. With the introduction of the 2002 BEC, strategies in mathematics teaching include discussions practical work, practice and consolidation, problem solving, mathematical investigation and cooperative learning. All these can be made possible by modular approach.

Apparently, the success of Mathematics teaching depends upon the methodology and approaches employed by the teacher because the "method is the lifeblood of Mathematics teaching" [13]. Such a primer on the concept is supported by the 2002 Basic Education Curriculum on the important role of the teachers in the classroom setting which is to generate interest and make the students learn the subject effectively. This would, therefore, require the teachers to have a working knowledge of different methods and approaches which can make them more resourceful in addressing the situations arising in the classroom.

Module on radicals which was used as the instrument of this study provided a thorough and complete data set regarding topics on radical expressions in order for the students to have a solid foundation and thorough understanding regarding the lesson. They are encouraged to read, write, do, and talk about Mathematics, particularly the lesson on radical expressions [26].

At present, the school lacks textbooks and reference materials for the grade 8 students in the school where the researcher teaches. Majority of them especially in the lower sections lack the interest in mathematics especially in algebra which is too abstract and difficult for them to understand in the classroom setting. The teacher finds it also difficult to attend to all of their questions and problems as these are big-size classes. Thus, the researcher became interested to find out if such approach is likewise feasible in a school environment like the Astorga National High School. She believes that the use of the modular approach in teaching is advantageous to both the teachers and students.

Statement of the Problem

This study investigated the effectiveness of the modular approach in teaching Mathematics, particularly on radicals, to the grade 8 high school students at Astorga National High School, Alang- Alang, Leyte during the School Year 2019-2020.

Specifically, the study seeks answers to the following:

1. What is the performance of the conventional and experimental groups of the grade 8 high school students in the pre-test of the in the following skills:
   a. simplifying radicals;
   b. addition and subtraction of radicals;
   c. multiplication and division of radicals.
2. What is the performance of the students on the evaluation after each lesson?
3. What is the performance of the students in the posttest of the conventional and experimental groups along the identified skills?
4. What is the pretest-posttest achievement of the students between the conventional and experimental groups along the identified skills?
5. Is there a significant difference in the pretest results between the conventional group and the experimental group along the identified skills?
6. Is there a significant difference in the posttest results between the conventional and experimental groups along the identified skills?
7. Is there a significant difference in the pretest-posttest achievement of students between the conventional and experimental groups?

Null Hypotheses

The following null hypotheses were tested:

1. There is no significant difference in the pretest of the control group and experimental group in the following skills:
   a. simplifying radicals;
   b. addition and subtraction of radicals;
   c. multiplication and division of radicals.
2. There is no significant difference in the posttest results between the conventional and experimental groups along the identified skills.
3. There is no significant difference in the achievement of the between the conventional and experimental groups in the pre-posttest.

Theoretical/Conceptual Framework

This study is anchored on the following principles advocated by prominent educators and philosophers. The Theory of Constructivism by Piaget, cognitive structuring of the knowledge was fundamental. According to this theory, cognitive structures are patterns of physical or mental action that underlie specific acts of intelligence and correspond to stages of child development.

He articulated a mechanism by which knowledge is internalized by learners. Constructivism is premised on his view of the psychological development of children. Within his theory, the basis of learning is discovery: rediscovery and such conditions must be complied with if in the futures individuals are to be formed who are capable of production and creativity and not simply repetition [1].

Piaget's theory of constructivism is closely related to the present study since students are expected to discover independently the lessons presented in the module. The use of module enhances students' interest to understand the lessons and find out the answers on their own capability.

John Dewey's philosophy of pragmatism or progressivism states that the individual possesses the capacity to deal with human problems by using his natural intelligence.

Progressivists believe that education should focus on the child's rather than on the content or the teacher. This educational philosophy stresses that the learner is not passive. The learner is a problem solver and thinker who make meaning through his or her individual experience in the physical and cultural context. Effective teachers provide experiences so that students can learn by doing. Curriculum content is derived from student interests and questions. The scientific method is used by progressivist educators so that students can study matter and events systematically and at first hand. The emphasis is on process-how one comes to know [8].

In this study, the use of modular method of teaching enhances the student's understanding by relying on his or her own capacity. It provides the development of skills where students learn to work individually following their own pace of learning. Also, it connotes learning independently with less teacher attention. Another theory on which the present study anchored itself is the facilitation theory, developed by Carl Rogers, et. al. [12]. The basic premise of this theory is that learning occurs with the educator acting as facilitator, that is, by establishing an atmosphere in which learners feel comfortable to consider new ideas and are not threatened by external factors. He believes that human beings have a natural eagerness to learn and are encouraged to take the responsibility for their own learning. The learners provide much of the input for learning through their own insights and experiences.

This study considered facilitation theory as a relevant model on the use of modular approach in teaching mathematics. It is designed that teachers as facilitators of learning are less protective of their constructs; they are expected to listen to the learners, especially on their reactions and feedbacks on lessons and exercises contained in the module. And that teacher may guide the students to discover and assimilate learning through modular approach which may contribute to solving significant problems and achieving significant results.

Cognitive-Gestalt approaches put emphasis on the importance of experience, meaning, problem-solving, and the development of insights. He noted that this theory has developed the concept that individuals have different needs and concerns at different times, and that they have subjective interpretations in different contexts. It is presumed in this study that performance of students in mathematics may be enhanced by providing them with the instructional material which will cater to their needs and concerns at given lessons and times [1].

Learning is an active process. It follows then that one learns through personal contact and manipulations of the things around him. In so doing, he discovers for himself solutions beneficial to himself and to others and uses them to meet his needs and satisfaction. This is the principle of self-activity [7]. This can be best practical using modules or modular approach in teaching different disciplines like mathematics.

Gregorio has cited the following advantages of using modular approach [7]. Develop the child's ability to think quantitatively and independently. The early stages of unfamiliar lesson are carefully and thoroughly studied. Easy materials should be introduced before difficult ones. Pupils learn to analyze, evaluate, and make their own conclusion.

Bustos has underscored by saying that the modular approach addresses to the principles of individual differences. Such principle recognizes that although all human beings possess the same general mental capacities, they have quantitative and qualitative differences in the development of these capacities. This fact of the existence of the individual differences is most evident and obvious, particularly in the classroom. Teachers recognize that students differ greatly from one another, but they frequently fail to recognize and extend their differences. Students differ in the amount and character of previous training of physical health, vigor, habits of zeal and interest, ambition, and persistence. Every pupil has destructive characteristics.

As such, the researcher decided to study radicals as one of the major lessons in Math II with the use of modules, for which the approach caters to individual differences and gives much time for self-activity. Modules are instructional materials having the qualities that make an individual an independent learner, self-pacing, and allowing measures to meet the needs of individual differences [31].

The approach in this study is based on a child centered philosophy; hence, awareness of parents is also suggested. They, too, contribute to the achievement of their children in the classroom. With this approach, the major role of the teacher is to guide the daily learning activities. He must always be the facilitator of any teaching activities and appraise the achievement through evaluation. Testing is considered basic and the most commonly used strategy of evaluation in the classroom. [6] appoint was made by the joint committee of American Association of School Administrations that teaching without testing is unthinkable.

Significance of the Study

The researcher believes that the findings of this study would benefit the following:

School Administrators. The results of this study shall provide insights to academic heads to come up with an intervention program during in-service trainings that may focus on modern approaches to discuss to tackle problems on how to increase academic/scholastic achievement among students.

Mathematics Supervisors. The findings of this study shall serve as an entry point of their supervision during learning enrichment activity program (LEAP) Sessions. New approaches shall be discussed that shall be used to evaluate the teaching competence of mathematics teachers and how the skills developed in the students.

Mathematics Teachers. The result of this study shall enable them to be more innovative on the methods/approaches to be used in teaching mathematics. It will guide them to be resourceful enough in looking for and Mathematics Teachers. The result of this study shall enable them to be more innovative on the strategies/methods/approaches to be used in teaching mathematics. It will guide them to be resourceful enough in looking for and using instructional materials that

suit the subject matter so that teaching mathematics would be more effective and meaningful.

Subject Teachers. The use of modules shall encourage students to study independently. As they are working on their modules the teacher can supervise them without "spoon-feeding" them. The modules can also be used for seatwork on specific subject matter when teachers are called to a meeting and school related activities.

Students. The method itself calls for an independent way of learning, thus, it would develop their potentials and improve their learning capabilities through self-discovery and realization at their own rate. It shall help maximize learning since they can proceed at their own pace at their own level of achievement as reflected in their scores in the self-evaluation.

Parents. They shall be able to realize that they must do their part by helping their children develop interest; love for the subject, and to promote mathematical consciousness even among family members through follow-up of the performance of their children at home. They may also help their children learn some difficult lessons for them.

Researchers. The results of this study shall encourage them to try and investigate other modern approaches of teaching that shall be most effective subjects.

Scope and Delimitation of the Study

This study was mainly concerned with investigating the effectiveness of modular instruction in mathematics 8 at the Astorga National High School. This involved 54 selected students in the grade 8 whose first and second grading grades in math ranged from 80 to 98 this SY 2019-2020. This involves two groups the conventional and the experimental group.

Grade 8 students were chosen because intermediate algebra is a subject in the junior high school curriculum.

The mathematical skills included in this study were limited to simplifying radicals using properties, and the four fundamental operations of radicals. The subjects of this experimental study are the 54 secondary students from two sections at Astorga National High School who are grouped into two, based on the students' first and second grading grades in mathematics. The 54 students were divided into a comparable group of 27 students each group matched using first and second grading period.

The control group was exposed to the traditional approach; while the experimental group was exposed to the modular approach handled by only one teacher.

Definition of Terms

The following terms are as an aid in understanding the contextual presentation of this study.

Achievement. In this study, this refers to the knowledge and skills attained as reflected on the rating of the students in the pretest and posttest in Radicals.

Conventional Approach. This provides information detailing certain descriptions and procedures that are found in identified subjects such as Mathematics, Physics and Biology. Each of those subjects contains a sequence of content topics to be covered in class, one after the other. In this study this refers to the control group who were exposed to the lecture method.

Effectiveness. This refers to the gain in the test results obtained by the students from the pre-test and post-test instruments on radicals. It is also the capability of producing an effect and is most frequently used in connection with the degree to which something is capable of producing a specific, desired effect [33] or achievement gained through the pre-test and posttest.

Experimental Group. This refers to the group of subjects that are exposed to the variable of a control experiment [34]. In this study this group was taught using module on radicals.

Modular Approach/ Instruction. In this study it refers to the strategy of teaching adopted by the teacher wherein modules are used in the teaching- learning-process. This uses teachers' ready-made-handouts and arranged topics/skills with explanation after each sample on radicals. This strategy was applied to the experimental group [35].

Module. This refers to a relatively short self-contained independent unit of instruction designed to achieve a limited set of specific well- defined educational objectives intended to facilitate the student's achievement of an activity or a set of objectives. In this study, the following parts of module were adopted: Introduction, objectives, Title, Learning Activities, Practice Task/Worksheets, and Evaluation form.

Post-tests. It is a 40-item teacher- made – test to be administered to both the control and the experimental groups after the experimental period. The result was used to assess the effectiveness of modular approach.

Pre-tests. It is a validated teacher-made-test administered to both the control and experimental groups before the experimental period to find out what the students know about radicals. Also, it is a pre-assessment test administered to the students to determine if there is a need for them to undergo such lesson or if they are to advance to the next one. It is a procedure used to measure individual knowledge and skills about the module lessons.

Profile. This refers to the first and second grading grades of the grade 8 students in Mathematics who are the subject of the study and their sex.

Radicals. These refer to an expression consisting of a radical sign and the radicand. A radical sign is the sign which indicates the root of a number. A radicand is the number inside the radical sign or the number whose root is being considered. Index is the small number written at the upper left of the radical sign [14].

2. Review of Related Literature and Studies

2.1. Related Literature

This chapter presents the review of related literature and studies which the researcher considered relevant to the study. The first part consists of related literature taken from different sources noting the importance and the effectivity of the module as an approach. The second part consists of related studies, considering the similarities and differences to the present study which give emphasis on effectiveness and

acceptability of modular approach used in the teaching-learning process.

In the Press Release of Department of Education Metrobank-MTAP-DepEd Math Challenge, young Filipino math wizards once again proved their superb Mathematics prowess in the 2011 Metrobank-Mathematics Teachers Association of the Philippines (MTAP)- Department of Education Math Challenge – an annual academic event that brings together the country's finest young math enthusiasts.

Such annual academic event is participated by talented or gifted students and therefore calls for a review of past lessons, and enhancement activities for present and future lessons. Saturday Mathematics program is offered to regular pupils or students and for talented pupils or students.

The procedural ways highly involved in mathematical problems is an avenue to develop pupil's interest and creativity in the study of mathematics. In the opinion of Silva, one can even improvise his study habits in response to the solution of mathematical problem which eventually, will lead him to develop critical thinking which is most useful and relevant in real life situation [4].

A module is a new teaching strategy for arranging learning experiences in education and it has been receiving much attention. The strategy of learning modules has become a part of all levels of teaching. A learning module is a self-learning package dealing with one specific subject matter unit. It can be used in any setting convenient to the learner and may be completed at the learner's own pace. It may be used individually or in small groups. It is structured in such a way that learner can identify the objectives he/she wants to achieve, select the appropriate material, follow a learning sequence by selecting from a variety of methods of presentation, and evaluate his/her own achievements. In module learning teachers becomes a facilitator of learning rather than the traditional dispenser of knowledge. Sufficient theory and practice are available for the application of modular teaching in our classrooms.

Modular Method/Approach, the basic principles of modular courses involve the division of the curriculum into limited units or modules of learning which are assessed at the end of that unit, with the student building up a degree or award through such learning being credited [25]. Modular approach has three basic boundaries, these are: the modular course, where an individual course is modularized without any formal relationship to other courses; the modular field or faculty, where groups of related courses are modularized within a common framework and allow for cross-access; and the modular degree, where all courses operate within a common set of modular regulations. Modular approach also develops learner autonomy, if capability means anything it means being able to control your own learning, set your own goals and be responsible for your own achievements – knowing your strengths and weaknesses as a learner.

Individual Learning Plan or ILP is a user (student) specific program or strategy of education or learning that takes into consideration the student's strengths and weaknesses. Individualized instruction is like direct instruction, which also places greater reliance upon carefully prepared instructional materials and explicitly prepared instructional sequences. But where direct instruction is very rigidly structured for use with children in primary school, individualized instruction is recommended only for students of at least junior high school age, and presumes that they have greater self-discipline to be able to study more independently. Thus, individualized instruction has points of contact with the constructivism movement in education, started by Swiss biologist Jean Piaget, which states that the student should build his or her learning and knowledge. Individualized Instruction, however, presumes that most students at secondary school age still lack the basic knowledge and skills to direct most of their own curriculum, which must be at least partially directed by schools and teachers [24].

Smith states that modular instruction is one of the most recent outgrowths with the concepts of individualized instruction. In fact, according to him modules in themselves are part of the multi-media approaches to individualized instruction. This statement clearly signifies that we can use modular instruction to provide for the individual difference of students [16].

Learning resources are an important aspect of any educational experience. This approach proposes the use of these resources as the primary means of teaching the content of all or part of a subject. The teacher has a significant role in supporting learning through the selection of the materials and the design of the learning processes. Students are able to exercise choices over the way they engage with the materials because the teaching and learning arrangements are displayed overtly.

Independent study means a lot more that students working on their own; rather it emerges when students play a significant part in choosing their own direction, discovering their own learning resources, formulating their own problems, deciding their own course of action, and reflecting on the outcome of that process. If students are to develop independence, they need to be given the space in which to act as autonomous learners, they need freedom. However, this does not mean that to develop independent learning skills students simply need to be abandoned. Rather, a safe learning structure needs to be constructed that provides training, support and guidance from tutors and peers through the experience. The key challenge is the balance between freedom and structure. Academics are understandably cautious about letting go of control particularly in the new quality culture, however ways can be found to create temporary autonomous zones of student-centered practice that are defensible and even desirable.

In addition, when mathematics is well provided to the students it develops good mathematical experiences that are suitable to the state of their existing concepts [11]. It develops students to analyze new material for themselves so that they can synthesize their own concept in ways most meaningful to them. She further imparts that one major purpose of mathematics instruction is to arouse and develop among the learner's appreciation for mathematics [11].

Also, she pointed out that appreciation will make students

realize how mathematics can be used to solve their own life-like problem. To relate such student's experience and appreciation, the teacher must engage in student-centered activities that would ensure student's awareness of their own educational growth and development [11].

The present study is very much supported by the following individualized programs: (1) the Individually Prescribed Instruction (IPI) for every student an individual plan was prepared for each skill or subject based on diagonals of the students proficiency levels, where learning tasks were individualized and students' progress was continually evaluated; (2) the Program for Learning in Accordance with Needs (PLAN), which relied on instructional objectives and two week modules arranged according to the student's level of achievement; instructional materials were upgraded, and alternative sets of materials were available for each unit of instruction; (3) the Independent Study, which was more applicable in the secondary school level because students have mastered certain public skills; elementary school students could be moved from learning related to their specific abilities needs and interests.

The same study is advantageous for the following reasons found when using individualized instruction on educational technology: (1) cognizant of individual differences among the students and motivated by the desire to effect better transfer of learning; (2) instructional materials prove rewarding to all types of students of students, when students work and learn at their own pace and that the teacher would have ample time to guide the slow learners and provide challenging tasks.

Orlando advanced the idea that children had differed in attitudes and abilities in mathematics, thus they differed in attitudes towards numbers as such [9]. To help the majority of pupils, a new method of teaching called individualized instruction was tried where in the classroom a self was learning laboratory [2]. The children were keeping busy with the different activities. That is why, the researcher finds importance in a studying this kind of instruction in same way that she can help maximize student' achievement.

The fact that each child is a unique individual with background, experience, inborn qualities, habits, and learning styles different from those of other individuals, she should grow and develop to her optimum potential at own pace. The module as an instructional material possesses the qualities that shall make the learner an independent, self-pacing and allowing measures to meet the needs of individual differences [28].

2.2. Related Studies

Modern teaching believes that in order to be more effective, teachers should give much importance to students' activities in the classroom. That is why, a large number of students in the graduate course deals with the development of instructional materials and experimenting different approaches that shall be beneficial to the students thru maximum participation and must increase in their scholastic achievement.

By this, authors want to show that before, now, and then, modular approach has been tested to be one of the most effective way in teaching, but the researcher wants to prove if it is effective in a different setting with different skills to be learned, different venue, with different subjects having varied I. Q. level.

She recommended to other researchers to try modules even using the format in order to validate. She suggested that they should assess the style to find out it would suit to students with different mental abilities in a particular group. The result would be the bases for revision of the module in terms of its format/style, contents, and the evaluative measure of the module. Donor's study was helpful to the present research especially in the selection of the parts of the module [23].

In his study on development and effectiveness of Modular Teaching in Biology at Secondary Level indicated that modular approach was more effective instructional paradigm for biology as compared to the traditional method of teaching. Further, modular teaching appeared more favorable for low achievers than high achievers [16]. The results of this study provide base for the application of modular approach in the biology classrooms as well as for further research in this field for the further extension of this method to other subjects and levels [16].

On a study, which aim at generating the development and evaluation of modules for enhancing problem-solving skills in Math for second year high school students, she found out that the second-year high school students encountered difficulties in translating word phrases/sentences to algebraic expressions/equations, transforming and solving equations, and acquiring the necessary technique for solving word problems [2]. The following conclusions were made in her study: majority of the second-year high school students recognized the need for additional learning aids in acquiring the skills in problem-solving, the teachers and the students found the prepared modules readable and possessing a highly favorable degree of content validity and reliability and students who used the modules performed better than those who were exposed to the traditional lecture-discussion method of instruction [2].

Lagon in his study on the proposed module in teaching Mathematics V, she programmed the teaching of the fundamental operations, world problem and solutions on whole number, ratio, and proportion for pupil in the public school [27]. Her study was a supplementary module, while in this present study; it is an instructional material in the teaching of radicals. [20] study contained all the essential parts of module patterned after Toralba. The programmed modules were on the translation of some English words to Spanish [20]. It has helped the present research in the organization of modules after the ideas presented in the formulation of modules were also sought [24, 28, 23].

Orlina studied the evaluation and proposed revision of modules, variation, and Mendelian Genetics. She concluded that the use of modules enabled students to gain higher scores in the achievement tests, and the module was an acceptable enrichment for high school biology [30]. Her study has enlightened the use of module and must verify the result whether it really has improved the achievement test result in Mathematics enrichment, while the present study focuses on instructional materials [30].

The study conducted focused on the construction function, validation of modules, circular trigonometric functions and

fundamental identities aimed to develop modules appropriate and interesting to the first year Bachelor of Science in Industrial Education students at Samar Polytechnic College [32]. The data gathering procedure also consisted of five major parts, namely: 1) construction and validation of diagnostic tests, 2) identification of difficulties; 3) development of modules; 4) validation of modules; 5) evaluation of the readability of the modules [32]. But the present study uses only the 4 phases; 1) construction and validation diagnostic tests; 2) development of modules; 3) validation of modules; 4) evaluation of acceptability of the modules.

In the light of her findings, she recommended that the developed modules on circular trigonometric function and fundamental identities should be used in SSPC and other schools to further confirm it's effectively. She added that the use of module could serve as effective remedial resources materials for men even if they were away from classes. Like the purpose of her study, the present research wants to determine its effectivity, serve overpopulated classroom and helps remediate students in order to attain higher scholastic achievement.

In her study, ventured on modular approach in solving system of linear equations by relaxation method. She aimed to evaluate the effectiveness of modular instruction using relaxation method and to determine the degree of acceptance of modular instruction by the students [29].

She recommended further the use of modular instruction to students with above average intelligence as often as possible in order to maximize the learning process and output. For average and poor students, modules could be used if they should be helped by traditional instruction. She also suggested transforming every possible subject matter into modular form. In response to her calling, the present study wants to verify her finding if modular approach could be effective in other fields and to determine the acceptability of mathematics experts.

In his study the Effectiveness or Self Learning kits among Grade V Mathematics found out that the experimental group performed better than the control group [24]. Moreover, the individual approach in teaching Geometry using the self-learning kits among the Grade V pupils is better than using the traditional lecture method [24].

He recommended the use of self-learning kits since it developed proper acquisition of mathematical abilities and skills of the pupils. Like the present study, this aims to develop proper acquisition of such mathematical skills.

Dacula studied on development and validation of module on percent and ratio for Mathematics I. She found out that the experimental group shows a significant amount of learning after the respondents' instruction. She also found out that the developed module was fairly very easy and appropriate for the first-year high school students and the module was interesting based on the results of the tests [21].

She concluded that the modular approach of teaching was more effective than the traditional lecture-discussion method on percent and ratio was concerned. The students could do the modules and learn its contents discover process and technique in learning the lesson until the feeling of self-satisfaction was attained.

She recommended that modular instruction could help the students learn to be independent, responsible, self-reliant and hard working. It is also the same aim of the present study to be a wholistic individual.

An example of an individualized program instruction [19]. His study was on programmed instruction of College Algebra in comparison with the traditional lecture method. Students assigned in the experimental group exposed to programmed instruction were made to follow the direction using the booklet which suggested that they would later compare their solutions with those in the programmed materials [19].

This strategy enhanced individualized instruction since a student was made to compare his solutions with the correct answer in the programmed material. If wrong, he had to go back to the preceding material and see where he made his error and then correct it to the preceding material and see where he made his error and then correct it immediately [19].

This is related to the present study because it focuses on the comparison of test result with the traditional method to the modular instruction, after which they would compare their result to the key. If they, couldn't make at least 75 percent proficiency level they should go back and find out their wrong process or solutions.

Azuelo in her study on the proposed self- Instructional Laboratory Guides (SILG) for a biology class at Central Mindanao University High School, Musuan, Bukidnon, during the last grading period of the second semester of SY 1982-83, prepared laboratory guides which included objectives of the course, teaching lesson skills and content to be developed strategies and evaluative measures [17]. Her findings showed that the nature of activities carried in biology classes was the laboratory integrated with demonstration lectures and discussion in the class.

She concluded that the SILG was effective in the sense that the test score of students who used the SILG was significantly higher than students who were not exposed to the use of SILG [17].

Also, Jamandron, determined the effectiveness of using modules on selected science concepts taught to first year students in St.Paul School (SPS) of Nueva Ecija during the School Year 1992-1993. Her study compared the content of teaching Integrated Science in St.Paul, Nueva Ecija during the 1991-1992 to the scope of the minimum essentials set forth by DECS. Jamandron concluded that modular approach in teaching can be effective means of improving learning gains of Science I students. Further, the post test results indicated that the use of modules effected better learning [25].

These studies support the present study the fact that they aimed to prove the effectiveness of modular instruction in teaching science concepts.

In the field of Chemistry, Serrano as cited by [28] explored the effectiveness of modules as enrichment activities in chemistry. She prepared and validated modules on selected topics in Chemistry [31]. The performance of the learners in all the modules turned out to be very satisfactory. The modules were evaluated by Chemistry teachers and non-formal education coordinators. The modules were found out to be readable, interesting, and useful to the target population of

third year school students and out-of-school youth and adults.

The present study is similar to Serrano's study in that both involve the preparation, validation, and evaluation of modules for those secondary mathematics experts but the purposes for which the studies were intended, the area of study considered, statistical procedures used, and the venues different. The modules prepared by Serrano were intended for enrichment activities while that of the researcher were used as instructional materials by students with varying ability level in lieu of the traditional method in teaching.

The review of related studies showed the effectiveness of module as they relate to student's achievement in mathematics. The studies made by several of the authors are mentioned related to the present study because they are all concerned with the construction of instructional materials that can be possibly used in the classroom activities. The studies mentioned above, and the present study makes use of instructional material.

Other works have some similarities to the present study because both deal with effectiveness on the use of module and acceptability of the use of instructional materials. But it differs from the other studies in terms of the scope of the problem, subject treated, instrument and the setting of the study.

3. Methodology

This chapter presents the research design, subjects and respondents of the study, locale and time of the study, research instrument, and validation of the research instrument, experimental procedure, and method of data analysis.

3.1. Research Design

This study employed the experimental method of research. According to Good (1993), it is a method or procedure involving the control or manipulation of conditions for the purpose of studying the relevance effects of various treatment applied to members of a sample or samples. Specifically, it adopted the pretest-posttest control group design as shown in Figure 1. The design requires two groups of equivalent standing in terms of a criterion measure e.g., achievement or mental ability. The first group is designated as the control group while the second group is the experimental group. Both groups are given the same pretest. The control group is not subjected to a treatment while the experimental group is given the treatment factor. After the experimental period, both groups are again given the same posttest [8].

R_1	Q_1		Q_2
R_2	Q_3	X	Q_4

Figure 1. *Pre-Post Test Design.*

Where:
R = random assignment
Q_1 = Control pretest
Q_3 = Experimental pretest
Q_2 = Control posttest
Q_4 = Experimental posttest
X = treatment (modular)

There were two groups under study, one is the control group exposed to the traditional or lecture method while the other group is the experimental group exposed to modular approach of instruction. The lesson covers simplifying radicals; adding and subtracting radicals; and multiplying and dividing radicals. The module used was developed by Mr. Pedro L. Monticello Jr. which had been used in the Division of Calbayog most particularly at Rafael Lentejas Memorial School of Fisheries, Calbayog City for 7 years now.

To find the effectiveness of modular approach in teaching radicals in high school Mathematics at Astorga National High School, the true experimental design was used, employing the pre-posttest control group design. A 40-item test was administered to the subjects of the study during the pre-posttests. The data generated statistically treated using the mean, standard deviation, and t-tests of dependent and independent samples.

3.2. Participants of the Study

The subjects of this study are the fifty-four (54) grade 8 students who are officially enrolled this School Year 2019-2020. They belong to the first section of Astorga National High School. They were grouped into two, based on their average grades of the first and second grading periods in mathematics. The 54 students were divided into a comparable group of 27 students each.

3.3. Research Instruments

The research instruments in this study are achievement tests, evaluation module, and practice exercises/ tasks.

Achievement Test. This test was prepared by the researcher to determine the pre-test/post-test mean scores of the two groups, namely: experimental group and conventional group. It was a 40-item test that was validated by a teacher-made test. It was administered to the experimental and conventional groups of students based on selected mathematics books where the topics are contained. This multiple-choice type of test was patterned after the Philippine secondary competencies, which used Blooms' Taxonomy of Objectives.

Evaluation. These are the short exercises given to the students every after each lesson for evaluation purposes.

Module. A Teaching Module on Radicals which provides a complete set of data regarding topics on radicals' expressions such as Lesson 1: Changing Radicals to the Simplest form Using Property of Radicals (Property 2), Lesson 2: Changing Radicals to its simplest Form Using Properties of Radical (Property 2), Lesson 3: Addition and Subtraction Radicals, Lesson 4: Multiplication of Radicals, and Lesson 5: Division of Radicals.

3.4. Validation of the Research Instrument

In order to ensure the validity of the test, a fifty (50) item-test on radicals was constructed by the researcher based on the table of specifications prepared by the researcher utilizing Blooms' Taxonomy of Objectives. To determine the effectiveness of module on teaching radicals, the pretest and

posttest scheme was adopted.

The said test was tried out to the grade 9 students of Tanauan National High School after the researcher asked approval from the principal and the mathematics teacher concerned on November 3, 2019.

The subjects of the dry run of the achievement test were the grade 9 students who were officially enrolled during this School Year 2019-2020. These groups of students were chosen to validate the test since they already took intermediate algebra last year. They were expected to help improve the teacher-made test on radicals which is the topic for the experiment.

The result of the test was analyzed. Items were revised as shown in the item analysis. Out of fifty (50) items subjected for validation, thirty-four (34) were retained, six (6) were revised and ten (10) were deleted. The final form of the achievement test included only forty (40) items. The selection of the items for the final forty (40) items was based on the results of difficulty and discrimination indices. It was the basis of the rejection, retention and revision of the test items that were included in the final form of the achievement test used for pre and posttests of this study. It used a table of equivalents to interpret the difficulty index [9].

The Kudar-Richardson Coefficient was computed to determine the reliability of the teacher-constructed test. It obtained a value of 0.731 which fall ± 0.70 to ± 0.90 interpreted high relationships [5]. It was the basis to conclude that the test was reliable.

3.5. Method of Data Analysis

The data gathered were scored, collated, tabulated, statistically treated, and interpreted. To determine the students' level of performance during the pre and posttests, the mean values was computed with the following interpretations:

Table 2. *Interpretations for Intermediate Algebra Topics.*

Simplifying Radicals (nineteen items)

Scores	Rating	Adjectival Description
16-19	95-100	Outstanding
12-15	89-94	Very Good
7-11	81-88	Good
4-6	76-80	Fair
1-3	71-75	Poor

Adding and Subtracting Radicals (seven items)

Scores	Rating	Adjectival Description
6-7	95-100	Outstanding
5	89-94	Very Good
3	81-88	Good
2	76-80	Fair
1	71-75	Poor

Multiplying and Dividing Radicals (fourteen items)

Scores	Rating	Adjectival Description
12-14	95-100	Outstanding
9-11	89-94	Very Good
5-8	81-88	Good
3-4	76-80	Fair
1-2	71-75	Poor

Combination of the three Mathematical Skills (forty items)

Scores	Rating	Adjectival Description
34-40	95-100	Outstanding
25-33	89-94	Very Good
14-24	81-88	Good
8-13	76-80	Fair
1-7	71-75	Poor

The following statistical techniques were employed in this study:

T-test for independent groups was employed to determine the significance of the mean difference between the pretest results/ posttest results of the experimental groups and the control group.

The t-test for dependent group used to determine the significance of the mean difference between the pretest results and posttest results in the experimental groups and the control group.

Formula:

$$t = \frac{\overline{D}}{\sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{n}}{n(n-1)}}}$$

Where: $\overline{D}$ = the mean difference between the pretest and the posttest

$\sum D^2$ = the sum of the squares of the difference between the pretest and the posttest.

$\sum D$ = the summation of the difference between the pretest and the posttest.

n = the sample size

The hypothesis formulated tested at 0.05 probability level.

4. Presentation, Analysis, and Interpretation of Data

This chapter presents the analysis, interpretations, and findings of the study. Statistical indicators were used to present the data gathered which were analyzed and interpreted. The discussions on the findings of this study are presented into sections according to the order of statement of the problems.

The discussions are supported by the tabular presentation of the statistical results.

Pretest of the Conventional and Experimental Groups in the Lessons Covered

A forty (40) item achievement test was administered to both control and experimental groups as a pretest in order to determine the achievement. The lessons covered simplifying radicals, adding, and subtracting, and multiplying and dividing radicals.

Simplifying Radicals

Presented in Table 3 is the pretest result in simplifying radicals for both conventional and experimental groups.

It can be gleaned from the table that the conventional group yielded a mean score of 82.35 while the experimental group yielded a mean score of 81.42. The qualitative description of

both conventional and the experimental groups were good.

Table 3. *Pretest in Simplifying Radicals.*

Rating		Conventional		Experimental	
		F	%	F	%
Outstanding	(95-100)	0	0	0	0
Very Good	(89-94)	1	4	0	0
Good	(81-88)	16	59	15	56
Fair	(76-80)	10	37	11	41
Poor	(71-75)	0	0	1	4
Total		27	100	27	100
Mean		82.35		81.42	
Qualitative Description		Good		Good	

These data show evidently that the two groups of students are almost equal in their capacity and skills at the start of the experiment because both of them belong to the same level of performance in simplifying radicals.

Adding and Subtracting Radicals

Presented in Table 4 is the pretest result in adding and subtracting radicals for both conventional and experimental groups.

As shown in Table 4, the conventional group yielded a mean score of 78.02 while the experimental group had a mean score of 77.54. Both groups had a qualitative description of "fair". It means that the students under study had common understanding in adding and subtracting radicals.

Table 4. *Pretest in Adding and Subtracting Radicals.*

Rating		Conventional		Experimental	
		F	%	f	%
Outstanding	(95-100)	0	0	0	0
Very Good	(89-94)	0	0	0	0
Good	(81-88)	7	26	5	19
Fair	(76-80)	11	41	13	48
Poor	(71-75)	9	33	9	33
Total		27	100	27	100
Mean		78.02		77.54	
Qualitative Description		Fair		Fair	

Multiplying and Dividing Radicals

Presented in Table 5 is the pretest result in multiplying and dividing radicals for both conventional and experimental groups.

Table 5. *Pretest in Multiplying and Dividing Radicals.*

Rating		Conventional		Experimental	
		F	%	F	%
Outstanding	(95-100)	0	0	0	0
Very Good	(89-94)	0	0	1	4
Good	(81-88)	10	37	8	30
Fair	(76-80)	14	52	15	56
Poor	(71-75)	3	11	3	11
Total		27	100	27	100
Mean		79.85		79.87	
Qualitative Description		Fair		Fair	

As shown in Table 5, the conventional group yielded a mean score of 79.85 while the experimental group yielded a mean score of 79.87. The qualitative description of both conventional and the experimental groups were fair.

These results indicate that the two groups of students are equal in their mathematical skills as both groups belong to the same level of rating.

Combination of Three the Mathematical skills

Presented in Table 6 is the pretest result in the combination of three mathematical skills for both conventional and experimental groups.

Table 6. *Pretest in the Combination of Three Mathematical Skills.*

Rating		Conventional		Experimental	
		f	%	F	%
Outstanding	(95-100)	0	0	0	0
Very Good	(89-94)	0	0	0	0
Good	(81-88)	13	48	13	48
Fair	(76-80)	14	52	12	44
Poor	(71-75)	0	0	2	7
Total		27	100	27	100
Mean		81.13		80.76	
Qualitative Description		Good		Good	

As shown in Table 6, the conventional group yielded a mean rating of 81.13 while the experimental group yielded a mean rating of 80.76. The qualitative description of conventional group was good, and the experimental group was also good.

On the three mathematical skills in radicals covered, both groups almost had similar test results. The results reveal that they belong to the same level of rating described qualitatively as good. Although the students were not yet exposed to the formal lessons covered in this study the finding implies that they have a positive inclination towards understanding radicals.

Comparison in the Pretest Results Between the Conventional and Experimental Groups

Table 7 shows the t-values between the pre-test of the conventional and experimental groups on the three mathematical skills tested.

Table 7. *t-Tests on the Comparison between the Conventional and Experimental Groups on the Pretest Conducted.*

Skills	t-Test	Interpretation
a. Simplifying Radicals	0.65	Not Significant
b. Adding and Subtracting	0.24	Not Significant
c. Multiplying and Dividing	0.06	Not Significant
d. Combination	0.36	Not Significant

Critical and tabular Value .05 = 1.645.

As reflected in the table, the computed for simplifying radicals was 0.65, in adding and subtracting radicals, t-test was 0.24, in multiplying and dividing radicals, t-test was 0.06 and in combining the three lessons the t-value was 0.36. All computed values less than the critical value which is 1.645 at 0.05 level of significance. Based on the results, the null hypothesis which states that there was no significant difference in the pre-test of the conventional group and experimental group was accepted. Therefore, these findings show that the two groups are of the same mathematical skills along the lessons covered. They had common background in radicals as one of the major lessons in algebra.

Summary

Table 8 presents the summary on the results of evaluation of the lessons covered.

Table 8. *Summary Table on the Results of Evaluation of the Lessons Covered.*

Group	1st*		2nd**		3rd***	
	Mean	Interpretation	Mean	Interpretation	Mean	Interpretation
Conventional	90.50	Very good	93.83	Very good	90.13	Very good
Experimental	91.65	Very good	94.09	Very good	91.13	Very good

* Simplifying Radicals
** Adding and Subtracting Radicals
*** Multiplying and Dividing Radicals.

As gleaned from the table, both the conventional and experimental groups performed very good on the three sets of tests. Both groups had almost similar performance in the second test in addition and subtraction of radicals. This means that both groups had been attended well by the researcher whether the lecture or serving as facilitator in the case of the experimental group.

Posttest of the Conventional and Experimental Groups

The following discussions are the results of the posttest of the conventional and experimental groups on the lessons covered.

Simplifying Radicals

Presented in Table 9 is the posttest result in simplifying radicals for both conventional and experimental groups.

Table 9. *Posttest in Simplifying Radicals.*

Rating		Conventional		Experimental	
		F	%	f	%
Outstanding	(95-100)	6	22	13	48
Very Good	(89-94)	13	48	10	37
Good	(81-88)	8	30	4	15
Fair	(76-80)	0	0	0	0
Poor	(71-75)	0	0	0	0
Total		27	100	27	100
Mean		90.76		93.35	
Qualitative Description		Very Good		Very Good	

In the conventional group, 6 or 22% students got an outstanding rating, while 8 or 30% students were good. In the experimental group, the overall mean rating was 93.75 (very good), with 13 or 48% students got an outstanding rating, while 4 or 15% of them were good. The overall mean rating was 90.76 described as very good.

This result shows that the experimental group had better performance than the conventional group in the posttest. It means that the students learned or acquired more skills using the modular as they had the chance to attend their lessons independently.

Addition and Subtraction of Radicals

Table 10 shows the mean rating and qualitative description in the posttest results on adding and subtracting radicals of the conventional group and experimental group.

In the conventional group, 15 or 56% students got an outstanding rating, while 7 or 26% students were good. In the experimental group, the overall mean rating was 94.13 (very good), with 13 or 48% students got an outstanding rating, while 1 or 4% of them were good.

The overall mean rating of conventional was 93.02 described as very good while the experimental group was 94.13 also described as very good. Both groups do the same performance in the post test.

Table 10. *Posttest in Adding and Subtracting Radicals.*

Rating		Conventional		Experimental	
		f	%	f	%
Outstanding	(95-100)	15	56	13	48
Very Good	(89-94)	5	18	13	48
Good	(81-88)	7	26	1	4
Fair	(76-80)	0	0	0	0
Poor	(71-75)	0	0	0	0
Total		27	100	27	100
Mean		93.02		94.13	
Qualitative Description		Very Good		Very Good	

Multiplication and Division of Radicals

Table 11 shows the mean rating and qualitative description in the posttest results on multiplying and dividing radicals of the conventional group and experimental group.

Table 11. *Posttest in Multiplication and Division of Radicals.*

Rating		Conventional		Experimental	
		F	%	f	%
Outstanding	(95-100)	3	11	7	26
Very Good	(89-94)	17	63	18	67
Good	(81-88)	7	26	2	7
Fair	(76-80)	0	0	0	0
Poor	(71-75)	0	0	0	0
Total		27	100	27	100
Mean		90.35		92.54	
Qualitative Description		Very Good		Very Good	

In the conventional group, 3 or 11% students got an outstanding rating, while 7 or 26% students were good. In the experimental group, the overall mean rating was 92.54 (very good), with 7 or 26% students got an outstanding rating, while 2 or 7% of them were good. On multiplying and dividing radicals, experimental group showed better achievement which was 92.54 mean rating than the conventional group whose means was 90.35.

Both groups were qualitatively described as very good.

Combination on the Three Mathematical Skills Tested

Table 12 shows the mean rating and qualitative description in the posttest results on the combination of the three mathematical skills tested of the conventional group and experimental group.

In the conventional group, 3 or 11% students got an outstanding rating, while 7 or 26% students were good, while the overall mean rating was 90.35 qualitatively describes as very good. In the experimental group, 8 or 30% students got

an outstanding rating, and 2 or 7% of them were good, while the overall mean rating was 92.76 qualitatively described as very good.

Table 12. *Posttest in the Combination of the Three Mathematical Skills.*

Rating		Conventional		Experimental	
		F	%	f	%
Outstanding	(95-100)	3	11	8	30
Very Good	(89-94)	17	63	17	63
Good	(81-88)	7	26	2	7
Fair	(76-80)	0	0	0	0
Poor	(71-75)	0	0	0	0
Total		27	100	27	100
Mean		90.35		92.76	
Qualitative Description		Very Good		Very Good	

On the three mathematical skills tested, the overall results showed that the conventional group has a mean of only 90.35 while the experimental group has a mean rating of 92.76 while.

Table shows that the experimental group had highest achievement than the conventional group. These then show that the experimental procedure has a greater advantage over the conventional approach as revealed by their overall mean rating.

Comparison of the Posttest Results between the Conventional and Experimental Groups

Table 11 shows the t-values between the conventional group and the experimental group of the 3 mathematical tested.

Table 13. *T-Values on the Difference between the Conventional and Experimental Group of the Posttest.*

Skills	t-Values	Interpretation
a. Simplifying Radicals	2.11	Not Significant
b. Adding and Subtracting	1.18	Not Significant
c. Multiplying and Dividing	3.45	Not Significant
d. Combination	2.66	Not Significant

As reflected from the table, the t-values obtained in simplifying radicals had 2.11, multiplying and dividing got a t-value of 3.45, and the combination had 2.66. All these values yielded significant results. These findings indicate that the mean comparison between the two groups yielded significant difference in favor of experimental group. This implies that the use of module is also a good approach in teaching radicals.

On the other hand, in adding and subtracting radicals the computed t-value of 1.18 is not significant at 0.05 level. This means that both groups had similar performance in adding and subtracting radicals. Both lecture and modular approach were found to be effective in these particular mathematical skills.

Hence, the null hypothesis which states that there is no significant difference the comparison of the pretest and posttest of the two groups is rejected along simplifying radicals, multiplying and dividing radicals, the hypothesis is accepted.

Pretest-Posttest Comparison between Conventional and Experimental Groups on the Lessons Covered

Simplifying Radicals

Table 14 shows the mean rating and qualitative description between the pretest and posttest of the conventional group and experimental group in simplifying radicals.

In the conventional group, in the pretest the mean rating was 82.35 (good) while in the posttest the mean rating was 90.76 (very good). These results indicate that there was really learning after the activity.

In the experimental group, the pretest the mean rating was 81.42 (good) while in the posttest the mean rating was 93.35. Figures then vouch that using modular instruction as a technique in teaching radicals is very effective.

Table 14. *Pre-Posttest Results of the Conventional and Experimental Groups on the Lessons Covered.*

Rating	Conventional				Experimental			
	Pretest		Posttest		Pretest		Posttest	
	F	%	F	%	f	%	f	%
Outstanding	0	0	6	22	0	0	13	48
Very Good	1	4	13	48	0	0	10	37
Good	16	59	8	30	15	56	4	15
Fair	10	37	0	0	11	41	0	0
Poor	0	0	0	0	1	4	0	0
Total	27	100	27	100	27	100	27	100
Mean	82.35		90.76		81.42		93.35	
Qualitative Description	Good		Very Good		Good		Very Good	

With the mean difference between the pre-posttests of 8.41 and 11.93 of conventional group and experimental group respectively, results show that the technique used by the teacher is effective.

Addition and Subtraction of Radicals

Table 15 shows the mean rating and qualitative description between the pretest and posttest of the conventional group and experimental group in adding and subtracting radicals.

In the conventional group, the mean rating in the pretest was 78.02 (fair) while in the posttest was 93.02 (very good). This shows that the students performed better since the mean rating in posttest was high.

Table 15. *Adding and Subtracting Radicals.*

Rating	Conventional				Experimental			
	Pretest		Posttest		Pretest		Posttest	
	f	%	f	%	f	%	f	%
Outstanding	0	0	15	56	0	0	13	48
Very Good	0	0	5	18	0	0	13	48
Good	7	26	7	26	5		1	4
Fair	11	41	0	0	13	48	0	0
Poor	9	33	0	0	9	33	0	0
Total	27	100	27	100	27	100	27	100
Mean	78.02		93.02		77.54		94.13	
Qualitative Description	Fair		Very Good		Fair		Very Good	

On the modular approach, the mean rating in the pretest was 77.54 (fair) while in the posttest was 94.13 (very good). This means that majority of the students have mastered the skills tested.

Multiplying and Dividing Radicals

Table 16 shows the mean rating and qualitative description between the pretest and posttest of the conventional group and experimental group in multiplying and dividing radicals.

In the control group, the mean rating in the pretest was 79.85 (fair) while the posttest was 90.35 (very good). In the experimental group, students' mean rating in the pretest was 79.87 (fair) while in the posttest was 92.54 (very good). This

means that majority of the students have mastered the skills tested.

Table 16. *Multiplying and Dividing Radicals.*

Rating	Conventional				Experimental			
	Pretest		Posttest		Pretest		Posttest	
	f	%	f	%	f	%	f	%
Outstanding	0	0	3	11	0	0	7	26
Very Good	0	0	17	63	1	4	18	67
Good	10	37	7	26	8	30	2	7
Fair	14	52	0	0	15	56	0	0
Poor	3	11	0	0	3	11	0	0
Total	27	100	27	100	27	100	27	100
Mean	79.85		90.35		79.87		92.54	
Qualitative Description	Fair		Very Good		Fair		Very Good	

This implies that after the students have been exposed to the modular approach there is an extensive improvement of the students' performance on the skill tested.

Combination of the Three Mathematical Skills

Table 17 shows the mean rating and qualitative description between the pretest and posttest of the conventional group and experimental group in the combination of three identified skills of radicals.

Results show that the control group exhibited a good increase from the pretest mean rating of 81.13 (good) to the posttest mean rating of 90.02 (very good), yet experimental group had an exorbitant raise from the pretest of 80.76 (good) to the posttest of 92.76. The result showed that the students found the lessons/skills easy when they were exposed to the modular approach.

Table 17. *Combination of the Three Mathematical Skills of Radicals.*

Rating	*Conventional*				*Experimental*			
	Pretest		Posttest		Pretest		Posttest	
	f	%	f	%	f	%	f	%
Outstanding	0	0	3	11	0	0	8	30
Very Good	0	0	17	63	0	0	17	63
Good	13	48	7	26	13	48	2	7
Fair	14	52	0	0	12	44	0	0
Poor	0	0	0	0	2	7	0	0
Total	27	100	27	100	27	100	27	100
Mean	81.13		90.02		80.76		92.76	
Qualitative Description	Good		Very Good		Fair		Very Good	

It can be gleaned from the table that posttest mean rating of the two groups is significantly higher than their pre-test mean rating.

The table revealed that the experimental group had highest performance among the two groups. These then show that the experimental procedure has a greater advantage over the conventional approach as revealed by their over-all results.

Comparison in the Pretest-Posttest Results between the Conventional and Experimental Groups

Table 18 shows t-values on the difference between the pre-posttest of the conventional and experimental groups of the three lessons covered in the study.

As shown in the table, it can be gleaned that on the conventional group, the comparison between the pre-test-posttests yielded significant results along the mathematical skills tested.

Table 18. *T-Values on the Comparison between the Pre-Posttest of the Conventional and Experimental Group.*

Skills	Conventional Group		Experimental Group	
	t-values	Interpretation	t-values	Interpretation
a. Simplifying Radicals	9.52	Significant	10.20	Significant
b. Adding and Subtracting Radicals	15.91	Significant	21.27	Significant
c. Multiplying and Dividing Radicals	8.81	Significant	15.55	Significant
d. Combination	10.33	Significant	18.52	Significant

Simplifying radicals had a t-value of 9.52, addition and subtraction of radicals, multiplication and division of radicals and combination obtained t-values of 15.91, 8.81 and 10.33 respectively. These findings reveal that there was a significant improvement of the students learning in the lessons before and after the lecture presented to them.

Likewise, the experimental group had shown a very good performance after the students had been exposed to using the modules. The mean comparison during their pre and posttests indicates that there was a significant result in favor of the post-tests. The computed t-values along the three topics and the combination were all greater than the critical or tabular value at 0.05 which is 1.645. These findings mean that students are expected to gain knowledge, skills and interest in the lessons after they had been thoroughly guide on the use of modules. They were exposed to experiential and independent learning where they were made to understand the concepts and discover the solutions to the exercises included in the material.

Thus, the hypothesis that there is no significant difference between the pretest and posttest of the two groups is rejected. This means that there was a significant difference between.

5. Conclusion

On the bases of the findings obtained in this study, the following conclusions were drawn:

1. The achievement of the conventional group and experimental group were the same in the pretest: simplifying radicals was good, addition and subtraction of radicals was fair, multiplication and division of radicals was fair, while the combination was good.
2. The computed t-values were all not significant.
3. The performance of both groups in the 3 evaluations was all very good but experimental group showed better performance than the conventional group.
4. The achievement of the control group in the posttest: simplifying radicals was very good, addition and subtraction of radicals was good, multiplication and

division of radicals was good, while the combination was very good. In the experimental group: simplifying radicals was very good, addition and subtraction of radicals was very good, multiplication and division of radicals was very good, and the combination was also very good.

5. There was a significant difference on the performance between the conventional and experimental groups in simplifying radicals, multiplication and division of radicals, and combination during the posttest, however, addition and subtraction of radicals did not yield significant result.
6. There was a significant difference on the performance of the two groups in the pretest-posttest along the three mathematical skills tested.

6. Recommendations

Based on the findings and conclusions of this study, the researcher recommends the following:

1. Since modular approach of teaching is more effective than the conventional method, the researcher recommends the use of modules in teaching algebra and other mathematics subjects. The use of this instructional material will contribute to students' ability to think creatively and will encourage active participation of the child during class discussion.
2. The use of modules shall be given importance which shall provide a solution to over increasing student population which created shortage of classrooms and buildings, textbooks, reference materials and even competent teachers. With the use of modules, a teacher can possibly manage 50 students or more in one class which will help minimize the problem on classroom management.
3. Teachers may be encouraged to attend seminars and related activities on the development of instructional materials like module preparation in mathematics. Teachers-made instructional materials may supplement the lack of textbooks, references, and learning resource materials in the public schools. Thus, the use of instructional materials is expected to gain more meaningful mathematics education among students.
4. Teachers are expected to discuss with the students and parents the need or importance of modular method of teaching not only in mathematics but in other subject areas. They need to be informed on how modules develop independent learning and better comprehension in mathematics among students. Likewise, parents and other members of the family may be able to help learning at home.
5. Students shall be motivated that modular approach is used not only to the above average and average students but also to the slow learners who may seek the help of the members of the family and their classmates and friends who have the knowledge and can understand mathematics better.
6. Administrators may create a committee which may be composed of teachers who may be expert in mathematics to review the modules and other instructional materials and recommend the same if found in order for implementation or use.
7. Further studies in the use of modules in other areas in mathematics should be undertaken to determine what other areas can be taught effectively through the modular approach.

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