# EFFECT OF MODULAR APPROACH ON THE LEVEL OF ACHIEVEMENT OF STUDENTS IN INORGANIC CHEMISTRY

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**Abstract**

In general, Filipinos have a deep regard for education. This study ascertained the effect on academic achievement of students in Inorganic Chemistry taught by using the modular approach in comparison with the lecture-discussion. This study was conducted among the third year Bachelor of Elementary Education (BEED) since they occupy the largest group in the College of Education (COE) and the only takers forming part of their general education subjects. This is a quasi-experimental research that utilized the Pretest-Posttest Control Group design which included the experimental and control groups which were carefully chosen. The two groups were given the same pretests before the conduct of the treatment to determine if the two groups are really comparable before conducting the experiment. The profile of students taking Inorganic Chemistry shows that majority belongs to 18 and below age brackets in both group which further indicates that essentially both groups belong to the same age range and majority were females. The grade point average (GPA) in science subjects of the participants clearly indicates that majority of them are good performers with a GPA of 1.6.1-2.5 while the reading comprehension skills in both groups were also used as a factor for the matching which indicated that the respondents are Limited English Readers (LERs) based on the scores they got from the 55-item standardized Ballard and Tighe's Idea Proficiency Test (IPT) 2004. The level of achievement of the students taught using modular instruction and lecture-discussion based on the results of the paired t-test between the mean pretest and mean posttest scores of the experimental and control groups suggests that the mean posttest score is significantly higher than the pretest score in both the control group and experimental group. This further emphasized that the pretest and posttest of both the control and experimental groups indicating the median posttest scores in both groups are higher than the median pretest scores. These results on the level of achievement of the students taught using modular instruction and conventional method also show that there is a significant improvement in the achievement scores in each group but no significant difference between the levels of achievement of the students in Inorganic Chemistry.

**Keywords**: Learning, Level of Achievement, Modular Approach, Teaching Strategies

**Introduction**

Education occupies a central place in Philippine political, economic, social and cultural life. It is a strategic priority to power economic progress and ignites a forward-looking tolerant and inclusive society. Education is an 'expectation builder' and a 'force multiplier' (Rizavi, 2012). In human beings, the crucial dimension that marks growth and maturity lies in marketing the right choices at present to achieve the desired shape of the future. In our context, this means getting the kind of education for a chosen career. The orientation, training and other preparation acquired by a person determine to a large extent the success or even just the survival of this person. As an empowerment right, education is the primary vehicle by which economically and socially marginalized adults and children can lift themselves out of poverty, and obtain the means to participate fully in the life of their communities.

In this regard, the teacher has been tasked to prepare the young people to become useful, upright, and active citizens in the community. To be equal to the task, he needs to develop certain competencies and skills. This calls for a clear understanding of the teaching process, roles, and responsibilities concomitant to his position in the classroom.

According to Navarro, et.al (2004), teaching is an exciting and rewarding activity, but like other professions, it is also demanding. The art and science of teaching requires specific knowledge and understanding in order to effect learning among the students. It is well to keep in mind that teachers in doing their responsibilities are actually communicating to the students. Ultimately, the measure of good teaching is seen how successfully the teachers have accomplished the objective of helping the students learn whatever is worth learning. Facilitating learning is the essence of teaching (Bustos, et.al, 2005). On the part of the teacher, this calls for the proper application of teaching methods to make the learning experiences meaningful. In performing this role, teachers have to remember that there is no single or perfect approach to teaching. Every situation requires a unique approach. No matter how attractive and seemingly effective a particular method is, it cannot serve as a panacea or a catch-all for the learning process. Therefore, teachers must not only be proficient and knowledgeable of present approaches to teaching, they must also have the foresight and the broadmindedness to be open to approaches other than those which they are currently using.

Teachers across disciplines can make a difference by producing instructional materials for use on the classroom and also for reference of other teachers in their specialized areas in the academe (Bala, 2011). Instructional materials or audio-visual materials of course

are not a substitute for effective instruction. They are aids and complementary materials which assist the teacher in the teaching-learning process.

According to Johnson (2011), instructional materials are specially designed classroom tools which contain instructions for learners or teachers' specifications for each increment of learning such as content to be learned, techniques of presentation, the practice and use of that content and the modes of teaching associated with those techniques.

It is observed that the shift to a more student-centered approach to learning will accelerate in the coming years (Lucido and Borabo, 1997). A critical problem facing the educator is to ensure that the implementation of new educational technology is carefully studied, understood, and used to maximize the learning process. This move towards student-centered techniques of learning may not completely replace the teacher –institution-centered approach, but there will be a slow and steady increase in the use of student-centered learning strategies within the traditional educational system where the main developments in the student-centered learning are taking place.

Pekrun, et.al. (2010) showed that academic emotions are significantly related to students' motivation, learning strategies, cognitive resources, self-regulation, and academic achievement as well as to personality and classroom antecedent. These findings were also strengthened by Brun (2008) who analyzed the learning style preferences and mathematics performance of fourth year high school students and Eder (2009) on the learning and instructional diversity and students' academic performance in science and mathematics.

These recent studies have reinforced the idea that students differ from one another in terms of interest, personality traits, rate of learning, memory, motivation, and general intellectually ability. Recognition of the wide disparity in student characteristics has caused some educators to move from the concept of group-based instruction on a common curriculum toward instructional programs which attempt to meet the individual differences and needs of students. The fundamental rationale underlying the adoption of individual methods is that it seems unlikely that one set of teacher behaviors alone is most effective for teaching everything to everyone.

As a major discipline in the tertiary education curriculum, Inorganic Chemistry is often regarded as a difficult subject, an observation that sometimes discourages learners from continuing with studies in chemistry (Sirhan, 2007). Chemistry has a paramount importance as a branch of science because it enables learners to understand the natural phenomena consisting the world. Because topics in chemistry are generally related to or based on the

structure of matter, chemistry seems to be a difficult subject for many students. Chemistry courses commonly incorporate many abstract concepts which are central to advanced learning in the rest of the natural and physical sciences.

It is commonly observed that the application of appropriate media materials in teaching can significantly lessen certain difficulties and problems in the teaching of many courses. This is also certainly true for chemistry.

A relatively recent development in the teaching of Inorganic Chemistry is the use of modular approach as a strategy to supplement classroom instruction. This strategy uses a self-instructional module which is a learning package that permits self-pacing. Since a module is an instructional package dealing with a single conceptual unit of subject matter (Russell, 2000), it is also a self-contained unit, offering a variety and adaptability to the instructional process. Modules take into account individual learning styles, they have flexibility to accommodate variable learner needs, and they place maximum responsibility of the learning on the learner themselves. Modules also provide for active participation by the learner. The modular approach finds solid philosophical rationale in the idea that learning is most meaningful and lasting when the learners are fully engaged in the learning process. In contemporary pedagogical circles, this Theory of Pragmatism is espoused by, among other thinkers, Charles Peirce, John Dewey, and William James.

Modular instruction rests on firm and solid foundations. One of these is the fundamental educational philosophy which stresses that the student is the determinate in the whole instructional process. According to Brun (2001), the use of modules has many advantages because a module is virtually embedded in the process of learning. The student is learning, studying, and experiencing while moving towards mastery of a subject-matter area. The student takes the availability and accessibility of subject-matter into account. She uses the educational materials she finds appropriate even as she asks, guidance or assessment from a teacher or any acknowledged expert. At the institutional level, the educational media, the guidance and tutoring can play a role in different modules related to the same or another domain. It would also allow a student to proceed at his own pace. The belief that self-pacing is desirable is based on the generally accepted assumption that learners do not achieve at the same rate and do not learn at the same time. Choice between different learning modes is desirable if we assume that learners solve problems and learn using different techniques based on unique behavioral repertoires or prior knowledge. It will also provide choices between large varieties of topics within any given ‘course’ or discipline, which is important if

we assume that students do not possess the same pattern of interest and are not pursuing the same goals. Students are also given a chance to identify their strengths and weaknesses and to 'recycle' through remedial modules, repetition, or a change in learning mode. This is important if we assume that it is desirable to save student time (frequent evaluation permits early diagnosis) and to allow as many students as possible to attain the stated objectives. Moreover, students can be tested earlier; progress and measures can be brought into line (control of duration of study).

In this scenario, the teacher pays attention to the learner's problem and is ready to extend help to answer individual questions. This modular approach will pave the way for a free interaction among the learners and the teacher.

Inorganic Chemistry course is designed for all third year Bachelor of Elementary Education (BEED) students as part of the General education subject taken in one semester. This is an introductory course designed to inform the students of the basic laws, theories and principles of Inorganic Chemistry. Specifically, it intends to familiarize the students with basic principles, laws and theories of bonding and molecular structure, intermolecular forces and properties and states of matter, major behavior of gasses, liquids, solids and solutions. This subject includes a wide variety of chemical concepts and principles. Admittedly, this is a rigorous field of study that stresses chemistry in the atomic and molecular level in theoretical areas enabling the students to visualize what is happening in chemical phenomena. Activities are designed to develop critical thinking and problem-solving skills through direct experience and inquiry-based learning experiences. Finally, this course would lead to a deeper understanding and appreciation of the role of chemistry in the creation and sustenance of life and the world as we know it.

Considering the topics of discussion in the study of Inorganic Chemistry, the contents of this study were not specifically elaborated since they were only subtopics. The topics under the study are actually the basic concepts introduced in the laws and theories of bonding and molecular structure. The writing and naming of chemical formulas are vital in fully understanding the topics on chemical bonding and molecular structures. After a full grasp of the chemical nomenclature or the system naming compounds, this will be the key to relate how chemical reactions would take place by writing it in a chemical equation. When chemical reactions are introduced, identification of the types of reactions is possible as well as determining whether the chemical equations representing the chemical reactions follows

the Law of Conservation of Mass. This would guide the students in knowing whether the chemical equation is balanced or not.

One of the biggest problems in classrooms is disengagement of students. A truism often heard in teaching is that if you have not learned, I have not taught. A reasonable conclusion then is that the importance of making instructional materials and teaching and learning Inorganic chemistry to help students learn the subject matter. This is also manifested by the poor results of various quizzes and tests given, solving chemically related problems and the inability of the students to actively participate in class discussion.

Instructional materials are print and non-print items that are designed to impart information to students in the educational process, instructional materials include items such as kits, textbooks, magazines, newspapers, pictures, recording, slides, transparencies, videos, video discs, workbooks, and electronic media including but not limited to music, movies, radio, software, CD-ROMs, and online services. Nicholls (2000) emphasized that Instructional materials play a very important role in the teaching-learning process and enhances the memory level of the students.

Instructional Materials (IMs) carry with them certain attitudes which are either favorable or biased towards learners and learning context. Often these attitudes are hidden either intentionally or unintentionally by the writers of IMs are devoid of relevant cultural contexts is a cause of worry since it impacts the learners' psychology who may feel excluded from the learning context creating a gap between them. Gradually, the gap widens with time as these learners climb up the educational ladder. Addressing the needs of every learner through the IMs is practically impossible, especially when producing materials on a large scale basis. Compromise is an inevitable part of the process. Consequently, textbook writers are cognizant of the uniqueness of each learner, yet in writing their materials the writers must assume that within certain parameters of abilities, the learners have common and general characteristics even in individual differences.

With these dilemmas, the researcher thought of making an instructional material that will help students learn Inorganic Chemistry concepts. Learning cannot take place unless learners are willing to do so. There cannot be any learning unless a person is willing to invest attention. Specifically, the researcher is planning to develop a learning module in Inorganic Chemistry. This instructional material is constructed to allow the learners to be actually involved in the learning process so that they will be able to internalize and promote learning by themselves. This was gathered by the researcher from years of actual teaching of the

subject where she learned of the difficulties of students in studying Inorganic Chemistry concepts. The highlight of this learning module is that learners are immersed in the learning process and they "personalize" the content, complete the task assigned, and learn the concept by using it. The learning module was constructed by the researcher to ensure that teaching the subject will facilitate a learner-friendly interaction. These learning modules were validated by experts in Chemistry as well as the experienced teachers handling Chemistry subjects for almost ten years already.

The philosophy of the learning modules hinges on the generally accepted fact that each child is a unique individual with different backgrounds, experiences, in-born qualities, habits and learning styles different from those of other individuals, and therefore, he should grow and develop his optimum potential at his own pace. In the classroom, the teacher meets different types of learners with different learning styles. A fundamental principle in teaching is the "principle of individual difference," first investigated by Galton as pointed out by Sarah E. Hampson and Andrew M. Colman (1995).

**Materials and Methods**

**Research Design**

This is a quasi-experimental research that utilized the Pretest-Posttest Control Group design aimed to determine the effect of modular approach to the level of achievement of the students in teaching Inorganic Chemistry.

**Respondents of the Study**

The sixty-four (64) third year BEED students in two classes enrolled in Inorganic Chemistry during the first semester, school year 2012-2013, served as respondents of the study after establishing the comparability of the two groups. There were actually 101 students enrolled in two Inorganic Chemistry classes. In order to establish comparability of the control and experimental groups along performance, randomization was used. This was done by ranking first the students according to their GPA in science subjects taken and their reading comprehension skills.

**Research Instruments**

The following research instruments were used to gather pertinent data for the study.

**Reading Comprehension Test.**

This test used the standardized Ballard and Tighe's Idea Proficiency Test (IPT) 2004 instruments to determine the reading proficiency of the respondents. The IPT-English Reading Tests assess the literary skills of the Limited Proficient Reader (LEP) students, also

called English Language Learners (ELLs). The tests measure the English competencies necessary for ELLs to function successfully in the mainstream classroom and are not designed as achievement tests to measure students' knowledge of the curriculum.

**The Reading Test** consists of five parts or subtests, each of which assesses a particular of reading comprehension. Part I (Vocabulary) contains 10 items that assess comprehension of vocabulary. This vocabulary includes labels, descriptive terms, and action words. Each item four multiple choice responses. Part II (Vocabulary in Context) contains 10 incomplete sentences that require students to comprehend and select appropriate words to complete them. Part III (Reading for Understanding) present two non-fiction passages and a poem, each followed by a series of item eliciting responses for a total of 15 items. This part evaluates comprehension of historical and biographical narratives and poetry, including understanding details, mood, and tone; determining cause and effect relationship; inferring and predicting; comprehending figurative language, interpreting meaning; and identifying main ideas. Each test item features four multiple choice responses. Part IV (Reading for Life Skills) features three text types found in real-life situations, such as a newspaper article, a graph, and a product information label. This part of the test assesses comprehension of informative texts and application of the information. Students in real-life situations and apply these skills to interpret, infer and predict from details. There are a total of ten items. Students select the appropriate answer from the choices. Part V (Language Usage) contains ten items that assess students' understanding of language usage. The items test whether students can select those grammatical structures that facilitate communication and enhance understanding. They select the appropriate answer from three choices.

**General pretest.** A 50-item test prepared by the researcher and administered to the experimental and controlled groups before the actual start of the experiment to check whether these groups were really comparable. This test is composed of questions derived from the topics listed for Module 1, like naming and writing chemical formulas and for Module 2 is on identifying types of chemical reactions, writing as well as balancing chemical equations.

**General posttest.** A 50-item test prepared by the researcher and administered to the students under study at the end of the instruction in both the modular and conventional methods. This is similar to the general pretest. It was a sort of a summative test designed to evaluate the student learning on all the topics in the two modules. This included test skills/concepts in the pretest.

**Inorganic Chemistry Modules.** These were the learning modules prepared by the researcher on the following topics: Module 1: Writing and Naming Chemical Formulas; and Module 2: Identifying, Writing Types of Chemical Reactions and Balancing Chemical Equations.

**Pretest.** A 30-item test prepared by the researcher given before the actual introduction of the lessons covered every module in modular instruction. Similar topics were also introduced using the conventional method of teaching which allowed the researcher to administer the same test to the control group.

**Posttest.** A 30-item test prepared by the researcher given after the actual introduction of the lessons covered in every module in modular instruction. Similar topics were also introduced using the conventional method of teaching which allowed the researcher to administer the same test to the control group. This test is the same in the present which was previously given.

**Quizzes.** The 10-item researcher made tests that were used to evaluate the students on the lessons covered in the learning modules both in modular and conventional methods of teaching but the scores were not used in the study but were utilized for the computation of their Inorganic Chemistry grade.

**Data Gathering Procedure**

The development of the modules included two steps: the preparation and validation of the modules. **Preparation of the Modules.** From among the different module formats, the researcher selected the appropriate format for the topics that the researcher identified from the teaching-learning competencies and skills prescribed by the Commission on Higher Education (CHED) for Inorganic Chemistry. The modules followed the following format: title that identified and described the subject area; target population that described for whom the module was intended; overview that presented the entire volume; objectives that were measurable and attainable by the students; instruction to the learner that were clear, brief, simple and specific; pre-requisite skills that specified what entry behavior and pre-requisites skills that enabled the learner to use it successfully; pretest that determined how much the learner has already known about the topic; pretest feedback and evaluation; learning activities that served as the heart of the module that specified different activities that students would undertake in order to achieve the specific learning objectives; posttest that determined how much the learner has learned from the module, and posttest feedback and evaluation that served as the key to correction and provided the performance level equivalent of the different scores obtained by the student. **Content Validation of the Modules.** The initial draft of the

modules was submitted to instructors in Chemistry for content validation. The modules and the 50-item general pretest and posttest coveringthe topics in the modules drafted were then tried-out on selected students in BSED major in Physical Sciences and Biological Sciences who have taken various Chemistry subjects as part of their major courses. These modules were further revised based on the suggestions of the evaluations as well as the general pretest and posttest. The same questions in the pretest were given during the posttest to determine the achievement level of the students before and after exposing them to modular and the conventional method of teaching. Before the modules were used in the actual conduct of the study, these were further revised based on the suggestion of the members of the panel of Examiners pre-oral presentation of the study.

**Experimental Procedure**

The researcher asked and received permission from the administration of the Leyte Normal University to conduct the study. Particularly, the persons concerned were the Chair of the Science Unit, the Vice-President for Academic Affairs and Planning, and the University President.

To measure the validity of the results of the experiment, the researcher ensured that the following steps were strictly observed: 1. establishing the comparability of the control and experimental groups; 2. manipulation of the variables; and 3. establishing the effect of modular instruction.

**Establishing the Comparability of the Control and Experimental Group.** Before the actual exposure of the respondents to instruction, entrance credentials like GPA in science subjects, namely Science 101 (Biological Science), Science 102 9Physical Sciences), Science 165 (Earth and Environmental Science) and lastly, Science 168 (Physics in Health Sciences) taken and the reading comprehension skills were used as basis for the initial matching of the two groups.

**Manipulation of Variables.** The given procedures were followed by the researcher to ensure that instruction for the two groups only differed in the teaching strategy used.

To establish the pre-requisite skills needed by the students in writing, naming, identifying and balancing chemical equations, Module 0 was developed and conducted to the experimental group. Preliminary lessons were presented to the control group with the following be presented to the control group with the following objectives: 1. Identify the types of compounds; 2. Explain how the types of compounds were formed; and 3. Describe the type of bonding that exists between elements in forming a compound.

Only one teacher, the researcher herself, handled both classes to prevent the teacher variable from affecting further the results of the experiment. In the introduction of the various topics in Inorganic Chemistry delivered in both experimental and control groups, certain things were considered to avoid contamination. It cannot be denied that students may have exchanged notes regarding the topics taught by the teacher. To avoid this, the teacher strictly observed the retrieval of the modules after using to ensure that the concepts were not readily handed to the other or they do not have access to them. Another measure to minimize or avoid contamination was following the strict schedule of imparting the topics to the groups so that no groups were left behind. The participants were oriented about the schedule of the entire study and reminded to do all the activities diligently. The schedule for the entire implementation of the study found in Appendix E largely revealed that the topics covered in the study were the last topics covered in Inorganic Chemistry for the first semester of school year 2012-2013. A similar pacing of the exposure of topics was strictly followed by the teacher.

**General pretest/posttest.** This 50-item test was given before the actual start of the experiment to check whether these groups are really comparable. The same test was administered to the groups after exposing the control group to the conventional method and the experimental group to modular instruction. The posttest was used to evaluate the students' learning on all the topics in the two modules for the experimental group and the same lessons for the conventional group.

**Establishing the Effect of the Modules on the Students' Level of Achievement.** After the actual exposure of the students to instruction or learning activities, the posttest was administered to the experimental and control group. In order to establish the effect of the two modules, the pretest and posttest scores of the experimental group were compared.

**Results and Discussions**

The study presents the findings on the effect of the modular approach on academic achievement of students in Inorganic Chemistry and likewise presents the corresponding analysis and interpretation of data based on the specific objectives of the study.

In profiling the respondents, it can be gleaned Table 2 that majority of the students fall within the age bracket of 18 years and below in both groups. It is therefore implied from the profile of the participants of the study that majority of the students fall under the below normal age which accounted for the 18 years and below age range. Those participants whose

age is above 20 years were categorized as above normal age and the age of 19 as the normal age range for third year students who should take the Inorganic Chemistry subject.

When it comes to sex, Table 3 revealed that majority of the students taking Inorganic Chemistry are females. This data in reality is verified to be true since the population of female students in Leyte Normal University is really high as compared to the male population.

Table 4 presents the profile of the third year BEED students taking Inorganic Chemistry based on the grade point average (GPA) in science subjects taken from school year 2010-2012 both in the first and second semesters. The grade point average in science subjects were derived from the following subject areas namely Science 101 (Biological Science), Science 102 (Physical Sciences), Science 165 (Earth and Environmental Science) and Science 168 (Physics in Health Sciences). This table also shows that majority of the students taking Inorganic Chemistry have a GPA in Science subjects of 1.6-2.5 which is categorized as Good following the Undergraduate Transmutation Table of Leyte Normal University. It can finally be gleaned that both groups were equally matched when it comes to their GPA; thus the comparability of both experimental and control groups was established.

Table 5 presents the profile of the respondents based on their reading comprehension skills. It can be gleaned further in Table 5 that there is an equal number of Competent English Readers and Limited English Readers in both groups since the reading comprehension skills were used to ensure that both groups were equally matched to establish the comparability of the two groups. As shown also in Table 5 though there was the establishment of the comparability of the two groups for the reading comprehension skills they vary in their mean and standard deviation values since there is an arbitrary scale assigned for the Competent and Limited English reader respectively. The participants who got a score of 48-55 were categorized as Competent English Reader (CER) and those who got a score of 34-47 were categorized as Limited English Reader (LER). The standardized reading test is composed of 55 items.

The general pretest and posttest were similar and these were similarly scored and a common scale was used to interpret the results. These tests were given before and after the exposure of the students to the methods employed in Inorganic Chemistry. The results of these tests measured the achievement level of the students in Inorganic Chemistry.

Table 6 presents the level of achievement of the control and experimental groups based on their pretest and posttest performance. The table represents that the experimental

group was exposed to modular instruction while the control group was exposed to the conventional method of teaching. The table suggests that both groups have increased their pretest and posttest performance based on the mean, standard deviation, and computed t values.

From the data given in Table 6, it can be seen that the pretest scores of the experimental and control groups got a poor level of achievement based on the mean results of 13.34 and 12.66 respectively. In comparing their pretest performance and experimental group has a lower mean score compared to the control group. If we also look at their mean posttest scores, it largely reveals that both groups have increased their performance as shown by their mean scores of 24.63 for the control group and 24.38 for the experimental group. If we compare the mean posttest scores of the two groups, the control group has a slightly higher mean than the experimental group. This is evident also in the pretest mean scores that the control group has a higher result than the experimental group. Therefore, from these results, the control group has a slightly higher mean score both in pretest and posttest as compared to the experimental group.

From the data shown in Table 6 relating it to the arbitrary scale assigned to describe the level of achievement of the students, it is interpreted as Poor for the level of achievement in pretest for control and experimental groups while fair for the posttest performance of both the control and experimental groups. It can be gleaned also from Table 6 that the mean posttest score is significantly higher than the mean pretest score in both the control group ($t = 9.984$; $p < 0.001$) and the experimental group ($t = 9.186$; p , 0.001). This further suggests that there is a significant improvement of the achievement scores of students in each group before and after the experiment.

From this claim, it is therefore safe to reject the null hypothesis which states that there is no significant improvement in the achievement scores in each group before and after the experiment because from the given data in Table 6 it largely suggests that there is a significant improvement in each group both for their pretest and posttest.

Table 7shows the mean posttest scores of the experimental and control groups as well as the reading comprehension of the Competent English Reader (CER) and Limited English Reader (LER) in both groups using their pretest scores. This table shows that mean of the adjusted posttest score with pretest scores as covariate of the control group exposed to the conventional method of teaching has a mean of 24.77 with a standard error of 1.35 while the experimental group has 25.48 with a standard error of 1.34.

It can also be gleaned from the table that the reading comprehension of the Competent English Reader in the control group has a mean of 25.38 with a standard error of 2.33 and the Limited English Reader has a mean of 24.18 with a standard error of 1.34. The Competent English Reader in the experimental group has a mean of 27.39 with a standard error of 2.32 while the Limited English Reader has a mean of 23.57 with a standard error of 1.35. This table shows that from the mean posttest scores of the experimental group adjusted using the pretest scores is higher than that of the control group as well as the Competent English Reader and the Limited English Reader.

Table 8 below shows that from the mean posttest scores of the Competent English Reader and Limited English Reader groups in general adjusted using the pretest scores.This table clearly shows that the thirty-two respondents both in Competent English Reader and Limited English Reader have a mean of 26.38 from the adjusted posttest scores with pretest scores as covariate with a standard error of 1.65 while the Limited English Reader has 23.87 at 0.95 standard error. This indicates that the Competent English Reader has a higher mean compared to the Limited English Reader. This result firmly supports the claim of Lacaba (2010) that if students' reading comprehension skills are well developed, they are most likely to perform better in academics. With these findings, it is safe to say that the reading comprehension skills have bearing on the achievement or performance of the students.

It can be gleaned from Table 8 that the achievement levels in chemistry between the experimental and the control groups are not significantly different ($F = 0.136$; $p = 0..713$). Hence the null hypothesis cannot be rejected. The same table shows that main effects of reading comprehension is also not significant ($F = 1.741$; $p = 0.192$) between the experimental and control groups

The same table shows that the effect size of method of teaching is very small (R Squared = .069) indicating that the method of teaching explains only about 6.9 percent of the variation in achievement scores leaving a high percent of 93.1 percent unexplained. This table shows that the dependent variable used are gain scores obtained by the students when they took the pretest and posttest exposed to modular approach and conventional teaching was not the same.

Table 9 presents also that reading comprehension was made as a covariate and was hold constant throughout the groups being studied. It shows that reading comprehension has a significant difference between the students exposed to the different methods of teaching. In

other words, when reading comprehension was held constant, the students exposed to modular approach performed better compared to students exposed to conventional teaching.

In general, the Competent English Reader group posted higher mean adjusted posttest scores in both the experimental and control groups. However, Figure 3 seems to show that Reading Comprehension modified the effects of method of teaching on the level of achievement in Chemistry in that the difference in the mean adjusted posttest scores between the Competent English Reader and Limited English Reader groups in the control group is smaller than the difference in the mean adjusted posttest scores between the Competent English Reader and Limited English Reader groups in experimental group. However, as shown in the ANCOVA table, this moderating effect is not significant ($F = 0.481$; $p = 0.490$).

Figure 1 shows that the Competent English Reader group in the experimental group benefitted the modular approach more than the Limited English Reader group.

**Conclusion**

Based on the foregoing results the following conclusions were formulated: The profile of the participants in this study suggests that they belong to the below normal age range, majority of them were females, they have good GPA in Science subjects taken, and majority of them are Limited English Readers. Another is that modular approach is more effective compared to conventional method in teaching Inorganic Chemistry and the last was that reading comprehension moderates the effect of method of teaching on the levels of achievements of the students in Inorganic Chemistry.

**Recommendation(s)**

In the light of the result of this study, the following recommendations were formulated:

1. The reading comprehension skills should not be made as a variable in establishing the comparability of the experimental and control groups so that this will pave the way in determining the effect of their reading comprehension skills in the achievement level in Inorganic Chemistry.
2. The participants should be grouped from the top, average and bottom performers so that it would be easier to determine who really benefits more in the used of modular instruction.
3. The entire topics covered in Inorganic Chemistry should be fully taught so that the achievement level of the students in Inorganic Chemistry would be known further and more conclusively.

4. The students should be exposed to various teaching strategies in the classroom specifically the use of modular approach which would eventually help the various type of learners.
5. The learning modules should be utilized by teachers who are teaching Inorganic Chemistry for further improvement and refinement.
6. Develop other modules in Inorganic Chemistry.
7. A similar study be conducted incorporating other variables not investigated in this study.

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**Tables and Charts**

**Table 1**

*The Expansion of the Experimental Research that Utilized the Pretest-Posttest Control Group Design*

| Scientific Random Assignment of Subject to: | 1st observation (measurement) of the dependent variable $O_1$=Pre-test | Exposure to the Treatment (X) (independent variable) | 2nd observation (measurement) of the dependent variable $O_2$=Post-test |
|---|---|---|---|
| Experimental Group | Experimental Group's average score on the dependent variable | Modular Approach | Experimental Group's average score on the dependent variable |
| Control Group | Control Group's average score on the dependent variable | Conventional Method | Control Group's average score on the dependent variable |

**Table 2**

*Profile of Experimental and Control Groups in Terms of their Age*

| Variable | Experimental Group (n = 32) | | | Control Group (n = 32) | | |
|---|---|---|---|---|---|---|
| | Mean (S.D.) | F | % | Mean (S.D.) | F | % |
| Age<br>• 20 years Above<br>• 19<br>• 18 and Below | 18.63 (.83) | 4 | 12.5 | 19.22 | 9 | 28.1 |
| TOTAL | | 32 | 100.00 | | 32 | 100.0 |

**Table 3**

*Profile of Experimental and Control Groups in Terms of their Sex*

| Variable | Experimental Group (n = 32) | | | Control Group (n = 32) | | |
|---|---|---|---|---|---|---|
| | Mean (S.D.) | F | % | Mean (S.D.) | F | % |
| Sex<br>• Male<br>• Female | - | 6<br>26 | 18.8<br>81.3 | | 9<br>23 | 28.1<br>71.9 |
| TOTAL | | 32 | 100.00 | | 32 | 100.0 |

**Table 4**

*Profile of Experimental and Control Groups in Terms of their Grade Point Average (GPA) in Science Subjects Taken*

| Variable | Experimental Group (n = 32) | | | Control Group (n = 32) | | |
|---|---|---|---|---|---|---|
| | Mean (S.D.) | F | % | Mean (S.D.) | F | % |
| GPA IN Science<br>• 20 years Above<br>• 19<br>• 18 and Below | 18.63 (.83) | 4 | 12.5 | 19.22 | 9 | 28.1 |
| TOTAL | | 32 | 100.00 | | 32 | 100.0 |

**Table 5**

*Profile of Experimental and Control Groups in Terms of their Reading Comprehension Skills*

| Variable | Experimental Group (n = 32) | | | Control Group (n = 32) | | |
|---|---|---|---|---|---|---|
| | Mean (S.D.) | F | % | Mean (S.D.) | F | % |
| Reading comprehension Skills<br>• Competent English<br>• Reader<br>• Limited English Reader | 45.88 (3.3) | 8<br><br>24 | 25.0<br><br>75.0 | 44.63 (4.7) | 8<br><br>24 | 25<br><br>75.0 |
| TOTAL | | 32 | 100.00 | | 32 | 100.0 |

**Table 6**

*Comparison on the Level of Achievement of the Students Taught Using the Modular Approach and Conventional Method of Teaching*

| Group | Pretest | | Posttest | | Computed t (df=31) | p-value |
|---|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | | |
| Control (n = 32) | 13.34 | 3.2 | 24.63 | 6.3 | 9.984 | <0.001 |
| Experimental (n=32) | 12.66 | 4.0 | 24.38 | 7.2 | 9.186 | <0.001 |

**Table 7**

*Mean Posttest Scores of the Experimental and Control Groups Adjusted Using the Pretest Scores*

| **Group** | **Adjusted Posttest Score (With Pretest Scores as Covariate)** | |
|---|---|---|
| | **Mean** | **Standard Error** |
| **Control ( n = 32)** | **24.77** | **1.35** |
| Competent English Reader | 25.38 | 2.33 |
| Limited English Reader | 24.18 | 1.34 |
| **Experimental (n = 32)** | **25.48** | **1.34** |
| Competent English Reader | 27.39 | 2.32 |
| Limited English Reader | 23.57 | 1.35 |

**Table 8**

Mean Posttest Scores of The CER and LER Groups Adjusted Using the Pretest Scores

| Group | Adjusted Posttest Score (With Pretest Scores as Covariate) | |
|---|---|---|
| | Mean | Standard Error |
| Limited English Reader | 23.87 | .95 |
| Competent English Reader | 26.38 | 1.65 |

**Table 9**

*Analysis of Covariance Table*

*Tests of Between-Subjects Effects*

**Dependent Variable: Gain Scores**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 197.836[a] | 2 | 98.918 | 2.246 | .114 |
| Intercept | 33.512 | 1 | 33.512 | .761 | .386 |
| Reading Comprehension | 194.774 | 1 | 194.774 | 4.423 | 0.040 |
| Method of Teaching | .178 | 1 | | | |
| Error | 2686.164 | 61 | .178 | .004 | .949 |
| Total | 11348.000 | 64 | 44.035 | | |
| Corrected Total | 2884.000 | 63 | 44.035 | | |

**Figure**

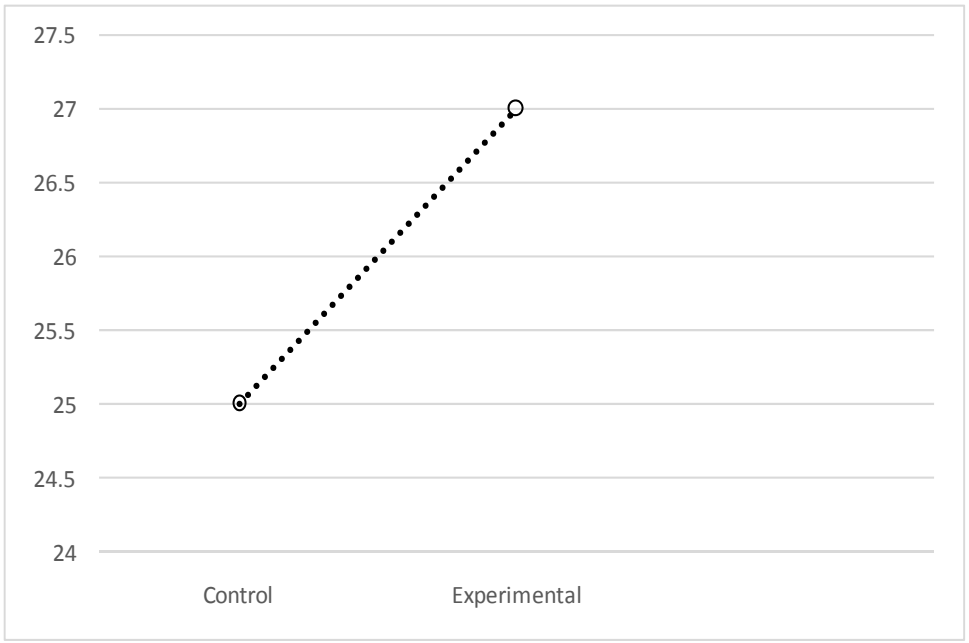


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**Figure 1. Interaction between Reading Comprehension and Method of Teaching**