SECONDARY CHEMISTRY TEACHERS' MISCONCEPTIONS ON MOLECULAR GEOMETRY

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APPROVAL SHEET

In partial fulfillment of the requirements for the degree, Master of Arts in Teaching, this Master's Thesis entitled **"SECONDARY CHEMISTRY TEACHERS' MISCONCEPTIONS ON MOLECULAR GEOMETRY"** has been prepared and submitted by **ERMELINDA CABUELLO FLORETES**, who having passed all the requirements, is hereby recommended for oral examination.

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DEDICATION

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ABSTRACT

The main task of the study was to identify and evaluate secondary chemistry teachers' in Public National High School in the Division of Samar understanding on the topic "Geometry of Molecules". To test if there was a significant difference between the level of misconceptions of chemistry majors and non-chemistry majors. The data after computing the one tailed t-test reveal that the computed t value of 5.69 is greater than the critical value of 1.701 with α set at .05. Thus the null hypothesis, which states "There is no significant difference between the level of misconceptions of chemistry major teachers and the non-chemistry major teachers" is rejected. There are no significant relationships that exist between the level of misconceptions of secondary chemistry teachers and the teachers' profile in terms of age, sex, civil status, and undergraduate degree, teaching experience and teaching loads. There are significant relationships that exist between chemistry teachers' level of misconceptions and each of the succeeding variables: a) undergraduate major b) chemistry units earned c) teaching experience d) in-service trainings/seminars/workshops attended. Most chemistry teachers in the Division of Samar are relatively young and showed little professional growth in their field of specialization. Majority of the chemistry teachers were female and inexperienced in the teaching profession. Most chemistry teachers in the Division of Samar have additional loads other than chemistry.

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Chapter 1

THE PROBLEM AND ITS BACKGROUND

Introduction

The struggle to have an effective teaching-learning process in science has been endless. Science educators have continuously search for a better means to improve science teaching (Ebenezer and Connor, 1998). Teachers being the key factor in developing the potentials of the individual should possess certain standard needed competencies for effective teaching-learning process so that learners become self-fulfilled person. It is the teacher who is the key to excellence in any subject.

The quality of Philippine education in the past up to the present has not improved considerably. According to Luis-Santos (1996), the problems experienced by the educational system 60 years ago are still the same problems the educational system is facing today when it comes to quality Philippine education. Through the years, it has been observed that students learn only less, a little more than half of the competencies required at the end of the school year.

Results of the last National Secondary Assessment Test (NSAT) for the school year 2000-2001 showed that the Division of Samar only 59.07 percent was the mean percentage score in science. This is the lowest passing rate among the subjects even lower than English, which is 59.59 percent.

The same scenario is happening in the international scene. In the Third International Mathematics and Science Study (TIMSS) conducted by the International Association for the Evaluation of Educational Attainment, the Philippines ranked second from the bottom out of 40 participating countries (Schmidt, 1997). One of the findings emerged from the study. Filipino secondary students had difficulty with chemistry items.

The implications of the results of these studies are many but one significant inference is the effect of teacher factor in the teaching-learning process. It is very normal to point fingers that whenever issues of student achievement in science in general, or chemistry in particular are raised, the discussion inevitably raises issues on teachers' mastery of subject matter knowledge (Moore, 2000). Indirectly, the knowledge of subject matter of teachers is measured by the performance of the students and it is determined by the quality of education that has been provided them.

On the other hand, the failure of students to learn in school the required competencies in any subject like chemistry is also attributed to the nature of the subject. In this regard, chemistry as a science subject in the secondary curriculum is noted for its abstract nature (Gabel, 1999). Most concepts involved are complex like atomic orbitals, molecular orbitals, and hybridization, which are beyond comprehension for ordinary students and even teachers who are, not majors. This is one reason why students find chemistry difficult and makes chemistry a frequently misunderstood subject (Nakhleh, 1992). However, it will still boil down to the teacher's ability to remove the complexity of concepts by using the appropriate teaching strategy.

In order to help students understand and learn chemistry concepts, teachers should have a collection of strategies. However, a number of factors can still jeopardize their effectiveness. These include teacher-related variables such as subject-matter knowledge and instructional variables such as the method of presentation and the explicitness of explanations provided. Teachers must understand and possess no misconceptions or misunderstanding about the subject matter in order to select the appropriate teaching strategy as well as use them effectively (Osborne, 1996).

Unfortunately, teachers are often poorly prepared to teach chemistry and can even hold what have been popularly termed as 'misconceptions' similar to that of their students (Pardham and Bano, 2001). Teaching chemistry, like any subject, is sharing knowledge, basic concepts, principles and methods. It is a common knowledge among science educators that a teacher cannot give what he/she does not have. The learning of content is as important as the process of teaching (Driscoll, 1994). Once no learning takes place in a teaching-learning situation it is tantamount to the saying that the teacher did not teach at all.

Exposing chemistry teachers' misconception or misunderstanding will also identify their mastery of subject matter knowledge. In this context the researcher conducted this study to find out teachers' misconceptions on the topic 'molecular geometry'. This topic leaves room for misconceptions due to its complexity as compared with the rest of the topics in the chemistry curriculum (Pfennig and Frock, 1999). Moreover, the importance of molecular geometry is spelled out in the definition of chemistry itself, which says, "chemistry is the science which deals with the study of matter; its structure, properties, composition, changes and the energy involved during the change". The structure or geometry of molecules is one of the major parts in the study of chemistry, which have not yet been deeply explored.

The ultimate aim of the study is to improve the teaching of chemistry for quality education. This can only be made possible by exposing and identifying misconceptions to determine what is to be improved.

Statement of the Problem

The main task of the study was to identify and evaluate secondary chemistry teachers' understanding on the topic 'geometry of molecules'. Directly evaluating their subject matter knowledge and understanding of a chemistry concept is tantamount to exposing and identifying secondary chemistry teachers' misconceptions.

Specifically, the study sought answers to the following questions:

1.0 What is the profile of the respondents involved in this study in terms of:

1.1 Age

1.2 Sex

1.3 Civil Status

1.4 Educational Background

1.5 Teaching experience

1.6 Relevant in-service trainings, seminars, workshops, scholarship attended

1.7 Number of teaching loads

2.0 As revealed by the diagnostic test, what are the misconceptions of chemistry teachers on the topic geometry of molecules?

3.0 What is the level of misconceptions of two groups of chemistry teachers on molecular geometry as revealed in the diagnostic test?

4.0 Is there a significant difference on the level of misconceptions between chemistry major teachers and non-chemistry major teachers?

5.0 Are there significant relationships between the chemistry teachers' level of misconception and the following variables:

a. Age

b. Sex

c. Civil Status

d. Educational Background

e. Teaching Experience

f. In-service trainings, seminars, workshops, scholarships attended

6.0 What implications can be derived from this study?

Null Hypotheses

The following hypotheses were formulated to answer the questions formulated above:

1.0 There is no significant difference between the level of misconceptions of chemistry major teachers and the level of misconceptions of non-chemistry majors.

2.0 There is no significant relationships that exist between the level of misconceptions of secondary chemistry teachers and the following variables:

a. Age

b. Sex

c. Civil status

d. Educational Background

e. Teaching Experience

f. In-service trainings, seminars, workshops, scholarships attended

Theoretical Framework

This study was anchored on constructivist science teaching espoused by Northfield et al (1996). According to the authors, "teachers are learners who continually and actively are constructing their views of teaching and learning based on personal experiences and which are shaped strongly by prior ideas and beliefs". This theory is fundamental to a constructivist view of learning.

The constructivist approach to learning is based on the idea that learners construct their own knowledge and understanding of a science concept (Osborne, 1996). Knowledge, according to constructivists, is not received passively but is built up by the cognizing individual. In other words, it is not possible to transfer ideas or knowledge into students' head intact; rather, students construct their own meaning and understanding from the words or visual images provided them by the teacher. When students are not provided the right stimuli, students create in their minds their own meaning and understanding which are usually contrary to the accepted scientific meaning. This erroneous constructed meaning or understanding is called 'misconceptions'.

One negative characteristic of misconceptions is that they are resistant to traditional instruction (Shiland, 1999). These negative characteristics of misconceptions have a detrimental effect on the quality of learning in subsequent topics. Unless these misconceptions are identified and prevented, there will be a widespread and continuous proliferation of misconceptions. One way to prevent this is through constructivist science teaching.

In order for science teachers to successfully implement constructivist science teaching, teachers need to possess different knowledge bases. One of these knowledge bases requires that teachers should possess a strong foundation or mastery on subject-matter knowledge (van Driel et al, 2000). By strong foundation or mastery of subject matter knowledge means the teacher has the correct understanding of the concept and similarly, the teacher possesses no misconceptions.

When teachers themselves possess misconceptions, instead of preventing the proliferation of misconceptions, misconceptions among students will become rampant.

Conceptual Framework

The conceptual paradigm (Figure 1.0) found in the succeeding page illustrates the totality of how the study was conducted. At the base of the schema is the research environment, which is composed of the public national secondary chemistry teachers of the Division of Samar.

The next two upper blocks represent the research variables - teachers' knowledge on molecular geometry and teachers' profile. Teachers' knowledge and misconceptions on the topic were identified and measured using a multiple-choice diagnostic test with open-ended question. Teachers' profile such as educational qualification, length of teaching experience, and seminars, workshops and scholarship attended was obtained by integrating into the diagnostic instrument as part one of the whole instruments. The diagnostic activity is represented by a smaller rectangle that is connected to the two larger rectangular blocks by double-headed arrows.

Furthermore the best approach for identifying misconceptions, which may be of more use in the classroom teaching, is to use tests based on multiple-choice format with open-ended question. Most multiple-choice test only tests content. It is recommended by most science educators

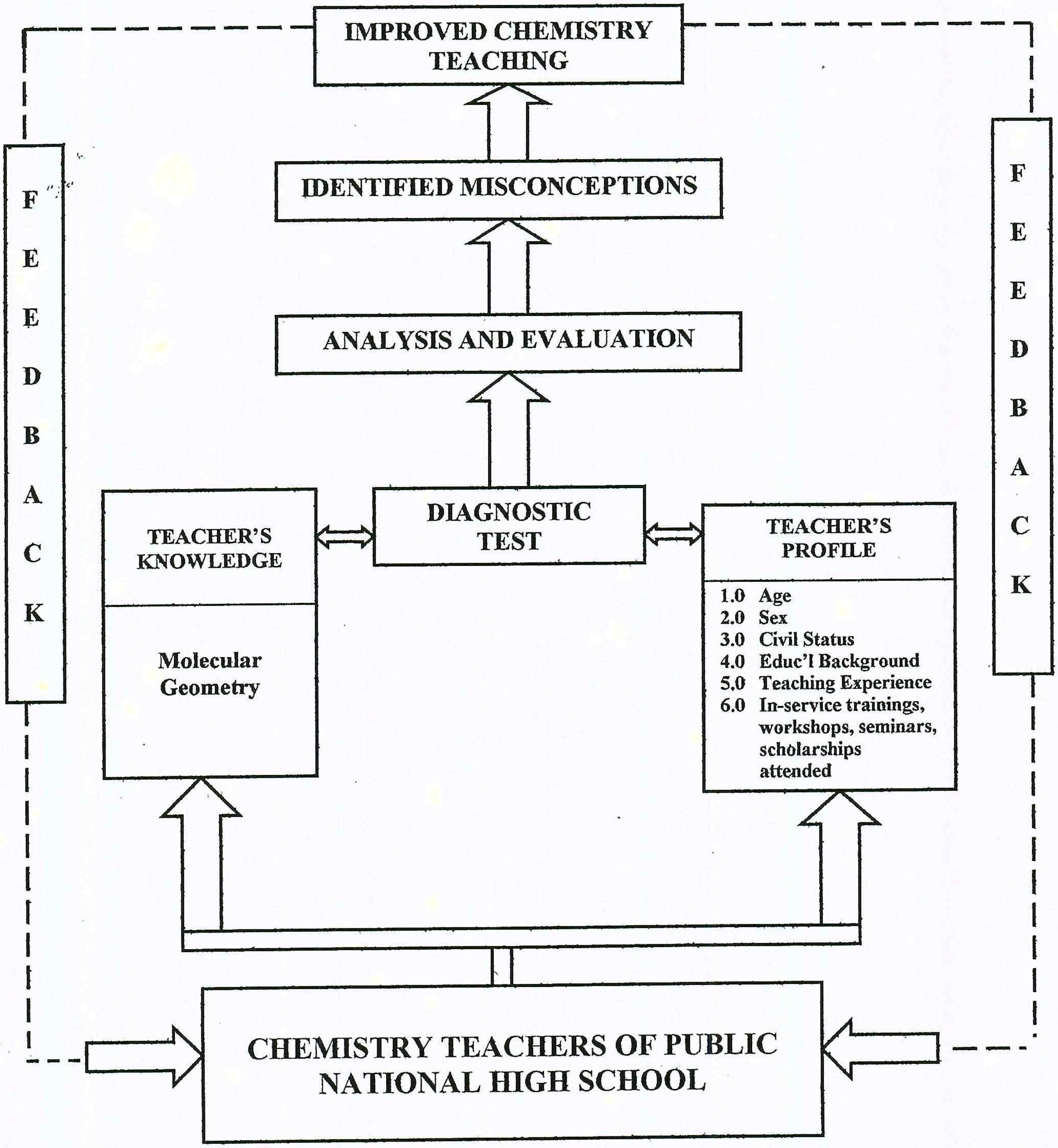


Figure 1.0 Conceptual Framework of the Study showing the Variables involved and the Research Environment

to test reasoning by accompanying each item with an open-ended question for improvement, as included in the test to find out more about their understanding and knowledge (Ebenezer and Connor, 1998). The results of the diagnostic test were analyzed and evaluated for any misconceptions held by secondary chemistry teachers on the topic 'geometry of molecules'. The next upper rectangular box represents this. Further, the level of misconceptions between the two groups of chemistry teachers (major and non-major) was compared statistically using the appropriate statistical tool. Furthermore, a broken line to the bottom box connects the rectangular box.

Finally, the result of the study would be beneficial to the teachers once misconceptions would be identified. The findings would serve as feedback mechanism to the teacher respondents. The ultimate goal of the study, which is improved chemistry teaching.

Significance of the Study

This study will prove beneficial in many ways, especially to the teachers, students, school administrators and supervisors, parents and future researchers.

To the teachers. This study will serve as guide in imparting to the students the right concept of the subject matter. Teachers will have the opportunity to cover all the important topics and will be in a better position in utilizing different strategies/methods in the teaching-learning process in order to facilitate students learning the correct understanding of chemistry concepts particularly on molecular geometry. The results of the study will encourage teachers to continue updating their content knowledge in chemistry. Teachers may also enjoy in teaching the subject matter by utilizing instructional materials in his/her effort of establishing logical and meaningful connections between the motivating stimulus presented and the concept to be learned eventually.

To the students. Through correct ideas imparted by the teachers, students will gain more accurate knowledge. They will understand and likewise improve their learning capabilities. By the use of the right instructional materials for specific concepts students will easily internalize what is being taught. Being well guided by good teaching students can think their way through to the right concepts. In other words, as they intentionally and consciously learn chemistry concepts, they incidentally develop skill of good thinking. The students therefore develop a unified whole view of chemistry, and not as compartmentalized disciplines.

To the school administrators and supervisors. The study will serve as eye openers to the plight of chemistry teachers and the quality of chemistry education being provided to students. Hopefully, through the results of the study, these people would become more supportive and encourage chemistry teachers to pursue higher education and to attend workshops, seminars, and trainings for the improvement of subject matter content knowledge of their teachers.

To the parents. The study would give them an assurance that learning the right concept is the focus of the teachers. Parents can rely on teachers and the school itself as the best developers of their children. They can be assured of a better and quality output in the educational pursuit of their children.

To the future researchers in chemistry education. They can utilize this study as another vehicle for takeoff for further studies and explore other topics in chemistry. This study may even serve as their reference of related research literature, related studies, research design, and instruments.

Scope and Delimitation

This research undertaking tried to identify the misconceptions of chemistry teachers on the identified topic 'molecular geometry'. This is a direct way of evaluating secondary chemistry teachers' subject matter knowledge.

The construct competence is delimited to a single variable, which is the knowledge on molecular geometry. The respondents of this study involved 30 chemistry teachers in 29 public high schools in the Division of Samar. The schools involved in the study were, Samar National High School, Guintarcan National High School, Sta. Margarita National High School, Daram National High School, San Andres National High School, Villareal National High School, Tarangnan National High School, Gandara National High School, Matuguinao National High School, Pagsanghan National High School, Jiabong National High School, Calbiga National High School, Lawa-an National High School, Tominamos Integrated School, Motiong National High School, Igot National High School, Hinabangan National High School,

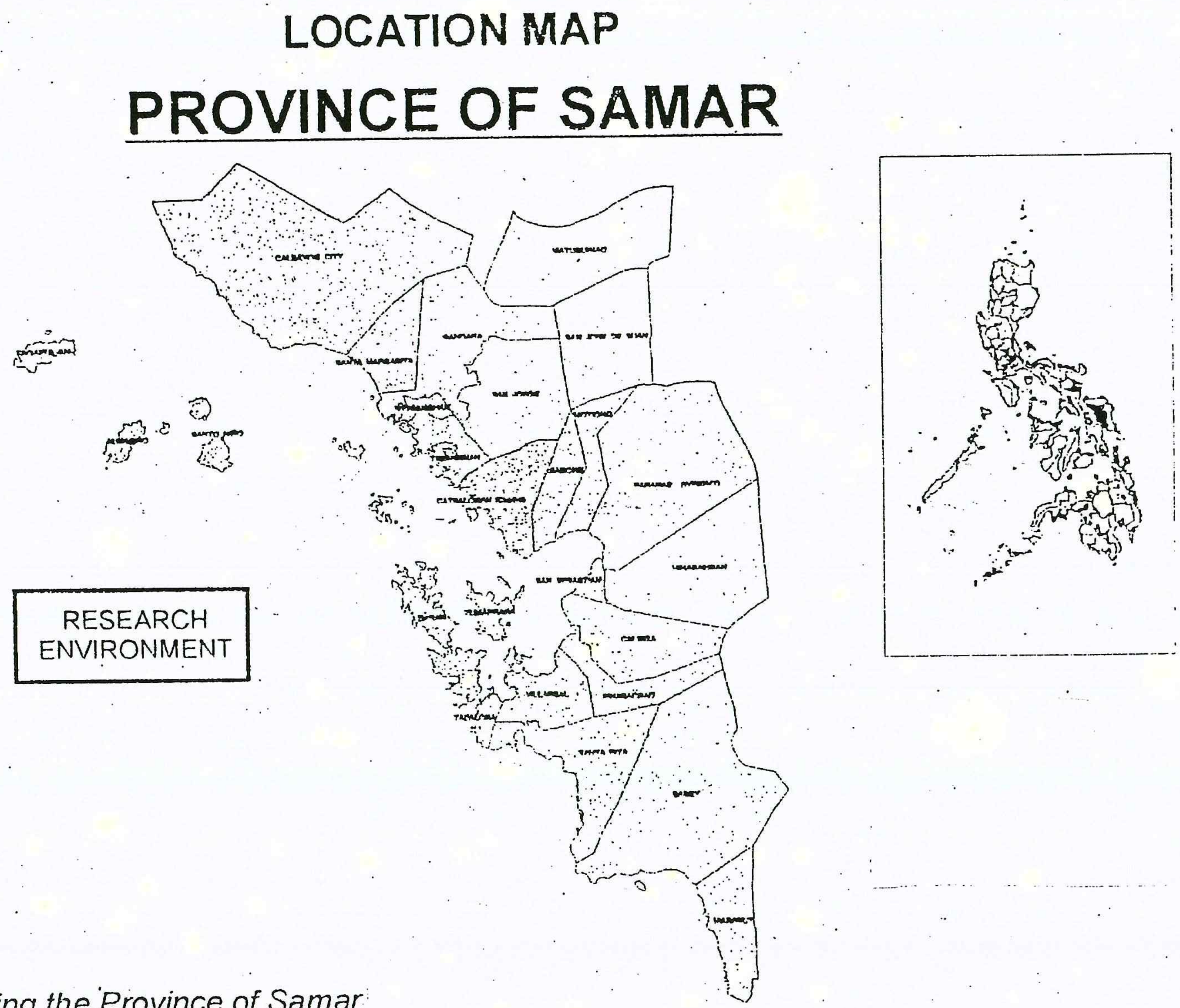


FIGURE 1
Map showing the Province of Samar

Casandig National High School, Basey National High School, Marabut National High School, Talalora National High School, Sto. Niño National High School, Tagapul-an National High School, Sta. Rita National High School, San Sebastian National High School, West Coast Agricultural School, Independencia National High School, Almagro National High School and Simeon Ocdol National High School. From these schools were taken the 30 chemistry teachers who were respondents of this study.

The main instrument used was a 35-item multiple-choice with open-ended question. Items included in the test were on molecular geometry. They were as follows: Lewis structure, polarity of molecules, electronic configurations, and hybridization, which are pre-requisite background knowledge.

The study covered the period school year 2000-2001.

Definition of Terms

To provide a common frame of reference to the readers, the following terms are herein defined conceptually and/or operationally.

Chemistry. Refers to the branch of science, which deals with the study of the properties, composition and structure of matter, the changes or transformation it undergoes, and the laws and principles, which govern these changes (Gove, 1986).

Chemistry majors. These are public secondary chemistry teachers who graduated with a degree in BSChemistry, BSEChemistry, or BSChemical Engineering.

Competence. As used in the study, it refers to chemistry teachers' mastery of content knowledge or acceptable understanding of a scientific concept or knowledge. It also connotes an inverse meaning with the term 'misconception'. A teacher who is competent in content knowledge correctly understands the meaning of a concept; therefore, possess no misconception on the concept. Conceptually this term refers to the capability or ability to perform (New Bantam Dictionary, 1987).

Diagnostic test. A test that has a sufficient number of test items to allow correct inferences about the type of errors a learner makes or about a learner's mastery of a particular skill or concept (Salvia and Hughes, 1990). In this study, it refers to the research instrument used to expose and identify chemistry teacher's misconception of the identified topic on geometry of molecules. Further, it is a 35-item multiple-choice test with open-ended question.

Level of misconception. This term refers to the scaled adjectival interpretations of percentage test scores obtained by the two groups of secondary chemistry teachers in the diagnostic test as to the accepted meaning or understanding of a concept.

Misconception. This term refers to the act of misconceiving or erroneous conception (Scribner, 1987). Operationally, this term refers to the understanding of concepts or scientific knowledge, which differs, from the commonly accepted scientific meaning or understanding of the concept or knowledge. In other words, it is a wrong or unacceptable understanding of the concept or a misunderstanding of a concept.

Molecular geometry. This term refers to one of the major topics in the study of chemistry, which pertains to the 3-dimensional shape of a molecule (Petrucci and Harwood, 1998). It also includes related concepts such as chemical bonding, hybridization, intermolecular reactions, valence of central atom, electron cloud repulsion, cloud overlap of bonding electrons, VSEPR theory, resonance and Lewis structure.

Non-chemistry majors. Teachers teaching third year level secondary science that are not graduate in BSEChemistry, BSChemistry, or BSChemical Engineering.

Understanding. The process of acquiring or developing the correct or appropriate meaning of various types of concepts and knowledge and the ability to use this knowledge to cope with situations (White in Malindog, 1993). This term is also related to the term misconception specifically if the understanding is scientifically unacceptable.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the review of related literature and studies that have similar bearing to the present study, which established the theoretical as well as conceptual foundation of the study. In gathering relevant information pertaining to the problem under study, the researcher exhaustively reviewed several books, theses, journals, periodicals, and magazine, other reading materials and surfed the Internet.

Related Literature

This section will focus not only on teachers' misconceptions or misunderstandings in chemistry but also mention some information about teachers' subject-matter knowledge mastery or competence, which is very much related to the present study. The argument is: if misunderstanding or misconceptions of specific and basic chemistry concepts is not a prerequisite for teachers' subject matter knowledge competence, then it should be put in its place other than pedagogic competence.

Professionals including teachers ought to possess qualities and competencies for them to function effectively in their job and consequently experience a sense of fulfillment. Arends (1994) cites some prerequisite for effective teaching. Effective teaching requires as its baseline individuals who are academically able, who have 'strong command of the subjects' they are required to teach, and who care about the well being of children and youth. It also requires individuals who can produce results, mainly those of student's academic achievement.

These qualities or attributes that a teacher ought to possess cited by Arends (1994) are likewise claimed by Lardizabal et al (1995). Lardizabal et al write that studies on the characteristics of an effective teacher generally point to two major categories: professional qualities and personal qualities. The professional qualities include among others that an effective teacher should possess 'mastery of the subject matter/field' one teaches. The absence of this attribute weakens the effects of the other attributes.

Moore (2000) also supports the importance of subject matter knowledge competence for effective teaching. According to Moore (2000), science teachers with more content knowledge possess less misconception. They are more likely to ask questions that requires higher-level of thinking; are more attuned to seeking information from students through questioning during discussion; and are better at enabling students to understand scientific concepts.

Competence is one of the essential components for quality education in the Philippine education just like any subject matter. In this context, it is sobering to note the opinion of Santos about the Philippine education. Luis-Santos (1996) writes that the problems that experienced by the Philippine educational system 60 years ago are the same problems the educational system is facing today. Through the years, it has been observed that students learn only a little less more than half of the competencies required at the end of the school year.

The opinion of Luis-Santos (1996) is confirmed by results of local and international survey on the status of the quality of Philippine education especially when the respondents are coming from public schools. The last National Secondary Assessment Test (NSAT) for the school year 2000-2001 showed that Division of Samar only 59.05 percent was the passing percentage in science. This was the lowest among the subjects. It was lower than English, which is 59.59 percent.

The results of international survey points to the same findings. Schmidt (1997) reports that in the Third International Mathematics and Science Study conducted by the International Association for the Evaluation of Educational Achievement, the Philippines ranked second from the bottom out of forty-five (45) participant countries. One finding of the study was Filipino students had the most difficulty with chemistry items. For example, an item that required students to explain how carbon dioxide fire extinguishers work. The item was answered correctly by only about half of the students tested. Moreover, Filipino high school students do not perform well when compared with their counterparts in other Asian countries.

Science educators, school administrators, and even parents are not surprised by these opinions on teachers' subject matter knowledge competence. Everybody knows from personal experience how important it is for teachers to have a thorough understanding of the subject matter content students are expected to learn. Such understanding becomes more critical when discovery-oriented and inquiry-based pedagogy is called for to teach a particular science concept (Ebenezer and Connor, 1998). De Jong (1999) also expresses the same idea:

> "How can we possibly expect teachers to ask questions and design learning environment that will help students to discover and understand scientific principles and facts the correct way, if the teachers themselves possess misconceptions of the concept?"

Along this line also, the Science Education Institute of the Department of Science and Technology (DOST) in 1992 conducted a survey on the educational qualification of public secondary science teachers (Ogena, 1995). Findings of the survey revealed that only 8 percent are educationally qualified to teach physics; 21 percent in chemistry; 41 percent in biology; and 40 percent in general science.

Even with the above figures, the mastery of subject matter knowledge of these educationally qualified teachers can be refuted. Bodner (1991), a graduate professor in chemistry, for three consecutive school years, gave conceptual knowledge exam covering a wide variety of topics as diagnostic test before beginning his lecture and found that misconceptions still exist in entering graduate students.

The quality of education of teachers is affected by the inputs these teachers got in the teacher education institution where they graduated. If the quality of training in terms of content knowledge was weak it is expected that these teachers possess misconceptions on some topics of their major subjects and even in the professional subjects (Luis-Santos, 1996).

As pointed out by Bodner (1991), even graduates' students in chemistry possess misconceptions. Implicitly, it seems to be assumed always that chemistry teachers know the right scientific answers. When such people demonstrate misconceptions, for example, when teaching lessons or writing books, mistakes are simply deprecated (Goodwin, 2000). Clearly, it would be ludicrous to suggest that such professionals should not know the facts and understand the principles of the material they are teaching to their students. The researcher agrees with Bodner (1991) and Goodwin (2000) that chemistry teachers carry with them facets of basic chemical knowledge that may not 'pass muster' when subjected to critical examination by others.

The learning of science or chemistry in particular is not only by students but also by chemistry teachers. The understanding and abilities required to be a masterful teacher of science are not static. Science content increases and changes, and a teacher's understanding in science must keep pace. Knowledge of learning is also continually developing, requiring that teachers remain informed. If teachers will not keep pace with the changing understanding of science concepts then their knowledge becomes obsolete and becomes misconceptions.

For the past twenty years there has been much research and writing about misconceptions of students in their understanding and learning of chemistry concepts (Northfield et al, 1996). The educational focus was very heavily weighted towards misconceptions of students.

The idea about 'misconceptions' originated from the studies of constructivism. The single statement that captures the essence of constructivism is that knowledge is constructed in the mind of the learner. One idea of constructivism is based on the psychology of Ausubel (Gabel, 2000) that lays great stress upon the internal mental networks that a student develops for him or herself rather than upon external teaching networks. And this is the implicit idea that every student constructs his/her own knowledge and understanding in his own way. When the student does not construct the correct understanding or meaning it leads to 'misconceptions'. Misconceptions are contrary to the accepted scientific understanding or meaning.

Knowledge, according to constructivists, cannot be passed intact from the head of the teacher to the head of the student (Osborne, 1996). In order to learn, the student has to 'unpack' what he/she is taught and then 'repack' it in a way that suits his/her previous knowledge or understanding and his/her own learning style.

In order for students to avoid misconceptions and construct the scientifically accepted understanding or meaning of a science concept, teachers should provide varied teaching strategies and that the teacher himself/herself does not possess any misconceptions. That is, teachers should possess a sound understanding of subject matter knowledge. Otherwise, misconceptions among students will proliferate and go on forever until the students finish the subject.

One famous characteristic of 'misconceptions' is that they are tenacious and resistant to instruction (Driver and

Easley, 1978). These negative characteristics of misconceptions have profound effects on the quality of learning in subsequent topics. Unless this is prevented there will be a widespread and continuous proliferation of misconceptions.

Unfortunately, some teachers are often inadequately prepared to teach chemistry and may even possess misconceptions similar to students (Parham and Bano, 2001). With this comment of Pardham and Bano, it is no wonder why misconceptions abound among students after instruction even after employing tested teaching models.

Students' misconceptions will have a negative effect on their learning of succeeding lessons or topics. According to Moore (2000), there is a negative and multiplicative effect of teachers' misconceptions during instruction. Teachers' misconception begets misconceptions among students - a blind leading another blind.

The best way is to expose and identify these misconceptions before any remedy could be suggested. And the best approach of correcting these misconceptions is to know its origin.

Along this line, Johnstone (2000) writes some sources of misconceptions. According to him, it could be from the authority (chemistry teacher in college) from which the material was originally learned; the text used or referred to may have become outdated or been in error; teachers have the wrong understanding or misconceptions of the concept acquired during their college days; or simply teachers possess these misconceptions because they were required to handle a subject not their major.

Gonzales (1998) expressed that there can be no excellence in chemistry, at any level of education, without good chemistry teaching. Many factors that contribute to good teaching like the right syllabus or curriculum, more and appropriate teaching resources; new teaching methods, high technology teacher aids, and better pay for teachers have been identified. None of these can ensure excellence if the teacher does not possess a good and strong grasp of the subject matter. As an answer to this problem of science teachers inappropriately and poorly prepared to teach science, Gonzales in his capacity as secretary of the then Department of Education, Culture and Sports spearheaded the implementation of a program called 'Project RISE' (Rescue Initiatives for Science Educators) intended for elementary and secondary science teachers. The training focused on subject content knowledge. Through this training, misconceptions of chemistry teachers will be corrected.

Related Studies

The section summarizes a review of related studies on teachers' misconceptions as well subject matter knowledge competence, which has similar bearing to the present study. These studies were reviewed, analyzed, and investigated thoroughly to ascertain whether these studies were similar in research design, subjects, research topic, and other research variables such as profile of teachers.

Just like in the related literature, science teachers' content knowledge competence were also included aside from those studies that directly focus on misconceptions. It has already been explained and argued that subject matter competence of teachers especially on content knowledge is directly related to their understanding and misconceptions. It goes to say that teachers who do not possess a strong grasp of content knowledge and do not understand well their subject matter, and therefore possess misconceptions.

A study on "Competencies of Secondary Schools Chemistry Teachers" was conducted by Oliva (1991), which revealed the following findings: (1) chemistry teachers are not fully confident of their knowledge of chemistry concepts, (2) the teachers feel competent with four teaching methods, namely: lecture-demonstration, laboratory activity, directed study and problem solving but sparingly use the last two in the teaching of concepts, (3) there is a significant relationship between the teachers competencies and the students' extent and facility of learning the concepts and skills. The study came up with significant recommendations as: (1) that training programs for teachers should progressively offer advance chemistry course that will raise teachers' competencies in knowledge and laboratory skills beyond just the fundamental in general chemistry, (2) training in the different teaching strategies and assessment techniques should be generally emphasized as that of knowledge of concepts and proficiency in the laboratory skills, (3) chemistry teachers should be encouraged to join associations of chemistry teachers like Philippine Association of Chemistry Teachers (PACT), and encourage too, to pursue continuing education conducted by these associations to keep pace went recent discoveries and development since their impact to society and the environment affects trends in chemistry teaching, (4) chemistry teachers training program should emphasize the following: (a) content, teaching strategies, and assessment techniques for concepts and skills which teachers claim they lack competency and which students find difficult to learn, and (b) teaching strategies and assessment techniques appropriate for concepts and skills where teachers feel competent with their knowledge and proficiency but students find difficult to learn.

This study is relevant to the present study since both studies dealt on secondary chemistry teachers' content knowledge competence. On the other hand, they differ in the sense that the previous study used a checklist as the main research instrument while the present study used a diagnostic test to expose chemistry teachers' actual understanding of chemistry concepts on molecular geometry. Moreover, the result of the previous study serves as input to proposed model for staff development, while the present study supports the claim of the previous study that indeed teachers lack the required subject matter competence in one area of chemistry.

Calumpiano (1992) centered her study on the Teaching Effectiveness at the Samar School Regional of Fisheries: Perception of Teachers and Students. Found through that study was the idea that there is a need for the teachers to equip themselves with knowledge of content, competencies and skills in teaching and professional improvement. She strongly recommended that improvements in the curriculum should be made in the following areas, namely: availability and number of textbooks, strengthening of teachers' and students' values toward their responsibilities, development of curriculum guides for the learning competencies of the subject components, and the close supervision in the implementation of bilingual policy, and there is also a need for strong and viable research and development program duly funded by the school and equally supported by the competent, quality and qualified teachers.

Calumpiano's study is related to the present study since both studies were focused on teachers' factor. The present study was more direct because a teachers' content knowledge competence, vis., misconceptions, were exposed using a diagnostic test. The previous study differs from the present study since it studied the effectiveness of teachers at Samar Regional School of Fisheries while the present study is on the secondary chemistry teachers' misconceptions in teaching chemistry in the Division of Samar.

Bernales (1996) conducted a study entitled "Competency of Secondary Mathematics III Teachers in the Division of Samar: An Input to a Program", revealed the following findings: (1) the competency in Mathematics of the teachers falls under the fairly low competency, (2) there is no significant relationship between the teachers' test performance and their undergraduate degrees, undergraduate major, number of Math units earned, teaching experience, in-service training, number of teaching preparation and with the present secondary mathematics program, (3) there is no significant relationship between the test performance in Mathematics and their sex and age, (4) there is a significant difference between the knowledge competencies possessed by mathematics teachers in relation to the location of the school assigned to. Respondents from urban schools have higher level of competency to the respondents from rural schools.

The study of Bernales recommended that in-service trainings of Mathematics teachers that led to the development of teaching competencies especially on knowledge where teachers have found difficult; that mathematics teachers should be encouraged through incentive to grow professionally by pursuing graduate studies and to subscribes math journals and affiliate with associations of math teachers; researches of assessing competency of teachers should be periodically conducted and probably improved for use as bases in planning future in-service training programs; researches should be conducted to determine the factors that may influence the teachers' fairly low competency in mathematics; and finally, there should be an extension of the same study on Mathematics I, II, and IV teachers also to assess their competency.

The above mentioned study is related to the present investigation since both studies assert on the importance of subject matter content knowledge competence of teachers, the importance of attending seminars and trainings. However, the present investigation differs with that of Bernales in as much as the present study is in chemistry teachers not on Mathematics.

A study entitled "Performance of Science and Technology Students and Teachers of Public National High Schools" was conducted by Dimakiling (1998) and some of the findings revealed that as to the profile of seminars/trainings/ workshops attended by secondary and technology teachers in Calbayog City Division, most of the teachers attended the trainings/seminars occasionally and the areas of concentration were on instructional facilities/apparatus/ equipment utilization.

On the other hand, another finding showed that in the field of specialization, it was found out that none of them were chemistry majors. In the light of Dimakiling's findings, she arrived at the following conclusions: (1) the data on the educational attainment, major field of specialization and attendance to seminars/trainings/ workshops of the science and technology teachers of Calbayog City Division indicate their capability to teach science and technology subjects although the need for chemistry majors were evident, and (2) the science and technology teachers' performance rating which implies that they have met the expectations from them by their superiors.

Dimakiling highly recommended that some science and technology teachers should upgrade themselves professionally. They can do it by enrolling in graduate education, attending more trainings and workshops to improve their teaching competencies. Their lack of experience in teaching can be supplemented in attendance in graduate classes and in trainings. In this way, they can also maintain if not improve their very satisfactory work performance, that the training of science and technology teachers on content, teaching strategies, and assessment techniques is imperative to improve their skills and competencies.

The above-mentioned study is related to the present study since both studies concerned teachers' as respondents. The study differs since teachers' misconceptions being the focal point of the study it also aims to determine the teachers' subject matter content knowledge on the topic molecular geometry.

Webb (1992) conducted a study entitled "Primary Science Teachers' Understanding of Electric Current". The study investigated the conception of electric current flow held by pre- and in-service primary science teachers and compared their ideas with the understandings of electric current generally described as 'misconceptions'. Thirty-six Australian third-year education students and twenty-one primary science teacher were presented with four major views held by children as regards the flow of electric current in a simple circuit. These views were illustrated with diagrams.

(1) There will be no electric current in the wire attached to the base of the battery.

(2) The electric current will be in the direction toward the bulb in both wires.

(3) The direction of the electric current will be less in the return wire.

(4) The direction of the electric current will be the same in both wires.

Data from this study also suggest that not only are there similarities of ideas held by adults and children as regards electric current, but comparable success rates are attained when similar methods are used to teach towards conceptual change. Webb concluded that if teachers are expected to teach towards conceptual change in their pupils, it seems probable that a profitable way of teaching towards the understanding at tertiary institutions is to lead prospective and in-service teachers through the same process, at the same time making explicit the reasons for doing so.

The present study and the study of Webb are similar since both studies tried to identify if teachers held some misconceptions on some selected science concepts. The main difference though lies in the topic that was diagnosed and the types of teachers - primary teachers against secondary chemistry teachers.

Another study was conducted by Lee (1999) to ascertain how university chemistry lecturers and pre-service chemistry teachers perceive a chemical reaction between magnesium metal and oxygen gas. The study employed ten chemistry lecturers from a university in Singapore and 88 pre-service chemistry teachers. The 88 pre-service chemistry teachers were pursuing a graduate chemistry education enrolled in a one-year Post Graduate Diploma Program of the National Institute of Education. The instructional mode of the course was lecture with tutorial on various pedagogical methods that may be used to teach high school chemistry. The tutorial activities were conducted in groups. One representative of each group reports to the whole class about the results of their activities at the end of the tutorial session. The overall feedback from the peers and lecturer followed.

The lecturers were approached individually and invited to make a diagrammatic representation of particles to show the reaction mechanism. Each lecturer was advised to use unshaded and shaded circles to represent their diagrams. To the pre-service chemistry teachers, the researcher demonstrated an experiment on the reaction in one of the lecture-with-tutorial sessions. After the demonstration, the pre-service teachers were then instructed to explain the reaction mechanism using circles like what the lecturers did. The different diagrams created by the two groups of teachers were analyzed and showed that well-educated chemistry teachers (pre-service chemistry teachers) as compared to the university lecturers have views that differ from those currently accepted in the science that they are teaching. This means even university chemistry lecturers possess misconceptions of the topic on chemical reaction at the atomic level. The researchers concluded that pre-service chemistry teachers need help if they are to know how to link chemical at the macro-level into the atomic level and finally at the symbolic level. The ability to pass confidently between these three levels should be an important goal for chemistry teachers to ensure that they will not pass conceptual misconceptions to their students.

The study of Lee pertains to chemistry teachers' misconceptions just like the present study. However, the two studies differ in the chemistry topic involved in the study.

Lin and Cheng (2000) made a study to reveal high school students and high school chemistry teachers' understanding of gas laws. The subjects of the study were 119 11th-grade students and 36 high school chemistry teachers. The students were from three different sections in a prestigious high school and in an advanced program designed for high achievers of physical science. The majority of these students was college-bound and planned to major in either science or engineering. The 36 teachers were from 36 high schools in a suburb city of Taiwan. The teachers completed the assessment instrument while they were attending a teaching methods workshop. An open-ended pencil-and-paper test was used that ask teachers and students to predict the results of a demonstration or to explain or draw a diagram to show their ideas about a phenomenon. After they finished studying Charles', Boyle's, and the ideal gas law, the students were asked to respond to the same test instruments. The problems used in the study do not require substitution into a mathematical formula. Instead, the instrument requires conceptual understanding of gas properties and ideal gas laws and the ability to apply this knowledge in different situations.

The students' and teachers' answers were graded according to the following scheme: no explanation, explanations with irrelevant statements, and misconceptions were given zero (0) points and answers showing correct statements and use of target concepts were assigned 1 point. Analyses of test results revealed that teachers and students hold similar misconceptions or misunderstanding of gases. The following misconceptions were identified:

(1) Students and teachers held an Aristotelian view of gases as weightless substances.

(2) When a gas is heated inside a vessel, the gas molecules themselves expand.

(3) In boiling water, the bubbles produced are composed of hydrogen and oxygen gas.

The researchers concluded that chemistry teachers must have a sound understanding of their subject matter knowledge before they will be able to help their students construct the right understanding or meaning of scientific concepts instead of constructing misunderstandings or misconceptions.

The study of Lin and Cheng is similar to the present study since both studies focused on chemistry teachers' misconceptions. Moreover, the two studies used a paper-and-pencil diagnostic test instruments to identify chemistry teachers' misconceptions. However, the present study and the previous study focused on different chemistry topics for the study.

Chapter 3

METHODOLOGY

This section contains the research design, instrumentation, and validation of instrument, sampling plan, topic identification, instrumentation, data gathering and statistical treatment aspects of the research study.

Research Design

This research study made use of the descriptive method, specifically, the normative survey. Descriptive method was employed in the study since it is concerned with identifying the misconceptions held by chemistry major and non-chemistry major teachers on molecular geometry. The primary tool used in gathering the necessary data was a 35 multiple-choice diagnostic test instrument complemented by open-ended questions. All public secondary chemistry teachers in the Division of Samar served as respondents. The result was used to identify subject matter content misconceptions held by public national secondary chemistry teachers on the identified topic. After the instruments were prepared and validated, they were given to the respondents and afterwards they were subjected to tests using t-test for two independent samples at .05 significance, and the Pearson-Product Moment Correlation Coefficient (Pearson r). To test for the significance result of r, the Fisher's t-test was also used with the level of significance set at .05. The process gave way to the identification of misconceptions in teaching geometry of molecules.

Instrumentation

The main instrument used in this study was the diagnostic test constructed by the researcher. As a whole, the instrument was composed of two parts.

Part I was all about the personal profile of the respondents. It contained among others 1) age 2) sex 3) educational qualification 4) civil status 5) major 6) teaching experience 7) in-service trainings/seminars/ workshops/scholarships attended.

The diagnostic items were included as Part II of the instrument. It contained a 35-item multiple-choice item and open-ended questions. The purpose of the question was to identify chemistry teachers' misconceptions on the topic on molecular geometry. Indirectly, the instrument was a test of the subject matter knowledge mastery or competence of teachers.

The researcher constructed the first draft of the instrument, specially the content items with the guidance of the table of specifications (Appendix G, p.118), which covered learning objectives based on Bloom's Taxonomy, that is from knowledge level to evaluation. The researcher came up with thirty-five (35) multiple-choice items.

A copy of the first draft was then submitted to the research adviser to solicit comments and suggestions that could lead to further improvement of the test items.

After integrating the suggestions of the research's adviser, copies were produced and tried out to public secondary chemistry teachers of Calbayog City Division for validation.

Validation of Instrument

The instrument was tried out to and retrieved from public secondary chemistry teachers of first district of Samar - Calbayog City Division with the help of the Department of Education (DepEd) personnel. Validation of instrument was done on September 2000. The accomplished instruments were later scored for item analysis.

The formula for calculating the level of difficulty (L.D.) is:

$$L.D. = \frac{\text{Total number who answered the test item correctly}}{\text{Total number of examinees}}$$

Since the difficulty index of the item refers to the percentage getting the right item, the smaller the percentage value the more difficult is the item. The item whose difficulty index is between .30 and .90 were included in the final form of the test instrument. The following equivalents was used to interpret the results; Bright (1979)

Above 0.9	very easy
0.7 - 0.9	moderately easy
0.3 - 0.69	moderately difficult
below 0.3	very difficult

In the index of discrimination analysis, it determined the item's ability to distinguish between those teachers who were merely guessing. To judge the item discriminating power takes the total scores of the diagnostic test as the measure.

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

been overlooked as long as the item contributes to the overall pattern of the test.

Items with discrimination indices of .2 and above were included in the final form of the diagnostic test.

A draft of the validated and improved instrument was submitted again to the researcher's adviser for comments and suggestions. After integrating all suggestions, the open-ended question part of each test item was integrated. The final form served as the main instrument of the study.

Item Analysis of Diagnostic Test Instrument. The item analysis of the test instrument, which was tried out to 19 secondary chemistry teachers in the first District, Calbayog City Division. The result is given in Appendix H.

Level of difficulty ranged from 8 percent to 79 percent, providing a wide range of difficulty. Out of 35 items, 28 items were identified to be moderately difficult (MD) and 7 were difficult items (D).

The indices of discrimination ranged from 0.2 to 0.4. Items with discrimination indices greater than 0.2 were accepted without the need for further improvement. Five test items of the instrument; item numbers 2,13,16,19 and 24 had discrimination indices of 0.2 and below were improved and revised due to hazy statements or questions. Thirty (30) items of the said instrument were accepted.

As a whole, the test instrument was composed of moderately difficult items.

Sampling Procedure

Total enumeration was the sampling procedure used in this research study. All secondary chemistry teachers teaching in the Division of Samar were made as respondents. A list of secondary chemistry teachers was then obtained from the DepEd Division of Samar. All of them were requested to take the diagnostic test to obtain the necessary data.

The teachers involved were composed of both chemistry majors and non-chemistry majors. As it was there were a total of 30 teachers coming from twenty-nine national schools in the Division of Samar. Both chemistry majors and non-chemistry majors took the total enumeration as the secondary curriculum offers only - one chemistry subject in the third year.

Table 1 presents the schools and the respondents of the study.

Table 1

Schools and Respondents of the study

Schools	No. of Respondents
1.Samar National High School	2
2.Guintarcan National High School	1
3.Sta. Margarita National High School	1
4.Daram National High School	1
5. San Andres National High School	1
6. Villareal National High School	1
7. Tarangnan National High School	1
8. Gandara National High School	1
9. Matuguinao National High School	1
10.Pagsanghan National High School	1
11.Jiabong National High School	1
12.Calbiga National High School	1
13.Lawa-an National High School	1
14.Tominamos Integrated School	1
15.Motiong National High School	1
16.Igot National High School	1
17.Hinabangan National High School	1
18.Casandig national High School	1
19.Basey National High School	1
20.Marabut National High School	1
21.Talalora National High School	1
22.Sto.Niño National High School	1
23.Tagapul-an National High School	1
24.Sta. Rita National High School	1
25.San Sebastian National High School	1
26.West Coast Agricultural School	1
27.Almagro National High School	1
28.Independencia National High School	1
29.Simeon Ocdol National High School	1
	Total = 30

Data Gathering Procedure

The data for the study was generated through the use of the research instrument the diagnostic test. The researcher, to facilitate distribution and retrieval administered the diagnostic test personally. In places where it was quite impossible to personally administer the test, the researcher requested the assistance of the school principals, head teachers, teachers-in-charge, Science and Technology supervisor or district supervisors, who were concerned especially for respondents assigned in the islands. The researcher drafted a letter asking permission and approval from the Schools Division Superintendent of the Division of Samar before actual distribution of the data-gathering instrument.

The teachers were given about one day to accomplish the research instrument. Data collection was done on the month of October 2000 and the percentage of retrieval was 66 percent. After one day the accomplished diagnostic instrument was retrieved, sorted, corrected, scored, analyzed, and tabulated for statistical treatment.

Statistical Treatment of Data

Items of the diagnostic instrument were evaluated for both correct content answers and correct reasoning/ explanation following the suggestion of Jensen and Finley (1995). A correct response to the multiple-choice items and correct explanation was awarded a score of 1. A correct answer to the multiple-choice item and wrong explanation or a wrong answer to the multiple-choice item with a correct explanation was given a score of zero (0). Any correct content item and wrong explanations or a wrong content item with a correct reasoning means a misconception on molecular geometry.

To answer problem question number 2, the total percent correct response to each item for all respondents were computed. Total percentage score below 50 percent indicated a misconception. This condition answered question number 2.

To answer problem question number 3, the following range of mean and interpretation was used:

Mean Scores		**Interpretations**
35	--------------	Best understanding/ no misconceptions
23.00 - 34.99	--------------	Adequate understanding/ low misconceptions
11.00 - 22.99	--------------	Moderate understanding/ moderate misconceptions
1.00 - 10.99	--------------	Inadequate understanding/ high misconceptions
0	--------------	No understanding

Furthermore, to facilitate computational analysis of the data in the undergraduate degree by the teacher-respondents, the assigned numbers for each category were: BSE-5 points and non-BSE-3 points. Similarly, to facilitate computational analysis of the data in undergraduate major by the teacher-respondents, the assigned number to each category were: Chemistry major-5 points and non-chemistry major-3 points.

The following statistical tools were used to test the hypotheses posted in this study. The mean scores of the two groups of respondents were computed.

To answer question number 4 and the null hypothesis, No. 1 the t-test for two independent samples at .05 significance was used (Freund and Simon, 1992).

$$t = \frac{D}{\sqrt{\frac{(N_1 - 1)SD_1^2 + (N_2 - 2)SD_2^2}{N_1 + N_2 - 2} \left[\frac{1}{N_1} + \frac{1}{N_2}\right]}}$$

where:

t - computed t-value for independent means

D - difference of mean scores of chemistry major teachers and non-chemistry major teachers

N_1 - number of chemistry major teachers

N_2 - number of non-chemistry major teachers

SD_1 - standard deviation of scores of chemistry majors

SD_2 - standard deviation of scores of non-chemistry majors

To answer problem question #5 the relationship between the test performance in chemistry and each of teacher's variables, the researcher applied the correlation analysis using the Pearson r coefficient of correlation.The following is formula (Guilford, 1973).

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

Where:

r_{XY} = correlation coefficient between X and Y

N = total number of respondents under the study

ΣX = mean weighted point score for each teachers variable

ΣY = respondents mean percentage score in chemistry

ΣXY = sum of the product of X and Y

ΣX^2 = sum of the squared X values

ΣY^2 = sum of the squared Y values

To test the relationship between sex and the diagnostic test result, civil status and the diagnostic test result in chemistry obtained by male and female, married and single, respectively, the Korin's formula (Cited in Punzalan and Uriarte, 1987) was used:

$$E^2 = \frac{\Sigma ni\hat{Y}i^2 - N\hat{Y}^2}{\underset{rc}{\Sigma\Sigma}\hat{Y}i^2 - N\hat{Y}^2}$$

To determine the extent of correlation between X and Y, the following legend of interpretation was used:

0.00 - 0.20	negligible correlation
0.21 - 0.40	low or slight correlation
0.41 - 0.70	marked/moderate correlation
0.71 - 0.90	high correlation
0.91 - 0.99	very high correlation
1.00	perfect correlation

To test for the significance result of the r, the Fisher's t-test (Downie and Heath, 1984) was used wherein the level of significance set at .05. As a rule, if the computed r-value is less than the table r-value, the H_0 is accepted.

The formula used was:

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

Where:

r = computed Pearson r value

N = number of pairs

t = computed Fisher's t-value

Chapter 4

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter presents the findings, analysis and interpretation of data obtained from the respondents through questionnaire and performance test. The data consist of teacher's profile, result of the performance test, and the interpretation of the results based on the responses of the 30 secondary school chemistry teachers in the Division of Samar.

Profile of Chemistry Teachers

The following discussions are about the teacher's profile, which includes age, sex, civil status, educational background, teaching experience, seminars attended, and number of loads.

Sex and Age of the Respondents. There were 30 teachers who were respondents of this study. Table 1 presents the sex and the age profile of the chemistry teacher respondents. It can be noted that female teachers dominate the secondary school chemistry teachers in the Division of Samar. There were only five or 17 percent who were males and 83 percent or 25 teachers were female

Table 2

Sex and Age Profile of the Chemistry Teacher-Respondents

AGE	Frequency		TOTAL	Percent
	Male	Female		
21-23	0	4	4	13.33
24-26	2	6	8	26.67
27-29	2	5	7	23.33
30-32	1	3	4	13.33
33-35	0	1	1	3.33
36-38	0	1	1	3.33
39-41	0	0	0	0
42-44	0	1	1	3.33
45-47	0	1	1	3.33
48-50	0	0	0	0
51-53	0	3	3	10.00
TOTAL	**5**	**25**	**30**	**100.00**
Average	**139**	**765**	**904**	
Average Age	**27.80**	**30.60**	**58.40**	
Standard Deviation	**2.24**	**9.63**	**12.55**	

Table 2 also shows that, the oldest teacher is 53 and the youngest aged 21. There were 19 teachers who fell below the mean and 11 teachers who fell above the mean. Analysis of data reveals that the respondents were at the early stage of middle age. The greater bulk of teachers fell within the ages 24-26 and 27-29. This means that the teachers who are currently teaching chemistry in the Division of Samar are relatively young.

Civil Status. As to the civil status of chemistry teacher respondents, majority of them were married, as there were 66.67 percent or 20 out of 30 teacher respondents who belonged to this group. The remaining 33.33 percent or 10 out of 30 were single. Of the five male chemistry teacher-respondents, two were married and three were single. On the other hand, of the twenty-five female chemistry teacher-respondents, eighteen were married and only seven were single.

Educational Profile of Secondary Chemistry Teachers.

Table 3 shows the educational profile of the teacher respondents. As shown in the said table all of the teacher respondents were Bachelors degree holders with only 47 percent or 14 of the teacher respondents having major in chemistry.

On the other hand, 53 percent of 16 of the teacher respondents were not chemistry majors. The data signified that non-majors outnumbered those who possess the minimum qualification needed in teaching the subject. The 16 teachers who were not chemistry majors have other science courses as their major. Furthermore no one is a master's degree holder.

Table 3

Educational Profile of Respondents

Undergraduate Degree	Major Preparation	Number of Teachers	Percent
	Chemistry Major		
BSE	Physics-Chemistry	10	33.33
	Chemistry	3	10.00
BSChE	Chemical Engineering	1	3.33
	Total	**14**	
	Non-chemistry Major		
BSE	General Science	5	16.67
	Biology	1	3.33
	Mathematics	2	6.67
BSIE	Civil Technology	1	3.33
	THE	1	3.33
	Natural Science	3	10.00
	Physics	3	10.00
	Total	**16**	

Chemistry Units Earned. As a whole, the secondary chemistry teachers showed little professional growth along their field of specialization. Table 4 reveals that only one had units from 42-44. Nine or 30 percent of the teachers clustered in 18-20 units earned. This is so far the highest percentage while the rest had percentages of 7 and 10 with 0 as the lowest.

Table 4

Chemistry Units Earned by the Respondents

Units Earned	Frequency	Percent
0 - 0	2	7.00
3 - 5	0	0
6 - 8	2	7.00
9 - 11	2	7.00
12 - 14	2	7.00
15 - 17	0	0
18 - 20	9	30.00
21 - 23	1	3.00
24 - 26	3	10.00
27 - 29	2	7.00
30 - 32	0	0
33 - 35	3	10.00
36 - 38	3	10.00
39 - 41	0	0
42 - 44	1	3.00
Total	**30**	**100.00**

Teaching experience. Teaching experience is another factor, which needs to be considered in appraising the teaching competencies of chemistry teachers. As presented in table 5, about 46.67 percent or 14 out of 30 chemistry teacher-respondents had been in the service from one to two years only. Thirty percent or 9 teachers have been teaching from three to five years. The rest have teaching experience of more than five years but they were randomly distributed in the brackets with only one or two found in each. This means that the teachers are neophytes or still inexperienced in the teaching profession. They have a long way to learn the ins and outs of the job.

Table 5

Years of Teaching Experience of the Respondents

Years of Experience	Frequency	Percent
0 - 2	14	46.67
3 - 5	9	30.00
6 - 8	1	3.33
9 - 11	1	3.33
12 - 14	2	6.67
15 - 17	1	3.33
18 - 20	1	3.33
21 - 23	0	0
24 - 26	1	3.33
Total	**30**	**100.00**
Average	**5.1**	
Standard Deviation	**4.5**	

Seminars/Trainings/Workshops Attended. Table 6 reveals the profile of the chemistry teacher-respondents as to their seminars/trainings/workshops attended. As revealed most of the seminars attended by the chemistry teacher-respondents are those of the division level with 33.33 percent of the total number of seminars attended by them. The school and the district level with 26.67 and 20 percent follow this, respectively. The next number was that of the regional level with 13.33 percent of the total number of seminars attended. The least attended seminars were that of national level with 6.67 percent.

The data cited implies that the chemistry teacher-respondents have limited opportunity for professional growth along this line. They have to be updated with the modern curricular trends and thrusts of the subject matter. This shows that aside from their educational qualification, they still need more seminars/trainings/workshops especially on the content of the subject.

Table 6

Seminars and Workshops Attended for the Last Five Years

Level	Frequency	Percent
School	4	26.67
District	3	20.00
Division	5	33.33
Regional	2	13.33
National	1	6.67
Total	**15**	**100.00**

Teaching Loads. Table 7 reveals that some of the respondents are teaching in their area of concentration but other teachers have teaching loads other than chemistry.

Table 7

Loading of Teachers

Repondents No.	No. of Loads	Teaching Load
1	1	Chemistry
2	1	Chemistry
3	2	Chemistry, English
4	3	Chemistry, Values, General Science
5	2	Chemistry, PEHM
6	3	Chemistry, THE, English
7	4	Chemistry, Gen. Sci., Biology, Physics
8	3	Chemistry, THE, Values Education
9	2	Chemistry, Biology
10	2	Chemistry, Physics
11	2	Chemistry, Filipino
12	1	Chemistry, Biology
13	2	Chemistry, Mathematics
14	2	Chemistry, Mathematics
15	2	Chemistry, English
16	3	Chemistry, English, THE
17	3	Chemistry, Filipino, Value
18	3	Chemistry, Biology, General Science
19	2	Chemistry, General Science
20	4	Chemistry, English, PEHM, Physics
21	3	Chemistry, Mathematics, Physics
22	2	Chemistry, Mathematics, Physics
23	2	Chemistry, General Science
24	2	Chemistry, English
25	3	Chemistry, Mathematics, Biology
26	2	Chemistry, Physics
27	2	Chemistry, Physics
28	3	Chemistry, Values, Filipino
29	2	Chemistry, Mathematics
30	3	Chemistry, Mathematics, Physics

This signifies a maximum chemistry teaching learning process while some respondents are slightly bothered by their other loads.

Test Performance and Identified Misconceptions. Results of the diagnostic test of chemistry teachers' misconceptions were analyzed by assessing the percentage of correct responses by item and by comparing the two groups with regards to their responses. Table 8 contains data of the number of frequency and percent response by item.

As indicated in the Table 8, for chemistry major, the most answered item was item no. 4. The result implies that the number of teachers getting the correct answer even did not reach 50% of the teachers answering the item correctly (42.86%). This would mean that the other 50% of the teachers or 8 teachers possess misconceptions. The least answered test items were items 2, 5, 10, and 13, which comprised only 10% of teachers answering the items correctly. Again, the results imply that about 90% of the teachers have misconceptions on the concept exemplified by these items.

For the non-chemistry major, the most answered items were item no. 4; the result is similar to the chemistry majors. The non-chemistry major teachers possess moderate misconceptions exemplified by item 4. The least answered items were item numbers 2, 5, 8, 10, 11, 13, 15, 19, 21, and 34. It was noted that the non-chemistry major teachers - item numbers 2, 5, 10, and 34, actually did not answer four of items correctly. This only means that non-chemistry major teachers have complete or total misconceptions on the concepts exemplified by these items.

Item 2 tested the ability of chemistry teachers to write correct Lewis formula.

Item 2. Which of the following chemical species obeys the 'octet rule'?

*a. SO_4^{-2} b. BCl_3 c. PCl_5 d. SiF_6

Both groups of teachers performed poorly in this item. Only 2 (7.71%) of the chemistry majors getting the correct choice and explanation and 12 (92.29%) of the teachers still hold some misconceptions on the topic. The situation is even worse for the non-chemistry major teachers. Nobody from this group of teachers got the correct answer. This simply means that all non-chemistry major teachers have no understanding of the concept of Lewis structures.

Table 8

Number of Frequency and Percent of Correct Responses By Item (N = 35)

Item No.	Chemistry Major		Non-Chemistry Major	
	F	%	F	%
1	5	14.28	4	11.43
2	2	7.71	0	0.00
3	12	34.28	6	17.14
4	15	42.86	13	37.14
5	2	5.71	0	0.00
6	11	37.14	7	20.00
7	13	37.14	6	17.14
8	9	25.71	3	8.57
9	11	31.43	7	20.00
10	1	2.86	0	0.00
11	7	20.00	2	5.71
12	5	14.28	4	11.43
13	4	14.00	3	8.57
14	5	11.43	5	14.29
15	14	28.57	3	8.57
16	4	14.28	4	11.43
17	10	28.57	4	11.43
18	5	14.29	6	17.14
19	6	17.14	2	5.71
20	10	28.57	5	14.29
21	4	11.43	3	8.57
22	11	31.43	5	14.29
23	7	20.00	6	17.14
24	8	22.86	4	11.43
25	3	8.57	4	11.43
26	10	28.57	4	11.43
27	13	37.14	6	17.14
28	9	25.71	6	17.14
29	5	14.29	5	14.29
30	7	20.00	9	25.71
31	9	25.71	5	14.29
32	6	17.14	4	11.43
33	8	22.86	4	11.43
34	5	14.29	0	0.00
35	7	20.00	7	20.00
Total	**263**		**157**	

Further the proof is evident on item 10 where only one (2.86%) of the chemistry major teachers and none (0%) of the non-chemistry majors got the item correct.

Item 10. Which of the following molecule has a linear geometry?

a. H_2S b. SO_2 c. O_3 d. $CaCl_2$

It is expected then why they will not be able to predict the geometry of molecules because of their misconceptions on Lewis structures. The ability to draw Lewis structures is crucial in predicting molecular geometry. The geometry of molecules is predicted based on its Lewis structures.

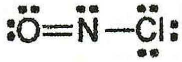
Another pre-requisite knowledge on how to draw the Lewis structure is that teachers should know how to determine the central atom from a given chemical formula. This understanding was tested by item 1 which shows different placements of the atoms.

Item 1. A molecule, called nitrosyl chloride, is composed of one (1) atom each of nitrogen, oxygen, and chlorine. Which is the most plausible Lewis formula for this molecule?

a. 

b. 

c. 

d. 

Results show that only 5 (14.28%) in chemistry majors (14.28%) and 4 (11.43%) of the non-chemistry majors got the correct answer of item 1 (choice d). The very low percentages of teachers getting the correct response and explanation confirm that teachers really possess misconceptions on writing Lewis structures. This finding is very alarming. How then could students learn the correct meaning or understanding of chemistry concepts such as molecular geometry when the teachers themselves are full of misconceptions?

The negative characteristic of misconception, that it affects learning of succeeding topic, is seen in item 11 (choice c) where only 7 (20%) of the chemistry majors and 2 (5.71%)of the non-chemistry majors got the item right. If teachers have a strong grasp of the pre-requisite understanding (Lewis structure) then they will be able to understand the next concept, which is geometry of molecules.

Item 11. Of the following molecules, which molecule is NOT linear?

a. :O≡C:

b. H—C≡N:

c. $H-\ddot{\underset{\cdot\cdot}{O}}-H$

d. $H-\ddot{\underset{\cdot\cdot}{Cl}}:$

The result points that indeed teachers possess misconceptions because only very few teachers were able to pinpoint the correct answer for item 11 (choice c). Teachers could not apply the effect of lone pairs of the central atom.

The acid test of chemistry teachers understanding of Lewis concept is deducible from items 2 and 5.

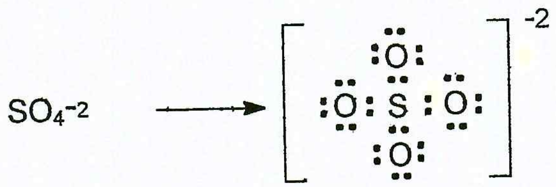
Item 2. Which of the following chemical species obeys the 'octet rule'?

*a. SO_4^{-2} b. BCl_3 c. PCl_5 d. SiF_6

Item 5. Which chemical specie does NOT follow the octet rule?

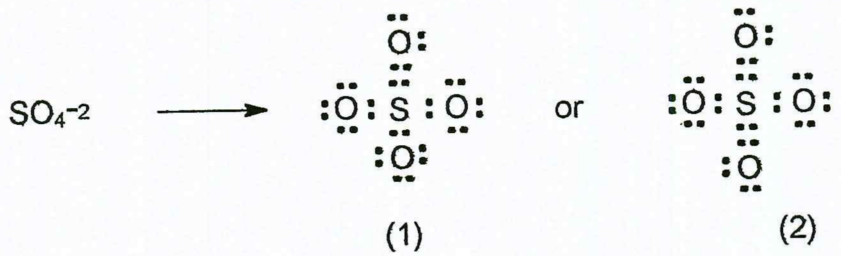
a. SO_4^{-2} b. $CHCl_3$ c. CO_3^{-2} d. H_2O

In item 2 the correct answer is sulfate ion, SO_4^{-2} (choice a) because it follows the 'octet rule' in writing Lewis structures – eight valence electrons around the atoms shown in the diagram shown below. The non-chemistry majors did poorly on this item, 0%. With a total of 32 valence



electrons (6 coming from sulfur, 24 for oxygen plus the 2 extra charge), all electrons are accounted with each atom having eight electrons.

However, in item 5, the same ion is the correct choice (choice a), which means sulfate ion, does not follow the 'octet rule'.

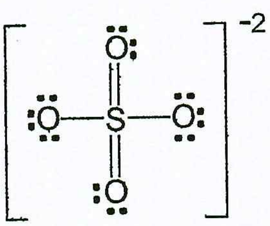


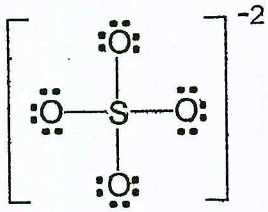
Sulfur atom being a second-row period element is an exception to the 'octet rule' and it can possess 8, 10, and 12 valence electrons in forming Lewis structures. In structure (1) sulfur has 10 valence electrons (there are 4 resonance structures) and 12 valence electrons in structure (2) and there are again four (4) resonance structures. Zero percent (0%) or none of the non-chemistry majors got the item correctly is very evident that these teachers possess a very high misconceptions which is tantamount to 'no understanding' or 'wrong understanding' of the concept of 'octet rule'. As regards to the chemistry majors, only 5 (14.28%)got the correct answer which means that most of the chemistry major teachers still possess some level of misconceptions on the concept on 'octet rule'.

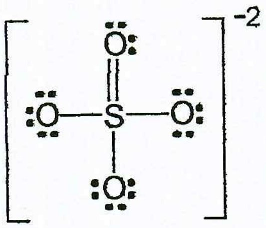
Misconception 1: In writing Lewis structures, most of the teachers assumed that eight electrons except hydrogen atom should surround all atoms in the chemical formula.

This misconception on the ability of third period elements to attain variable valence electrons is again tested with item 34.

Item 34. Which Lewis structure is correct?

a. 

b. 

c. 

d. All of the above

Again, the non-chemistry major teachers got zero score (0%) while the chemistry major teachers barely scoring at 5 (14.25%) of the total number of teachers. If chemistry teachers are really well versed on the Lewis structure topic, then they should have answered items 7 and 9. These items required chemistry teachers to identify the kinds of

Item 7. Which molecule contains a triple bond?

a. N_2 b. O_2 c. F_2 d. H_2

Item 9. Which molecule contains a double bond?

a. Br_2 b. Cl_2 c. C_6H_6 d. I_2

bond present in molecules through Lewis structure writing. In these items, about 31.43% responded correctly and 20% in the non-chemistry major teachers. The results on these two items are confusing since both groups scored higher on these items, which is more difficult than previous items. It could be inferred that chemistry teachers' understanding is hazy due to the presence of misconceptions.

The link between Lewis structure and molecular geometry is exemplified by item 11 and 14. The shape of molecules can be predicted by applying VSEPR Theory (Valence Shell Electron-Pair) to the given Lewis structures of molecules.

Item 14. Which of the following molecule has a linear geometry?

a. H—C≡N: b. :Cl—Sn—Cl:

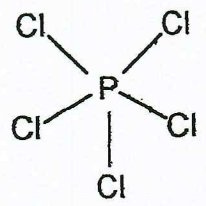
c. :Cl—S—Cl: d. H—O—H

With item 14 above, only 11.43% or 5 chemistry major teachers got the correct answer. The rest of the teachers of this group possess misconceptions. For the non-chemistry major group, only 5 teachers (14.29%) got the correct choice and explanations. These results are comparable to item 11. The low percentages of teachers getting the correct choice and explanation leads one to infer that the remaining teachers possess high misconceptions on the VSEPR Theory.

Misconception 2: In predicting the geometry of a covalent molecule, most chemistry teachers disregard the effect of electron pairs of the central atom.

To confront directly chemistry teachers' misconceptions on molecular geometry, a structure that uses line bonds were employed. These are exemplified in items 11, 13, 16, 18, and 19. The highest number of chemistry teachers getting the correct response to these items was only pegged at 20.0% (7 teachers) for the chemistry majors and 17.14% (6 teachers) for the non-chemistry major. However, the two groups markedly differ in item 19 where only 2 (5.71%) of the non-chemistry major teachers getting the correct answer and explanation.

Item 19. Predict the shape of the following molecule, PCl_5.



a. square planar
b. T-shape
b. square pyramidal
c. triangular pyramidal

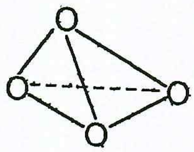
These results led to the identification of another misconception, that is, the problem of identifying the correct molecular shape is compounded by teachers inability to view molecular geometry drawn in two dimensions. Chemists call this misconception as 'functional fixedness'. This means teachers do not know the use of other figures in representing the chemical bond.

Misconception 3: Regardless of the three-dimensional positioning of peripheral atoms, most teachers always use lines as bonds in three-dimensional molecular drawings.

However, it is very worrisome why most chemistry major teachers could not get the correct answer. The topic on Lewis structure is very common that it is a part of any chemistry lesson. Even in high school chemistry it is discussed. This misconception also suggests that teachers did not even bother to check their understanding having been teaching this topic for several years or they just simply skip this topic.

Even notable about these items (specifically, items 13, 16, 18, and 19) are that the molecules are drawn in their correct geometrical shape. Yet, only 5 (14.29%) of the chemistry major group and 6 (17.14%) of the non-chemistry group of teachers got the right response for item 18.

Item 18. What is the name of the shape of the following molecular shape?



a. triangular
b. triangular pyramidal
c. tetrahedral
c. square planar

Based on these findings the researcher identified this misconception.

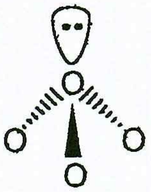
Misconception 4: Most chemistry teachers give the wrong name for a given geometry of a covalent molecule drawn in three-dimensions.

Items 17, 20, and 22 tested the effect of lone-pairs in atomic orbitals of the central atom on the geometry of the molecule as a whole. Item 17 is supposed to be answered correctly by most teachers because the answer is very evident - choice c. But because of 'misconception of number 4' they were not able to answer correctly. Only 10

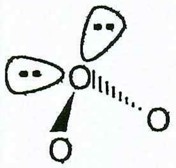
(28.57%) of the chemistry majors did get the correct answer and explanations and quite lower for the non-chemistry majors which was pegged at 5 (14.29%)

Item 17. Which of the following representations has a pyramidal shape?

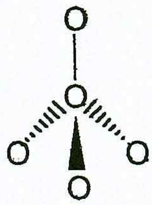
a.



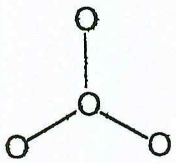
b.



c.

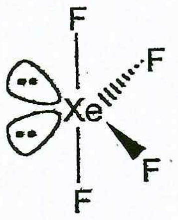


d.



To the rest of the items, the number of teachers getting the correct answer reached only to 20%, which is way below the 75% mastery level for students. This means that not even half of the chemistry teachers completely understand the effect of lone-pairs. For most of the teachers not getting the correct response for item 20 is understandable. The concept is more complicated than item 17. Even then this is not an excuse since chemistry teachers are expected to be teaching the right concept not misconceptions.

Item 20. Predict the shape of the molecule shown below for xenon tetrafluoride, XeF_4.



a. square planar
b. square planar
c. T-shaped
d. tetrahedral

Misconception 5: Most chemistry teachers consider only the effect of bonding electrons between atoms in predicting the shape of a covalent molecule.

Another theory that is applied to predict the geometry of molecules is hybridization. Items 8 and 12 identified misconceptions on this theory. Nine teachers (25.71%) in the chemistry major group understand the theory and only 5 teachers (14.28%) of the non-chemistry majors.

Item 8. What type of hybridization is involved in nitrogen atom in NH_4^+?

a. sp^4 b. sp^3 c. sp^2 d. sp

Item 12. What kind of hybridization would you expect in oxygen atom in water?

a. sp^4 b. sp^3 c. sp^2 d. sp

The low percentages of teachers getting the correct answer points that most of the remaining chemistry teachers possess high misconceptions on the concept of hybridization.

Misconception 6: The hybridization pattern of atomic orbital among bonded atoms in a covalent molecule has no effect on the geometry of a given molecule.

Still important in the teaching of molecular shape is the idea on the application of the topic itself to physical properties of substances. Items 24, 25, 26, 27, and 29 test this topic. For example, water has molecular mass of 18 amu while carbon dioxide has a mass of 44 amu. Theoretically, it is expected that water being liquid will boil ahead than carbon dioxide. Yet, the reverse is true. In fact carbon dioxide normally exist, as a gas while water is liquid. Data reflected on the table says that only

Item 29. Which molecule contains the most polar bond?

a. Cl_2 b. CH_3Cl c. NaF d. ClF

three teachers of the chemistry major group (about 8.57%) got item 29 correctly and 4 of the non-chemistry majors (11.43%). Again the rest of the teachers possess moderate misconceptions.

Misconception 7: Most of the teachers consider polarity of individual bond in predicting the polarity of the whole molecule regardless of its geometry.

The individual item analysis conducted on secondary chemistry teachers' misconception on the topic `molecular geometry' is quite established. The general trend is that most of these teachers have moderate misconceptions. No item was answered by at least 30% of the teachers regardless of their major. Some teachers have even high misconceptions as revealed by the data in Table 8. Yet, in the field students are supposed to have attained 75% mastery level in a day's lesson as mandated by DepEd. It is impossible to attain the mastery level when teachers themselves possess misconceptions. The data imply that students are being taught the wrong understanding or meaning of chemical concepts, ideas, principles and theories on molecular geometry.

Level of Misconceptions of Chemistry Teachers.

Table 9 shows the results of the test in terms of raw scores and percentage of correct responses in the test. As indicated by the said table, the median score was 13 while the mean was 13.97. This implies that thirteen or 43 percent were above the mean and seventeen or 57 percent were below the mean. This result provided evidence that only three respondents or 10 percent of them obtained the adjectival rating of "adequate understanding/low misconceptions", misconception level of 37.47 percent which falls under inadequate "understanding/high misconceptions". The data above point to the fact that the mean scores obtained by the chemistry major was higher than non-chemistry major. From the result it is worth noting that chemistry major respondents tend to have low misconceptions.

Table 11 shows the scores of the chemistry teacher-respondents, and the non-chemistry major in the diagnostic test. As indicated by the said table, the highest score for the chemistry major respondents was 25, which was obtained by two respondents it followed by a score of 24, which was obtained by one respondent. Meanwhile, one respondent got the lowest score of 12. The total score of the chemistry major-respondents in the diagnostic test was 263 with mean of 18.78. This implies that for the chemistry major respondents, their performance was moderate understanding/moderate misconceptions.

On the other hand, one respondent obtained the highest score in the diagnostic test for the non-chemistry major-respondents. This was followed by the score of 15, which was obtained also by one respondent and 14, which was obtained by one respondent. The lowest score for this group was 1, which was obtained by one respondent. Thus, the total score of the non-chemistry major-respondents in the diagnostic test was 157 with a mean of 9.81. This implies that they have "inadequate understanding/high misconceptions" on the topic.

Table 11

Distribution of the Final Rating of the Diagnostic Test of the Chemistry Teacher-Respondents

Chemistry Major		Non-Chemistry Major	
Respondents No.	Score	Respondents No.	Score
1	25	1	19
2	25	2	15
3	24	3	14
4	22	4	11
5	22	5	11
6	21	6	10
7	18	7	10
8	18	8	10
9	18	9	10
10	16	10	10
11	15	11	9
12	14	12	9
13	13	13	9
14	12	14	5
		15	4
		16	1
Total	263		157
Mean	18.78		9.81
Absolute Mean Difference	8.97		
Interpretation	Moderate under standing/ Moderate misconceptions		Inadequate understanding/ Low misconceptions
Computed t value	5.69	Tabular t value $\propto$ = 0.05:1.701	
Evaluation	Reject Ho	Df = 28	

It can be seen that in the diagnostic test, the chemistry major respondents obtained a higher score and mean than the non-chemistry major-respondents with a numerical difference of 8.97. The t-test for two independent samples was applied to find out whether the observed difference was significant. The computed t-value resulted to 5.69. This was numerically greater than the critical t-value of 1.701 at 0.05, one tailed. Consequently, the hypothesis that " there is no significant difference between the level of misconceptions of chemistry major teachers' and non-chemistry major teachers' as revealed in the diagnostic test" was rejected.

This means that the difference was significant, implying that during the test, the chemistry major-respondents performed better. This result posed a positive result for the chemistry major-respondents.

Thus, on the basis of the result of the test of the hypothesis the non-chemistry major respondents had inadequate knowledge on the subject they are teaching.

Relationship of Level of Misconception with Teacher-Related Variables. The relationships between the diagnostic test and teacher related variables, which influence the level of misconceptions of the teachers, were computed using the Pearson Product Moment formula. Table 12 shows the computed correlation of coefficient and the t-ratio between the diagnostic test results and teacher-related variables.

Specifically, one hypothesis revealed that there is no significant relationship exists between the levels of

Table 12

Computed Correlation Coefficient Between Chemistry Teachers' Diagnostic Test and the Teachers' Profile

Teachers' Profile	Computed Pearson r	Interpretation	Fisher's t-value	Evaluation
1. Age	0.124	Negligible correlation	0.661	Accept Ho
2. Sex	0.144	Negligible correlation	0.770	Accept Ho
3. Civil Status	0.022	Negligible correlation	0.116	Accept Ho
4. Undergraduate degree	-0.092	Negligible correlation	0.489	Accept Ho
5. Undergraduate major	0.735	High correlation	5.736	Reject Ho
6. Chemistry units earned	0.744	High correlation	5.894	Reject Ho
7. Teaching experience	0.302	Low/slight correlation	1.678	Accept Ho
8. In-service trainings/ seminars/ workshop	0.654	Marked/moderate Correlation	4.578	Reject Ho
9. Teaching loads	-0.088	Negligible correlation	-0.470	Accept Ho

misconceptions of secondary chemistry teachers and the age of respondents. The computed Pearson r for the age variate was 0.124; with this value, this signifies a negligible relationship between these two variables. The computed t-value was 0.661 and is lower than the critical t-value of 1.701 at 0.05 level of significance. Consequently the results led to the acceptance of the null hypothesis. This means that age is not significantly related to the misconceptions of the teacher-respondents. This implies that the level of misconceptions of the older and younger teacher-respondents were equal.

Another aspect is the sex variate. The result of the computed r was 0.144. This signifies a negligible relationship between the levels of misconceptions of chemistry teacher-respondents and their sex. The computed t-value of 0.770 is smaller than the critical value of 1.701, which means that the null hypothesis was accepted. The result proves that the sex of the teacher respondents does not significantly relate to their misconceptions on the topic. Male teachers have same level of misconception with the female teachers.

On the relationship between the level of misconceptions and the civil status of the teacher-respondents, the computed r was 0.022. This denotes a negligible relationship between the two variables. The computed t-value was 0.116 and is lower than the critical value of 1.701. This result consequently accepts the null hypothesis. The acceptance means that there is no significant relationship between the level of misconceptions and the civil status of the teacher-respondents. This result implies that the civil status does not influence their test performance.

For educational qualification specifically undergraduate degree, the computed r-value was -0.092. This signifies a negligible relationship between the two variables. The computed t-value was 0.489 and is lower than the critical value of 1.701.

For undergraduate major, the result of the computed r was 0.735, which means high correlation. The computed t of 5.736 is greater than the critical value of 1.701. The hypothesis that states that there is no significant relationship that exists between the level of misconceptions of chemistry teachers and their undergraduate major was rejected. The rejection of the null hypothesis denotes that undergraduate major of the teacher-respondents is significant and related to their level of misconceptions.

On the relationships between the level of misconceptions and chemistry units earned by the teacher-respondents, the computed r was 0.744, which means high correlation. The computed t of 5.894 is greater than the critical value of 1.701. This denotes a rejection of the hypothesis. The rejection of the hypothesis implies that there is significant relationship that exists between the level of misconceptions of chemistry teachers and the chemistry units earned.

The hypothesis, which states that there are no significant relationships that exist between the level of misconceptions of secondary chemistry teachers and the teaching experience, was accepted. This is because the computed r was 0.302, which means low or slight correlation. The computed t value of 1.677, which is lower than the critical value of 1.701. This signifies that teaching experience has no significant relationship with the level of misconceptions of chemistry teachers.

Under the seminars/trainings/workshops attended, the computed r was 0.654, which implies a marked or moderate correlation. The computed t value of 4.578, which is greater than the critical t value of 1,701, resulted to the rejection of the null hypothesis. This implies that seminars/trainings/workshops attended by secondary chemistry teachers are significant in this study.

On the relationship between the level of misconceptions of chemistry teachers and the number of teaching loads, the computed r-value was -0.088. This signifies a negligible correlation between the two variables. The computed t value was -0.470 and this is smaller than the critical value of 1.701 at .05 level significance. This led to the acceptance of the hypothesis, which states that there is no relationship that exists between the level of misconceptions of secondary chemistry teachers and the teaching loads. This means that the teaching loads are not significantly related to the level of misconceptions of secondary chemistry teacher-respondents.

Implication of the Study. As pointed out earlier, the chemistry major-respondents performed better than the non-chemistry major-respondents. This signified that chemistry major-respondents are more competent and more knowledgeable on the topic molecular geometry, because they have less misconception on the topic.

On the other hand, the results showed, that non-chemistry majors obtained only 37.47 percent on inadequate understanding/high misconceptions. This finding is something that is disturbing. In a greater degree misconceptions on molecular geometry will be perpetuated among students and to think of the multiplier effect of teaching and education. Subsequently, students will carry on this misconception.

Such a practice of assigning non-chemistry major teachers in the public schools more specifically in the division of Samar should be dealt with if quality education should prevail.

The results of the study is important to the fact that it serves as the baseline data, basis for conducting in service training for the secondary teachers of Public National High School in the Division of Samar.

Chapter 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings, the subsequent conclusions drawn as well as the recommendations formulated.

Summary of Findings

Based on the results of the analysis of the data gathered the following were the findings of the study:

1. Profile of Chemistry Teachers

The following are the data concerning the profile of the respondents.

1. The average age of the male respondents was 27.80 years, while that of the female respondents was 30.60 years.

2. Of the 30 secondary chemistry teacher-respondents, majority that is 25 teachers or 83 percent were female, and of 5 teachers or 17 percent were male.

3. Majority of the teacher-respondents were married. There were 66 percent or 20 out of 30 teacher-

respondents who belonged to this group. The remaining 33 percent or 10 out of 30 were single.

4.

4.1 It was noted in this study, that of the 30 chemistry teachers, 27 or 90 percent were BSE degree holders, followed by BSIE holders of 7 percent, then the last group of teachers, represented the BSChE of 3 percent. Moreover 14 teacher-respondents or 47 percent were chemistry majors and 16 teacher-respondents or 53 percent were non-chemistry majors.

4.2 In the field of specialization of teacher-respondents in the Division of Samar the data showed that the highest number -10 teachers or 33.33 percent were Physics -chemistry major, followed by 5 teachers or 16.67 percent were General Science major, 3 teachers or 10 percent for each major in Physics, Natural Science and Chemistry. The least number were composed of teachers major in Biology, Civil Technology, Technology and Home Economics and Chemical Engineering, with one teacher each or 3.33 percent.

4.3 As to the masteral units earned, teacher-respondents showed little professional growth in their field of specialization. Of the 30 teacher-respondents, 2 or 7 percent have no graduate units, 2 or 7 percent had earned 6-8 units, 2 with 9-11 units, 2 with 12-14 units, 9 with 18-20 units, 1 with 21-23 units, 3 with 24-26 units, 2 with 27-29 units, 3 with 33-35 units, 3 with 36-38 units, and only one with 42-44 units, but no one is a masters degree holder.

5. As to the length of service of chemistry teachers, it was revealed that the oldest respondent in the service had spent the past twenty-six years, as a teacher while the youngest is barely a year or two. Majority of the teacher respondents were new and inexperienced in the teaching profession.

6. As to the profile of seminars/trainings/workshops attended by secondary chemistry teachers in the Division of Samar, most of them had attended the trainings/seminars/workshops occasionally in the Division level and the area of concentration were on the instructional materials development and equipment utilization.

7. As noted all respondents have additional loads other than chemistry. Other teacher have loads in Biology, Physics, General Science, Math, PEHM, THE, Values and English.

2. The Misconception Level of Chemistry Teachers

Results of a 35-item diagnostic test administered to thirty teachers bears this out clearly.

1. The misconception level of chemistry teachers was 13.97, which is interpreted to be moderate understanding/moderate misconceptions.

2. The median score was 13 while the mean score was 13.97. This implies that thirteen or 43 percent were above the mean and seventeen or 57 percent were below the mean.

3. In terms of misconception level, three or 10 percent of the teacher-respondents obtained "adequate understanding/low misconceptions", sixteen or 53 percent got "moderate understanding/moderate misconceptions", and the remaining eleven or 37

percent got "inadequate understanding/high misconceptions".

4. In terms of groupings, Chemistry major got the mean score of 18.78 or 37.47 percent, which means "moderate understanding/moderate misconceptions", while the non-chemistry majors obtained a 9.81 mean score or 62.60 percent which means "inadequate understanding/high misconceptions".

3. **Findings to answer hypothesis no.1**

Based from the diagnostic test conducted to 30 teacher-respondents, chemistry major teachers performed better than non-chemistry major teachers.

1. As revealed by the diagnostic test, for chemistry major teachers the most answered item was item no. 4, while the least answered item was item no. 10. For the non-chemistry majors the most answered item was item no.4 and the least answered items were item nos. 2,5 10 and 34.

2. The respondents performed better in questions involving electronic configurations.

3. However, difficulty was exhibited on questions involving Lewis structures, VSEPR Theory, chemical

bonding, hybridization, lone-pairs, polarity of molecules, and molecular shapes.

4. As a whole, analysis showed that most of the respondents exhibited difficulty on the diagnostic test.

The identified misconceptions are summarized below:

Misconception 1: In writing Lewis structures, most of the teachers assumed that eight electrons except hydrogen atom should surround all atoms in the chemical formula.

Misconception 2: In predicting the geometry of a covalent molecule, most chemistry teachers disregard the effect of electron pairs of the central atom.

Misconception 3: Regardless of the three-dimensional positioning of peripheral atoms, most teachers always use lines as bonds in three-dimensional molecular drawings.

Misconception 4: Most chemistry teachers give the wrong name for a given geometry of a covalent molecule drawn in three dimensions.

Misconception 5: Most chemistry teachers consider only the effect of bonding electrons between atoms in predicting the shape of a covalent molecule.

Misconception 6: The hybridization pattern of atomic orbital among bonded atoms in a covalent molecule has no effect on the geometry of a given molecule.

Misconception 7: Most of the teachers consider polarity of individual bond polarity in predicting the polarity of the whole molecule regardless of its geometry.

4. To test if there was a significant difference between the level of misconceptions of chemistry major and non-chemistry major. The data after computing the one tailed t test reveal that the computed t value of 5.69 is greater than the critical value of 1.701 with α set at 0.05. Thus the null, which states, "There is no significant difference between the level of misconceptions of chemistry major teachers and non chemistry major is "rejected."

5. Relationship of Test Performance by Teacher-Related Variables

1. The computed correlation coefficient for the six variates; age, sex, civil status, undergraduate degree, teaching experience and teaching loads, were 0.124, 0.144, 0.022, -0.092, 0.302 and -0.088 respectively. Meanwhile, the corresponding Fisher's t values of 0.661 for age, 0.770 for sex, 0.116 for civil status, 0.489 for undergraduate degree, 1.671 for teaching experience and -0.470 for teaching loads. The t-values proved to be lesser than the critical t-value of 1.701, which led to the acceptance of the hypothesis that says "there are no significant relationship that exist between the level of misconceptions of the secondary chemistry teachers and the teachers' profile in terms of age, sex, civil status, undergraduate degree, teaching experience and teaching loads.

2. Meanwhile, the computed correlation coefficient for the three variates; undergraduate major, chemistry units earned, in-service trainings/seminars/workshops attended were 0.735, 0.744 and 0.654 respectively, with corresponding Fisher's t-value of 5.736, 5.894

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APPENDICES

APPENDIX A

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

14 April 2000

The Dean of Graduate Studies
Samar State Polytechnic College
Catbalogan, Samar

Sir:

In my desire to start writing my thesis proposal, I have the honor to submit for your approval one of the following research problems, preferably problem no.1:

1. SECONDARY CHEMISTRY TEACHERS MISCONCEPTIONS ON THE TOPIC MOLECULAR GEOMETRY

2. COMPETENCIES OF TEACHERS ON SELECTED TOPIC IN CHEMISTRY

3. LEARNING DIFFICULTIES IN CHEMISTRY ENCOUNTERED BY HIGH SCHOOL STUDENTS IN CALBIGA NATIONAL HIGH SCHOOL

I hope for your early and favorable action on this request.

Very truly yours,

(Sgd.) ERMELINDA C. FLORETES
Researcher

APPROVED:

(Sgd.) EUSEBIO T. PACOLOR, Ph.D.
Dean, Graduate and Post Graduate Studies

APPENDIX B

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar
COLLEGE OF GRADUATE STUDIES

APPLICATION FOR ASSIGNMENT OF ADVISER

Name: FLORETES, ERMELINDA CABUELLO
(Surname) (First Name) (Middle Name)

CANDIDATE FOR DEGREE: M.A.T. - CHEMISTRY

AREA OF SPECIALIZATION: CHEMISTRY

TITLE OF PROPOSED THESIS/DISSERTATION:

SECONDARY CHEMISTRY TEACHERS' MISCONCEPTIONS ON THE TOPIC GEOMETRY OF MOLECULES

(Sgd.) ERMELINDA C. FLORETES
Applicant

Engr. ESTEBAN A. MALINDOG, Jr.
Name of Designated Adviser

APPROVED:

(Sgd.) EUSEBIO T. PACOLOR, Ph.D.
Dean, Graduate Studies

CONFORME:

(Sgd.) Engr. ESTEBAN A. MALINDOG, Jr.
Adviser

In 3 copies: 1st copy - for the Dean
2nd copy - for the adviser
3rd copy - for the Applicant

APPENDIX C

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

12 August 2000

The Schools Division Superintendent
DECS,Division of Samar
Catbalogan, Samar

Madam:

In order to improve and validate my diagnostic test in Chemistry, an instrument intended for my study entitled, "SECONDARY CHEMISTRY TEACHERS' MISCONCEPTIONS ON THE TOPIC GEOMETRY OF MOLECULES", I have the honor to request for your favorable endorsement to respondent schools to conduct dry run for the evaluation of my questionnaires.

Hoping for your favorable consideration on this request.

Very truly yours,

(Sgd.) ERMELINDA C. FLORETES
Researcher

APPROVED:

(Sgd.) JESUSITA L. ARTECHE, Ed.D.
Schools Division Superintendent

APPENDIX D

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

19 August 2000

The Schools Division Superintendent
Calbayog City Division
Calbayog, City

Madam:

I have the honor to request permission to conduct a try-out of my diagnostic test in Chemistry to your third year Chemistry Teachers. The objective of the try-out is to determine the validity and reliability of the said instrument.

I will remain ever grateful for your kind accommodation on this request.

Very truly yours,

(Sgd.) ERMELINDA C. FLORETES
Researcher

APPENDIX E

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, samar

26 August 2000

The Schools Division Superintendent
DECS, Division of Samar
Catbalogan, Samar

Madam:

I have the honor to request permission from your good office to administer my research instrument to Secondary Chemistry Teachers in all schools in the Division of Samar in connection with my thesis study entitled, " SECONDARY CHEMISTRY TEACHERS' MISCONCEPTIONS ON THE TOPIC GEOMETRY OF MOLECULES."

The findings and viable information that will be generated of this study may help improve and attain the quality of education in our Division.

Thank you for your whole-hearted support and approval on this request.

Very truly yours,

(Sgd.) ERMELINDA C. FLORETES
Researcher

APPROVED:

(Sgd.) JESUSITA L. ARTECHE, Ed. D.
Schools Division Superintendent

APPENDIX F

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

03 September 2000

The Principal, Head teacher, TIC
Public National High School
Division of Samar

Sir/Ma'am:

I have the honor to request permission to administer a diagnostic test among your teachers who are teaching Chemistry subject, in connection with the Master's Thesis I am writing on now entitled, "SECONDARY CHEMISTRY TEACHERS' MISCONCEPTIONS ON THE TOPIC GEOMETRY OF MOLECULES."

I am expressing my gratitude and appreciation for your kind assistance and approval to this permit, the result of which may help raise the quality education in our Division.

God Bless and more power.

Very truly yours,

(Sgd.) ERMELINDA C. FLORETES
Researcher

APPENDIX G

TABLE OF SPECIFICATIONS

TOPIC/OBJECTIVES	COGNITIVE SKILLS				
	K	C	HOTS	Total	%
	No. of Test Items				
1.0 Writing Lewis Structures					
1.1 Determine number of valence electrons.	1		1	2	5.6
1.2 Arrange atoms in correct order.		1	1	2	5.6
1.3 Apply "octet rule" in distributing valence electrons.			4	4	11.2
2.0 Identifying Plausible Lewis Structures					
2.1 Identify the plausible Lewis structure given an incorrect electron distribution.		1		1	2.9
2.2 Identify the plausible Lewis structure given several resonance forms.			1	1	2.9
2.3 Identify the plausible Lewis structure given different molecular formulas.		1	1	2	5.6
2.4 Identify the plausible Lewis structure based on formal charge calculations.			1	1	2.9
3.0 Visualizing Molecular Shape					
3.1 Infer molecular shape given molecular formula.			4	4	11.4
3.2 Infer molecular shape from its Lewis structure.			3	3	8.6
3.3 Identify molecular shape given spatial connections.	2	2	3	7	20
3.4 Apply hybridization concepts in predicting molecular shape.			2	2	5.6

Appendix G (Continuation)

4.0 Application of Molecular Geometry					
4.1 Predict polarity of molecule given molecular formula.		1	3	4	11.4
4.2 Predict polarity of molecule given Lewis structure.			1	1	5.6
4.3 Predict polarity of molecule given spatial bonding pattern.			1	1	5.6
TOTAL	3	6	26	35	
%	8.6	17.1	74.3		100

Legend:

K = Knowledge
C = Comprehension
HOTS = Higher Order Thinking Skills

APPENDIX H
TEST ITEM SPECIFICATIONS

TOPIC/OBJECTIVES	COGNITIVE SKILLS		
	K	C	HOTS
1.0 Writing Lewis Structures			
1.1 Determine number of valence electrons.	3		6
1.2 Arrange atoms in correct order.		1	31
1.3 Apply "octet rule" in distributing valence electrons.			2,7,9,35
2.0 Identifying Plausible Lewis Structure			
2.1 Identify the plausible Lewis structure given an incorrect electron distribution.		4	
2.2 Identify the plausible Lewis structure given several resonance forms.			34
2.3 Identify the plausible Lewis structure given different molecular formulas.		33	5
2.4 Identify the plausible Lewis structure based on formal charge calculations.			32
3.0 Visualizing Molecular Shape			
3.1 Infer molecular shape given molecular formula.			10,15, 21,23
3.2 Infer molecular shape from its Lewis structure.			11,14, 30
3.3 Identify molecular shape given spatial connections.	16,18	19,20	13,17 22
3.4 Apply hybridization concepts in predicting molecular shape.			8,12
4.0 Application of Molecular Geometry			
4.1 Predict polarity of molecle given molecular formula.		28	24,27 29
4.2 Predict polarity of molecule given Lewis structure.			25
4.3 Predict polarity of molecule given spatial bonding pattern.			26

Legend:

K = Knowledge
C = Comprehension
HOTS = Higher Order Thinking Skills

APPENDIX I
Item Analysis
Table 13. Test Item Analysis

Item No.	Number of Teachers who answered correctly	Number of Teachers who attempt-ted to answer	Level of Diffi-Culty	Inter-Preta-tion	No. of Teachers who correctly answered		Descri mina-ting power	Inter-pret-ation	Decision/ Action
					Upper 27%	Lower 27%			
1	14	19	74%	MD	5	3	0.4	D	Accepted
2	3	19	8%	D	2	1	0.2	MD	May need revision
3	14	19	74%	MD	4	1	0.6	D	Accepted
4	12	19	63%	MD	4	1	0.6	D	Accepted
5	5	19	14%	MD	4	1	0.6	D	Accepted
6	15	19	79%	MD	5	3	0.6	D	Accepted
7	15	19	79%	MD	5	3	0.4	D	Accepted
8	4	19	11%	D	3	1	0.4	D	Accepted
9	12	19	63%	MD	5	2	0.4	D	Accepted
10	13	19	68%	MD	4	2	0.6	D	Accepted
11	15	19	79%	MD	4	2	0.4	D	Accepted
12	12	19	63%	MD	4	2	0.4	D	Accepted
13	15	19	79%	MD	5	4	0.4	MD	May need revision
14	13	19	68%	MD	5	3	0.2	D	Accepted
15	15	19	79%	MD	5	3	0.4	D	Accepted
16	7	19	20%	D	4	3	0.4	MD	May need revision
17	12	19	63%	MD	4	2	0.2	D	Accepted
18	12	19	63%	MD	4	3	0.4	D	Accepted
19	15	19	79%	MD	5	4	0.2	MD	May need revision
20	4	19	11%	D	3	1	0.2	D	Accepted
21	11	19	58%	MD	3	1	0.4	D	Accepted
22	12	19	63%	MD	5	3	0.4	D	Accepted
23	15	19	79%	MD	5	3	0.4	D	Accepted
24	15	19	79%	MD	5	4	0.2	MD	May need revision
25	15	19	79%	MD	5	3	0.4	D	Accepted
26	13	19	68%	MD	5	3	0.4	D	Accepted
27	15	19	79%	MD	5	3	0.4	D	Accepted
28	6	19	17%	D	4	2	0.4	D	Accepted
29	15	19	79%	MD	5	3	0.4	D	Accepted
30	14	19	74%	MD	5	3	0.4	D	Accepted
31	13	19	68%	MD	5	3	0.4	D	Accepted
32	4	19	11%	D	3	1	0.4	D	Accepted
33	14	19	74%	MD	5	3	0.4	D	Accepted
34	15	19	79%	MD	5	3	0.4	D	Accepted
35	13	19	68%	MD	5	3	0.4	D	Accepted

APPENDIX J

RESEARCH INSTRUMENT

Dear FELLOW CHEMISTRY TEACHERS:

I would like to solicit your much needed cooperation in conducting a study entitled "SECONDARY CHEMISTRY TEACHERS' MISCONCEPTIONS ON THE TOPIC MOLECULAR GEOMETRY", as part of the requirement for my graduate studies at Samar State Polytechnic College, Catbalogan, Samar.

As respondent of this study, a questionnaire and a test will be administered to find out your teaching difficulties on molecular geometry. May I, therefore, request you to please answer the attached questionnaire and test honestly. The results of this study will be confidential and will not, in any way, affect your efficiency as a chemistry teacher. As a matter of fact, you need not write your name on the questionnaire.

Your whole-hearted support and cooperation regarding this matter will be highly appreciated for the good of chemistry education in our district.

Very truly yours,

The Researcher

A. PERSONAL INFORMATION

1. Name (optional): ______________________________
2. Age: ____________ 3. Sex: ________
4. Civil Status: _____________
5. Civil Service Status: __Permanent __Provisional __Substitute
6. Number of years teaching chemistry: ________
7. Undergraduate degree finished:
   ____ Science major (pls. specify) __________
   ____ Non-science major (pls. specify) __________
8. Graduate Degree:

a. Completed: _____ MS (pls specify major) ________________________
_____ MA/MAEd/MAT (pls. specify major) ____________

b. Earning units: ____MS (pls. specify major)______________________
____MA/MAEd/MAT (pls. specify major) ___________

B. DIAGNOSTIC TEST

General Directions:

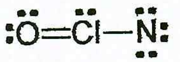
1. The whole test is composed of 32 items. Each item is composed of two parts. The first is a multiple-choice with lettered choices. Select the letter of your choice that corresponds to the best answer. Indicate the letter of your choice by encircling the letter. The second part is the explanation. To the letter of your choice on the first part, you are required to explain the why you have chosen it.

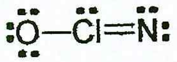
2. Use can accompany your textual explanations with illustrations, diagrams, or even drawings.

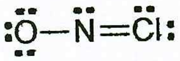
3. You are provided with extra sheets of paper to write on your explanations. Please, arrange the numbering of your explanations from consecutively from 1 to 32.

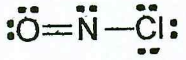
2. You are given one (1) week to accomplish the test and the same will be retrieve from you after one week.

1. A molecule, called nitrosyl chloride, is composed of one (1) atom each of nitrogen, oxygen, and chlorine. Which is the most plausible Lewis formula for this molecule?

a. 

b. 

c. 

d. 

Explain your choice: ______________________________

2. Which of the following chemical species obeys the 'octet rule'?

a. SO_4^{-2} b. BCl_3 c. PCl_5 d. SiF_6

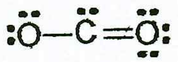
Explain your choice: ______________________________

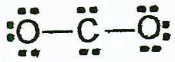
3. An atom of an element has the following electron configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$. How many valence electrons are there in the atom?

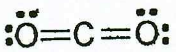
a. 2 b. 3 c. 5 d. 6

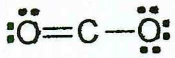
Explain your choice: ______________________________

4. Carbon dioxide is a covalent molecule. Choose the correct Lewis structure from the following.

a. 

b. 

c. 

d. 

Explain your choice: ______________________________

5. Which chemical specie does NOT follow the octet rule?

a. SO_4^{-2} b. $CHCl_3$ c. CO_3^{-2} d. H_2O

Explain your choice: ______________________________

6. Nitrous oxide has the formula NO. Which statement describes its Lewis structure?

a. All valence electrons are paired.
b. There is one unpaired electron in the nitrogen atom.
c. There is one unpaired electron in oxygen atom.
d. Both nitrogen and oxygen atoms contain one unpaired electrons.

Explain your choice: ______________________________

7. Which molecule contains a triple bond?

a. N_2 b. O_2 c. F_2 d. H_2

Explain your choice: ______________________________

8. What type of hybridization is involved in nitrogen atom in NH_4^+?

a. sp^4 b. sp^3 c. sp^2 d. sp

Explain your choice: ______________________________

9. Which molecule contains a double bond?

a. Br_2 b. Cl_2 c. C_6H_6 d. I_2

Explain your choice: ______________________________

10. Which of the following molecule has a linear geometry?

a. H_2S b. SO_2 c. O_3 d. $CaCl_2$

Explain your answer: ______________________________

11. Of the following molecules, which molecule is NOT linear?

a. :O≡C: b. H—C≡N:

c. H—Ö—H (with two lone pairs on O) d. H—Cl: (with three lone pairs on Cl)

Explain your choice: ______________________________

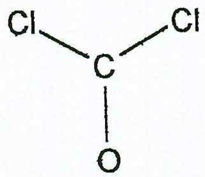
12. What kind of hybridization would you expect in oxygen atom in water?

a. sp^4 b. sp^3 c. sp^2 d. sp

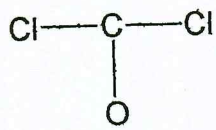
Explain your choice: ______________________________

13. A molecule has the molecular formula $COCl_2$. Which is the most plausible shape of this molecule?

a.



b.



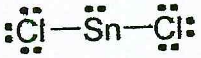
c.

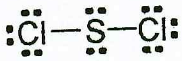
d. None of the above

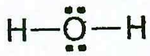
Explain your choice: ______________________________

14. Which of the following molecule has a linear geometry?

a. 

b. 

c. 

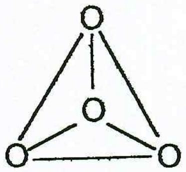
d. 

Explain your choice: ____

15. A molecule follows the general formula XY_4. The central atom (X) has no lone pair and Y are all of the same kind of atoms. What is the shape of this molecule?

a. triangular planar
b. square pyramid
b. square planar
d. tetrahedral

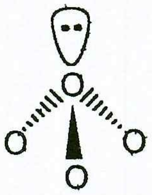
16. What is the name of the following molecular geometry?

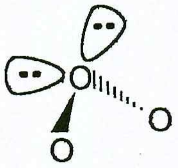


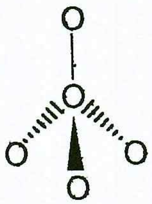
a. triangular planar
c. tetrahedral
b. triangular pyramidal
d. inverted V-shape

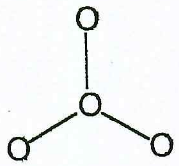
Explain your choice: ____

17. Which of the following representations has a pyramidal shape?

a. 

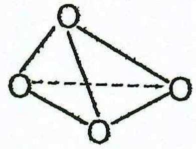
b. 

c. 

d. 

Explain your choice: ____

18. What is the name of the shape of the following molecular shape?

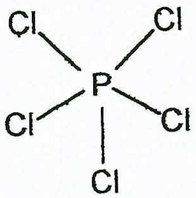


a. triangular
c. tetrahedral

b. triangular pyramidal
c. square planar

Explain your choice: ______________________________

19. Predict the shape of the following molecule of PCl_5.

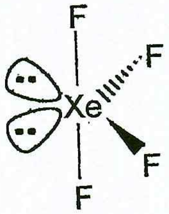


a. square planar
b. T-shape

b. square pyramidal
c. triangular pyramidal

Explain your choice: ______________________________

20. Predict the shape of the molecule shown below for xenon tetrafluoride, XeF_4.



a. square planar
c. T-shaped

b. square planar
d. tetrahedral

Explain your choice: ______________________________

21. A molecule follows the general formula AX_4. The central atom (X) has no lone pair and A are of different kind of atoms. What is the probable shape of this molecule?

a. triangular planar

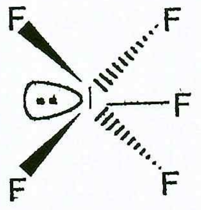
b. square planar

c. square pyramid

d. tetrahedral

Explain your choice: ______________________________

22. What is the molecular shape of the following molecule, IF_5?



a. triangular planar

b. octahedral

c. square pyramidal

d. trigonal pyramidal

Explain your choice: ______________________________

23. A molecule follows the general formula AX_4. The central atom (X) has two lone-pairs and A are all of the same kind of atoms. What is the plausible shape of this molecule?

a. square pyramid

b. square pyramidal

c. square planar

d. octahedral

24. Which of the following molecule is not polar?

a. $CHCl_3$ b. CH_3Cl c. CH_2Cl_2 d. BCl_3

Explain your choice: ______________________________

25. Given the Lewis structure for the molecules below, which is NOT polar?

a. :Ö–Ö=Ö:

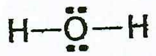
b. H–Se–H

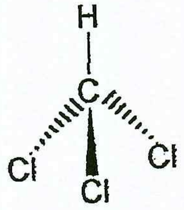
c. :Ö=C=Ö:

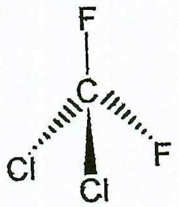
d. H–O–H

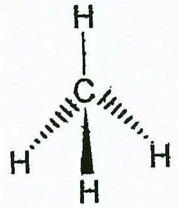
Explain your choice: ______________________________

26. Which of the following molecular shape is NOT polar?

a. 

b. 

c. 

d. 

Explain your choice: ______________________________

27. Which of the following molecules is polar?

a. $BeCl_2$ b. SH_2 c. CCl_2Br_2 d. CCl_4

Explain your answer: ______________________________

28. Given below are the steps to be followed in identifying whether a chemical species is polar or nonpolar.

1. Draw the Lewis structure.
2. Determine the dipole moment.
3. Determine the bond polarity.
4. Determine valence electrons.

Which is the correct of steps to be followed?

a. 1, 2, 3, 4 b. 2, 4, 1, 3 c. 3, 2, 4, 1 d. 4, 1, 3, 2

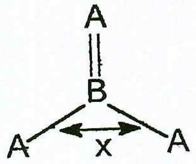
Explain your choice: ______________________________

29. Which molecule contains the most polar bond?

a. Cl_2 b. CH_3Cl c. NaF d. ClF

Explain your choice: ______________________________

30. The Lewis structure of a hypothetical molecule, BA_3, is shown below:



What will be the bond angle (marked x) between the two atoms?

a. equal to 120°
b. less than 120°
c. more than 120°
d. greater than 90°

Explain your choice: ______________________________

31. How many geometrical isomers are there for $Pt(NH_3)_2Cl_2$?

a. 0
b. 1
c. 2
d. 3

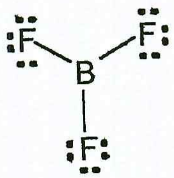
Explain your choice: ______________________________

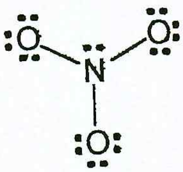
32. What is the formal charge of sulfur in the structure given below?

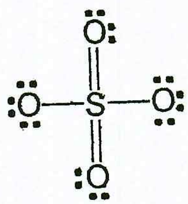
a. 0
b. 2
c. 4
d. 6

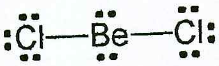
Explain your answer: ______________________________

33. Which Lewis formula is acceptable?

a. 

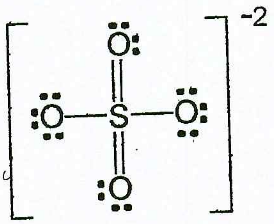
b. 

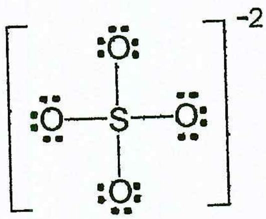
c. 

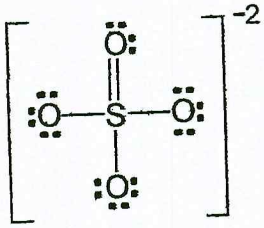
d. 

Explain your choice: ______________________________

34. Which Lewis structure is correct?

a. 

b. 

c. 

d. All of the above

Explain your choice: ______________________________

35. To be able to draw an acceptable Lewis structure, the following steps (NOT in proper order) should be followed.

1. Determine the total valence electrons.
2. Identify the central atom.
3. Know the molecular formula.
4. Distribute the electrons.

a. 1, 2, 3, 4 b. 2, 3, 1, 4 c. 3, 1, 2, 4 d. 4, 2, 3, 1

Explain your choice: ______________________________

APPENDIX K

Computation of Correlation Coefficient Between Test Performance and Teacher Related Variables

Respondents	Total	Age	X^2	Y^2	XY
1	25	26	625	676	650
2	25	23	625	529	575
3	24	30	576	900	720
4	22	26	484	676	572
5	22	46	484	2116	1012
6	21	23	441	529	483
7	19	25	361	625	475
8	18	52	324	2704	936
9	18	42	324	1764	756
10	18	29	324	841	522
11	16	22	256	484	352
12	15	28	225	784	420
13	15	28	225	784	420
14	14	24	196	576	336
15	13	38	169	1444	494
16	13	25	169	625	325
17	12	24	144	576	288
18	11	25	121	625	275
19	11	32	121	1024	352
20	10	22	100	484	220
21	10	30	100	900	300
22	10	24	100	576	240
23	10	51	100	2601	510
24	10	28	100	784	280
25	9	29	81	841	261
26	9	53	81	2809	477
27	9	26	81	676	234
28	5	29	25	841	145
29	4	23	16	529	92
30	1	25	1	625	25
	ΣX=419	**ΣY = 908**	**ΣX^2 = 6979**	**ΣY^2 = 29948**	**XY = 12747**

$$r = \frac{30\ (1274) - (419)\ (908)}{\sqrt{[30\ (6979) - (419)^2]\ [30\ (29948) - (908)^2]}}$$

$$r = \frac{1958}{15812.66}$$

$$r = 0.124$$

Appendix K (Continuation)

Respondents	Total Score (X)	Male (Y)	X^2	Y^2	XY
1	25	30	625	900	750
2	21	25	441	625	525
3	19	28	361	784	532
4	16	24	256	576	384
5	15	23	225	529	345
	ΣX=96	**ΣY=130**	**ΣX^2=9216**	**ΣY^2=3414**	**XY = 2536**

Respondents	Total Score (X)	Female (Y)	X^2	Y^2	XY
1	25	26	625	676	650
2	24	23	576	529	552
3	22	26	484	676	572
4	22	23	484	529	506
5	18	52	324	2704	936
6	18	42	324	1764	756
7	18	29	324	841	522
8	15	22	225	484	330
9	12	28	144	784	336
10	11	38	121	1444	418
11	11	25	121	625	275
12	10	24	100	576	240
13	10	25	100	625	250
14	10	32	100	1024	320
15	10	22	100	484	220
16	9	30	81	900	270
17	9	24	81	576	216
18	9	51	81	2601	459
19	4	28	16	784	112
20	1	29	1	841	29
21	14	53	196	2809	742
22	13	26	169	676	338
23	13	29	169	841	377
24	10	25	100	625	250
25	5	46	25	2116	230
	ΣX=323	**ΣY=778**	**ΣX^2=5071**	**ΣY^2=26534**	**XY=9906**

$$\Sigma^2 = \frac{5\ (19.2) + 25\ (12.92)^2 - 30\ (13.97)^2}{6979 - 30\ (13.97)^2}$$

$$\Sigma^2 = \frac{161.53}{1124.17}$$

$$\Sigma^2 = 0.144$$

Appendix K (Continuation)

Respondents	Total Score (X)	Civil Status Single (Y)	X^2	Y^2	XY
1	25	23	625	529	575
2	21	23	441	529	483
3	19	25	361	625	475
4	16	22	256	484	352
5	15	28	225	784	420
6	14	24	196	576	336
7	13	25	169	625	325
8	13	22	169	484	286
9	10	24	100	576	240
10	5	23	25	529	115
	ΣX=151	ΣY=239	ΣX^2=2567	ΣY^2=5741	XY=3607

Respondents	Total Score (X)	Civil Status Married (Y)	X^2	Y^2	XY
1	25	26	625	676	650
2	24	30	576	900	720
3	22	26	484	676	572
4	22	46	484	2116	1012
5	18	52	324	2704	936
6	18	42	324	1764	756
7	18	29	324	841	522
8	15	28	225	784	420
9	12	38	144	1444	456
10	11	24	121	576	264
11	11	25	121	625	275
12	10	32	100	1024	320
13	10	30	100	900	300
14	10	51	100	2601	510
15	10	28	100	784	280
16	9	29	81	841	261
17	9	53	81	2809	477
18	9	26	81	676	234
19	4	29	16	841	116
20	1	25	1	625	25
	ΣX=268	ΣY=669	ΣX^2=4412	ΣY^2=24207	XY=9106

$$\Sigma^2 = \frac{10\ (15.1) + 20\ (13.4)^2 - 30\ (13.96)^2}{6979 - 30\ (13.96)^2}$$

$$\Sigma^2 = \frac{24.85}{1132.55}$$

$$\Sigma^2 = 0.022$$

Appendix K (Continuation)

Respondents	Total Score (X)	Undergraduate Degree (Y)	X^2	Y^2	XY
1	25	5	625	25	125
2	25	5	625	25	125
3	24	3	576	9	72
4	22	5	484	25	110
5	22	5	484	25	110
6	21	5	441	25	105
7	19	5	361	25	95
8	18	5	324	25	90
9	18	5	324	25	90
10	18	5	324	25	90
11	16	5	256	25	80
12	15	5	225	25	75
13	15	5	225	25	75
14	14	5	196	25	70
15	13	5	169	25	65
16	13	5	169	25	65
17	12	3	144	9	36
18	11	5	121	25	55
19	11	3	121	9	33
20	10	5	100	25	50
21	10	5	100	25	50
22	10	5	100	25	50
23	10	5	100	25	50
24	10	5	100	25	50
25	9	5	81	25	45
26	9	5	81	25	45
27	9	5	81	25	45
28	5	5	25	25	25
29	4	5	16	25	20
30	1	5	1	25	5
	$\Sigma X=419$	$\Sigma Y=144$	$\Sigma X^2=6979$	$\Sigma Y^2=702$	XY=2001

$$r = \frac{30\ (2001) - (419)\ (144)}{\sqrt{[30\ (6979) - (419)^2]\ [30\ (702) - (144)^2]}}$$

$$r = \frac{-306}{3309.70}$$

$$r = -0.092$$

Appendix K (Continuation)

Respondents	Total Score (X)	Undergraduate Major (Y)	X^2	Y^2	XY
1	25	5	625	25	125
2	25	5	625	25	125
3	24	5	576	25	120
4	22	5	484	25	110
5	22	5	484	25	110
6	21	5	441	25	105
7	19	3	361	9	57
8	18	5	324	25	90
9	18	5	324	25	90
10	18	5	324	25	90
11	16	5	256	25	80
12	15	5	225	25	75
13	15	3	225	9	45
14	14	5	196	25	70
15	13	3	169	9	39
16	13	5	169	25	65
17	12	5	144	25	60
18	11	3	121	9	33
19	11	3	121	9	33
20	10	3	100	9	30
21	10	3	100	9	30
22	10	3	100	9	30
23	10	3	100	9	30
24	10	3	100	9	30
25	9	3	81	9	27
26	9	3	81	9	27
27	9	3	81	9	27
28	5	3	25	9	15
29	4	3	16	9	12
30	1	3	1	9	3
	$\Sigma X=419$	$\Sigma Y=118$	$\Sigma X^2=6979$	$\Sigma Y^2=494$	$XY=1783$

$$r = \frac{30\ (1783)\ -\ (419)\ (118)}{\sqrt{[30\ (6979)\ -\ (419)^2]\ [30\ (494)\ -\ (118)^2]}}$$

$$r = \frac{4028}{5503.90}$$

$$r = 0.735$$

Appendix K (Continuation)

Respondents	Total Score (X)	Units Earned (Y)	X^2	Y^2	XY
1	25	42	625	1764	1050
2	25	0	625	0	0
3	24	36	576	1296	864
4	22	36	484	1296	792
5	22	36	484	1296	792
6	21	33	441	1089	693
7	19	33	361	1089	627
8	18	33	324	1089	594
9	18	27	324	729	486
10	18	27	324	729	486
11	16	24	256	576	384
12	15	24	225	576	360
13	15	24	225	576	360
14	14	21	196	441	294
15	13	18	169	324	234
16	13	18	169	324	234
17	12	18	144	324	216
18	11	18	121	324	198
19	11	18	121	324	198
20	10	18	100	324	180
21	10	18	100	324	180
22	10	18	100	324	180
23	10	18	100	324	180
24	10	12	100	144	120
25	9	12	81	144	108
26	9	9	81	81	81
27	9	9	81	81	81
28	5	6	25	36	30
29	4	6	16	36	24
30	1	0	1	0	0
	$\Sigma X=419$	$\Sigma Y=612$	$\Sigma X^2=6979$	$\Sigma Y^2=15984$	$XY=10026$

$$r = \frac{30\ (10026) - (419)\ (612)}{\sqrt{[30\ (6979) - (419)^2]\ [30\ (15984) - (612)^2]}}$$

$$r = \frac{44352}{59571.96}$$

$$r = 0.744$$

Appendix K (Continuation)

Respondents	Total Score (X)	No. of Years in Teaching (Y)	X^2	Y^2	XY
1	25	5	625	25	125
2	25	2	625	4	50
3	24	7	576	49	168
4	22	5	484	25	110
5	22	14	484	196	308
6	21	1	441	1	21
7	19	2	361	4	38
8	18	18	324	324	324
9	18	1	324	1	18
10	18	5	324	25	90
11	16	3	256	9	48
12	15	1	225	1	15
13	15	3	225	9	45
14	14	4	196	16	56
15	13	1	169	1	13
16	13	15	169	225	195
17	12	2	144	4	24
18	11	1	121	1	11
19	11	1	121	1	11
20	10	2	100	4	20
21	10	1	100	1	10
22	10	1	100	1	10
23	10	1	100	1	10
24	10	12	100	144	120
25	9	1	81	1	9
26	9	1	81	1	9
27	9	25	81	625	225
28	5	5	25	25	25
29	4	1	16	1	4
30	1	1	1	1	1
	ΣX=419	**ΣY=142**	**ΣX^2=6979**	**ΣY^2=1726**	**XY=2113**

$$r = \frac{30\,(2313) - (419)\,(142)}{\sqrt{[30\,(6979) - (419)^2]\,[30\,(1726) - (142)^2]}}$$

$$r = \frac{9892}{32694.12}$$

$$r = 0.302$$

Appendix K (Continuation)

Respondents	Total Score (X)	In-Service Training (Y)	X^2	Y^2	XY
1	25	1	625	1	25
2	25	1	625	1	25
3	24	1	576	1	24
4		2	484	4	44
5	22	1	484	1	22
6	21	1	441	1	21
7	19	2	361	4	38
8	18	1	324	1	18
9	18	1	324	1	18
10	18	0	324	0	0
11	16	1	256	1	16
12	15	0	225	0	0
13	15	0	225	0	0
14	14	0	196	0	0
15	13	0	169	0	0
16	13	0	169	0	0
17	12	1	144	1	12
18	11	1	121	1	11
19	11	0	121	0	0
20	10	0	100	0	0
21	10	0	100	0	0
22	10	0	100	0	0
23	10	1	100	1	10
24	10	0	100	0	0
25	9	0	81	0	0
26	9	0	81	0	0
27	9	0	81	0	0
28	5	0	25	0	0
29	4	0	16	0	0
30	1	0	1	0	0
	$\Sigma X=419$	**$\Sigma Y=15$**	**$\Sigma X^2=6979$**	**$\Sigma Y^2=19$**	**XY=284**

$$r = \frac{30\ (284)\ -\ (419)\ (15)}{\sqrt{[30\ (6979)\ -\ (419)^2]\ [30\ (19)\ -\ (15)^2]}}$$

$$r = \frac{2235}{32694.12}$$

$$r = 0.654$$

Appendix K (Continuation)

Respondents	Total Score (X)	No. of Loads (Y)	X^2	Y^2	XY
1	25	1	625	1	25
2	25	1	625	1	25
3	24	2	576	4	48
4	22	3	484	9	66
5	22	2	484	4	44
6	21	3	441	9	63
7	19	4	361	16	76
8	18	3	324	9	54
9	18	2	324	4	36
10	18	2	324	4	36
11	16	2	256	4	32
12	15	3	225	9	45
13	15	3	225	9	45
14	14	2	196	4	28
15	13	1	169	1	13
16	13	2	169	4	26
17	12	2	144	4	24
18	11	2	121	4	22
19	11	3	121	9	33
20	10	2	100	4	20
21	10	2	100	4	20
22	10	2	100	4	20
23	10	2	100	4	20
24	10	2	100	4	20
25	9	2	81	4	18
26	9	2	81	4	18
27	9	3	81	9	27
28	5	2	25	4	10
29	4	2	16	4	8
30	1	3	1	9	3
	$\Sigma X=419$	$\Sigma Y=67$	$\Sigma X^2=6979$	$\Sigma Y^2=163$	$XY=925$

$$r = \frac{30\ (925) - (419)\ (67)}{\sqrt{[30\ (6979) - (419)^2]\ [30\ (163) - (67)^2]}}$$

$$r = \frac{-323}{3682.04}$$

$$r = -0.088$$

APPENDIX L

Computations of the t-test for the Significance of the Coefficient Correlation

Computation: t-ratio of Sex

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0.124\sqrt{30-2}}{\sqrt{1-(0.124)^2}} = \frac{0.656}{0.992} = 0.661$$

Computation: t-ratio of age

$$t = \frac{0.144\sqrt{30-2}}{\sqrt{1-(0.144)^2}} = \frac{0.762}{0.989} = 0.770$$

Computation: t-ratio of Civil Status

$$t = \frac{0.022\sqrt{30-2}}{\sqrt{1-(0.022)^2}} = \frac{0.116}{0.999} = 0.116$$

Computation: t-ratio of Undergraduate Degree

$$t = \frac{-0.092\sqrt{30-2}}{\sqrt{1-(-0.092)^2}} = \frac{0.487}{0.996} = 0.489$$

Computation: t-ratio of Undergraduate Major

$$t = \frac{0.735\sqrt{30-2}}{\sqrt{1-(0.735)^2}} = \frac{3.889}{0.678} = 5.736$$

Computation: t-ratio of Chemistry Units Earned

$$t = \frac{0.744\sqrt{30-2}}{\sqrt{1-(0.744)^2}} = \frac{3.937}{0.668} = 5.894$$

Computation: t-ratio of Teaching Experience

$$t = \frac{0.302\sqrt{30-2}}{\sqrt{1-(0.302)^2}} = \frac{1.598}{0.953} = 1.677$$

Computation: t-ratio of In-Service Training/Seminars/Workshops

$$t = \frac{0.654\sqrt{30-2}}{\sqrt{1-(0.654)^2}} = \frac{3.461}{0.756} = 4.525$$

Computation: t-ratio of Teaching Loads

$$t = \frac{-0.088\sqrt{30-2}}{\sqrt{1-(-0.088)^2}} = \frac{-0.466}{0.992} = -0.470$$

APPENDIX M

Respondents' Profile (N=30)

Variable/Category	Frequency	Percent	Cumulative Percent
A. Demographic and Personal			
Sex			
Male	5	83.0	83.0
Female	25	17.0	100.0
Age			
21-23	4	13.3	13.3
24-26	8	26.7	40.0
27-29	7	23.3	63.3
30-32	4	13.3	76.6
33-35	1	3.3	79.9
36-38	1	3.3	83.2
39-41	-	-	-
42-44	1	3.3	86.5
45-47	1	3.3	89.8
48-50	-	-	-
51-53	3	10.0	100.0
B. Educational			
Undergraduate Education			
BSE	27	90.0	90.0
Others	3	10.0	100.0
Undergraduate Major			
Chemistry	14	47.0	47.0
Others	16	53.0	100.0

Appendix M (Continuation)

Number of Graduate Unit			
0-0	2	6.7	6.7
3-5	0	-	-
6-8	2	6.7	13.4
9-11	2	6.7	20.1
12-14	2	6.7	26.8
15-17	0	-	-
18-20	9	30.0	56.8
21-23	1	3.3	60.1
24-26	3	10.0	70.1
27-29	2	6.7	76.8
30-32	0	-	-
33-35	3	10.0	86.8
36-38	3	10.0	96.8
39-41	0	-	-
42-44	1	3.3	100.0
Graduate Studies			
No Post Graduate Units	2	6.7	6.7
With Units to Chemistry related degrees	28	93.3	100.0

C. **Professional**

Years of Teaching Experience			
0-2	14	46.7	46.7
3-5	9	30.0	76.7
6-8	1	3.3	80.0
9-11	1	3.3	83.3
12-13	2	6.7	90.0
14-16	1	3.3	93.3
17-19	1	3.3	96.6
20-22	0	-	-
23-25	1	3.3	100.0

Appendix M (Continuation)

Teaching Loads/ Preparations			
Chemistry	30	44.1	44.1
General Science	3	4.4	48.5
Biology	4	5.9	54.4
Physics	7	10.3	64.7
Mathematics	7	10.3	75.0
THE	3	4.4	79.4
Values Education	4	5.9	85.3
English	5	7.4	92.7
Filipino	3	4.4	97.1
PEHM	2	2.9	100.0

CURRICULUM VITAE

CURRICULUM VITAE

NAME	:	ERMELINDA CABUELLO FLORETES
ADDRESS	:	Muñoz Catbalogan, Samar
PLACE OF BIRTH	:	Calbiga, Samar
DATE OF BIRTH	:	May 28, 1972
PRESENT POSITION	:	Secondary School Teacher II
STATION	:	Calbiga National High School
HUSBAND	:	Engr. Roi F. Floretes

EDUCATIONAL BACKGROUND

Elementary	Calbiga Central Elementary School Calbiga, Samar 1983-1984
Secondary	Calbiga Community High School Calbiga, Samar 1987-1988
College	Samar State Polytechnic College Catbalogan, Samar 1992-1993
Graduate Studies . . .	Samar State Polytechnic College Catbalogan, Samar
Curriculum Pursued. . .	Master of Arts in Teaching
Major	Chemistry

CIVIL SERVICE ELIGIBILITY

Professional Board Examination for Teachers (PBET), 1993

Presidential Decree No. 907

ACADEMIC AND SPECIAL AWARDS RECEIVED

Academic Awards

Elementary . . . . . . WITH HONORS
Calbiga Central Elementary School
Calbiga, Samar
1983-1984

Secondary . . . . . . WITH HONORS
Calbiga Community High School
Calbiga, Samar
1987-1988

College . . . . . . CUM LAUDE
Samar State Polytechnic College
1992-1993

Special Awards

Division Certificate of Recognition . . . Athletics Trainor
UNIT MEET
Basey National High School
October 25-28, 1994

Provincial Certificate of Recognition . . Meritorious Services
BSP and GSP Provincial Jamborette
Samar Nat'l Agricultural School
San Jorge, Samar
March 10-14, 1995

Provincial Certificate of Recognition . .	Outstanding and Meritorious Services 4^{th} BSP Provincial Jamborette and GSP Encampment Brgy. Panayuran Calbiga, Samar October 27-31, 1996
District Certificate of Recognition . .	Outstanding Performance as Demonstration Teacher in Science School In-service Program in Science and Technology November 7, 1997
Division Certificate of Recognition . .	Outstanding Performance as Coach 3^{rd} Place Winner 1999-2000 SCI-DAMATHS Divisional Level Competition Boy's Scout Building Catbalogan, Samar January 14, 2000
Division Certificate of Recognition . .	Outstanding Performance as Coach 2^{nd} Place Winner 2^{nd} SCI-DAMATH Division Level Competition Catbalogan, Samar October 25, 2000

PROFESSIONAL EXPERIENCE

Secondary School Teacher I . . .	Sacred Heart College Catbalogan, Samar 1993-1994
Secondary School Teacher I . . .	Marabut Nat'l High School Marabut, Samar 1994-1995
Secondary School Teacher I . . .	Calbiga Nat'l High School Calbiga, Samar 1995-1999

Secondary School Teacher II . . Calbiga Nat'l High School/ Eastern Visayas Regional Science High School 1999 to date

SCHOLARSHIP/STUDY GRANT

Academic Scholar, Samar State Polytechnic College, Catbalogan, Samar, 1989-1993.

DECS Integrated Short Term Scholarship Program in Biology University of the Philippines. Institute for Science and Mathematics Education Development, U.P. Diliman, Quezon City, April 26-May 21, 1999.

TRAININGS/SEMINARS/WORKSHOPS

National

First Science Camp for Teachers . . . Calaca Coal Fired Power Plant National Power Corporation Calaca, Batangas City May 19-22, 1998

DECS-ISP in Biology . . . . . UP-ISMED Diliman, Quezon City April 26-May 21, 1999

Regional

Regional Youth Science Technology Camp and PSYSC Convention . . . Alangalang Nat'l High School Alangalang, Leyte March 7-9, 1996

First Faculty Technology Transfer Program (Computer Literacy) . . . Regional Educational Learning Center DECSRO-8 Candahug, Palo, Leyte November 28-December 7, 1997

Regional Training for . . . Teachers of Regional Science High School	RegionalEducational Learnig Center, DECSRO-8 Candahug, Plao, Leyte December 7-9, 1999
Regional Seminar-Workshop. . on the Construction and Preparation of Low-Cost Instructional Materials	Leyte Park Hotel Tacloban, City December 26-29,2000

Division

Division Live-In Seminar. . on "Time on Task" of Secondary Teachers and Administrators	Pinabacdao Nat'l High School Pinabacdao, Samar July 9-10, 1994
Division In-service . . . . Training for Secondary Science Teachers	Basey National High School Basey, Samar August 27-28, 1994
Division Seminar-Workshop .. on LCIM's Production Utilization and Demonstration Teaching on Selected Topics in Genetics and Reproduction	Samar National High School Catbalogan, Samar January 26-27, 1996
Division In-service . . . . Program for Secondary School Administrators and Science Teachers	Simeon Ocdol Nat'l High School, San Antonio Basey, Samar October 12, 1996
Division Orientation . . . on SCI-DAMATHS	Boy's Scout Building Catbalogan, Samar November 5, 1999
Seminar Workshop on . . . . the Dynamics of Science Camping	Redaja Hall, DECS Division Office Catbalogan, Samar September 14-15, 2000

Member . . . . Divine Love Charismatic Community

Member . . . . Parish Council FLA-Education

Secretary . . . . ME-DLCC

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