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STUDENTS' DOMINANT INTELLIGENCE AND PERFORMANCE IN CHEMISTRY

A Thesis Presented
to the Faculty of College of Graduate Studies
and Teacher Education Research
PHILIPPINE NORMAL UNIVERSITY
Taft Avenue, Manila

In Partial Fulfillment of the Requirements for the Degree
Master of Arts in Science Education
with Specialization in Chemistry

ALBERTO VIDAR ESPENIDA

November, 2015

APPROVAL SHEET

This thesis entitled **“STUDENTS’ DOMINANT INTELLIGENCE AND PERFORMANCE IN CHEMISTRY”** prepared and submitted by **ALBERTO V. ESPENIDA** in partial fulfillment of the requirements for the degree of **MASTER OF ARTS IN SCIENCE EDUCATION** with specialization in Chemistry, is hereby recommended for approval and acceptance.

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Thank you,

The author

Abstract

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Title: Students' Dominant Intelligence and Performance in Chemistry

Key Concept: Dominant Intelligence groups have common preferred MI- inclined chemistry activities

Degree: Master of Arts in Science Education

Specialization: Chemistry

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The study aimed to describe the influence of multiple intelligences to the chemistry performance of the Grade 7 students. The research participants were composed of 59 intact population of grade 7 in Manlabong National High School. They were group based on the dominant intelligence. The study was conducted for one quarter and employed the descriptive research method. Questionnaires were used as the data gathering tool.

Based on the sub-problems the following findings were found out: (1) the participants were mostly naturalistic intelligent individuals; (2) using one-way ANOVA, it was determined that there were no significant differences in the performance of the groups in the laboratory exam and other MI-seatwork activities. However, there were significant differences in the performance of the groups in achievement test and linguistic intelligence inclined seatwork activities, but Scheffe post hoc test disproved this by giving no significant differences in the performances in any pairwise comparisons; and (3) though

most of the participants were naturalistic, they mostly appreciated chemistry activities related to visual-spatial intelligence. It was concluded that the research participants have dominant naturalistic intelligence but visual-spatial related chemistry activities are the common preferred activities they like to do.

The researcher recommends the following: MI profiling be conducted in the class using the standard MI assessment, conducting a study on the relationship of most tapped DI and chemistry performance, and giving more MI-inclined activities suitable to the identified MI profile of the class.

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Chapter I

THE PROBLEM AND ITS SETTING

Introduction

The theory of multiple intelligences (MI) states that human beings differ from one another, and there is absolutely no reason to teach and assess all individuals in the identical way (Gardner, 2011). MI theory stresses that humans have multiple intelligences and that strengths in each area vary from person to person. These intelligences are verbal, logical, spatial, kinesthetic, musical, social, intrapersonal, and naturalist.

The theory of MI proposes a major transformation in education. It suggests that teachers must teach to a broader range of talents and skills in order to accommodate these different intelligences (Brualdi, 1996). They should structure the presentation of material in a way that engages most or all of the intelligences whereby students benefit by being exposed to a variety of experiences which engage or stimulate the different "minds" or intelligences in them (Kwen, 2002).

Gardner's ideas sit well with science which has long been associated with logical people. There were notions that say science, especially chemistry, is a logical-math-biased subject. Indeed, logical math intelligence, together with linguistic and visual-spatial, was found to be a key to achievement in chemistry (Wright, 2004). Moreover, Martinez (2002) found positive correlations between application in chemistry and the dominant intelligence. This gave the idea that chemistry subject entertains not only logical-math intelligence but also other intelligences by providing different avenues of activities that match with the students' dominant intelligence.

Kwen (2002) suggested a list of learning activities in chemistry which can be used to enhance the learning of the students with strengths in various intelligences. The activities for group or individual will enable each one in the class to perform, perhaps not assumedly to achieve high in written endeavors but to become active participants. Students will have a chance to show their gift of uniqueness or intelligence as they perform the task. For example, there is a chance for a linguistic student to be a spokesperson or an elaborator, a joy for a bodily-kinesthetic individual to perform the labor, and an experience for visual-spatial to demonstrate his/her ability in making graphs, table, or other representations. Similarly, a musically inclined student may make an introductory part of singing or rapping in a group presentation; and logical, intrapersonal, or naturalist to become leader or moderator. All these activities utilize one's interpersonal intelligence as they interact with one another in front of the class.

Gupton (2011) conducted a study to find out if intelligences (MI) can be determined in individuals. He used the Multiple Intelligence Survey before giving an assessment to students to answer whether students would achieve higher scores on assessments when given instruction geared toward their given Multiple Intelligence domain. The results showed higher score on assessments. Armstrong (2000) in Gupton (2011) said, "No test can accurately determine the nature or quality of a person's intelligence." However, he did believe testing intelligence through paper and pencil tests would only be tapping into the logical and linguistic intelligences. Armstrong further went on to say, "The best way to assess your own Multiple Intelligences, therefore, is through a realistic appraisal of your performance on the many kinds of tasks, activities, and experiences associated with each intelligence."

This researcher then became concerned about the influence of the dominant intelligence's performance in various aspects. The idea was brought about by the belief that achievement (exam) is only a speck part of the students' accomplishments in the class. Thus, this study aimed to investigate the influence of dominant intelligence of the research participants on *chemistry performance* and to find out where the majority of them would perform well. Chemistry subject may be managed which make it know no particular intelligence and where diverse students can perform at par with one another in different class activities. The researcher also wanted to observe if same treatment and assessment given to students would make any great difference to their performance so as to treat and assess them individually in accordance with their dominant intelligence as what the MI theory seemed to emphasize. Consequently, working on multiple intelligences of the students required the researcher to use Multiple Intelligence Assessment by Armstrong.

Conceptual Framework

Wilson (2014) said that we have dominant intelligence. These dominant intelligences are: linguistic, logical, visual, movement, musical, intrapersonal, social and naturalist. We vary in intelligence because culture and nurture as well as biological aspect play in shaping large role in its development. All societies value different types of intelligences. The cultural value placed upon the ability to perform certain tasks provides the motivation to become skilled in those areas. Thus, while particular intelligences might be highly evolved in many people of one culture, those same intelligences might not be as developed in the individuals of another (Brualdi, 1996).

On the other hand, performance in chemistry is affected by several factors. Korau in Nbina (2012) reported that such include the student factor, teacher factor, societal factor, the governmental structure problem, language problem examination body related variables, curriculum related variables, test related variables, textbook related variables and home related variables. Saage in Nbina (2012) added identified specific variables such as poor primary school background, lack of incentives for test, lack of interest on the part of students, large classes, fear of the subject psychologically and others.

The researcher was able to construct the framework (figure 1) based on researches that connects these intelligence with chemistry achievement. Wright (2004) said that logical-math intelligence as well as visual-spatial and linguistic intelligence is a key to achieving in chemistry subject. Taking the “*visual-spatial and linguistic intelligence*” terminologies of Wright (2004) as **dominant intelligences**, and “*achieving in chemistry subject*” as **performance in chemistry**, (not termed as achievement in this study because the researcher wanted to cover all the possible achievements in chemistry not only those form achievement test or grade) the researcher aimed to find the connection of the two variables. Another study which links the connection of *dominant intelligence* and *performance* in achievement test was Martinez (2011) who finds that interpersonal, naturalistic, intrapersonal, verbal, and logical students performed better compared to other MI groups in chemistry achievement test.

This study, as the framework wanted to show, determines the performance of the identified dominant intelligences of the research participants in various MI-inclined chemistry activities like the MI-inclined seatwork activities. This also finds out the outcome of these performances in laboratory exam, achievement test and academic grade.

The independent variable is the identified dominant intelligence of the research participants. The dependent variable is the chemistry performances of the identified intelligences. These are achievement test, laboratory exam, achievement test and seatwork related to linguistic, logical, visual, and naturalistic intelligence.

Figure 1 displays the conceptual framework of the study. It shows the connection of variables being studied.

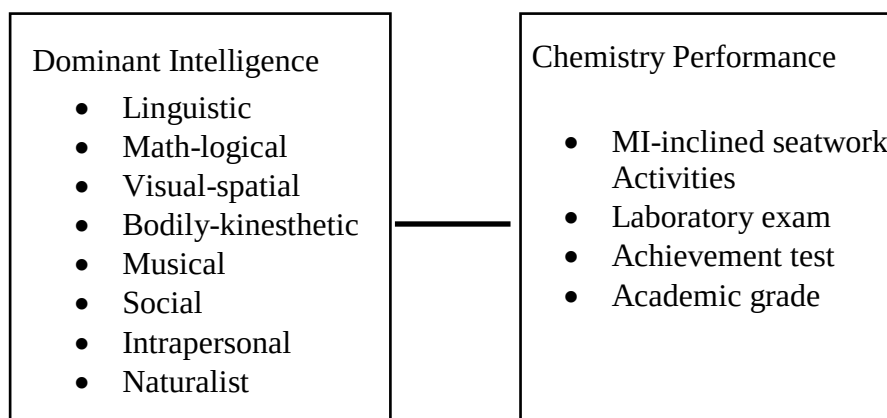


Figure 1. The Conceptual Framework

As to MI-inclined seatwork, the researcher considered the activities suggested by Kwen (2002). The *seatwork* inclined to a particular intelligence must be worked upon by individual students. These seatwork activities were related to:

- a. Verbal Intelligence - Read, write, send email, search the internet, write poetry and fiction stories concerning topics such as environmental pollution, bonding, Periodic Table (Kwen, 2002). In this study, writing a poem on solutions and essay on neutralization were given as seatwork activities.
- b. Logic-math Intelligence- Investigate/solve problems/puzzles on environment-related topics (Kwen, 2002). In this study, solving for the concentration of solutions was done.

- c. Visual Intelligence- Draw pictures or diagrams of events, phenomena. Make models. Extract or present information as concept maps, mind maps, charts or diagrams, photos, and spreadsheets (Kwen, 2002). This study made use of following mnemonics in making electron configuration.
- d. Naturalist Intelligence- Classify objects, events, and phenomena according to natural surroundings, find origins (Kwen 2002). This study, made use on classifying a given group of substances according to whether they are elements, compounds, acid or base.

Assumptions of the Study

1. There are MI-inclined activities which can be used to reduce the gap in performance among all the forms of intelligence in chemistry which is known to be a logically bias subject.
2. Students have common preference activities in chemistry despite of varied dominant intelligence.

Statement of the Problem

The study aimed to investigate the influence of multiple intelligences on the chemistry performance of the students in identified dominant intelligence.

Specifically, the study sought to answer the following questions:

1. What is the dominant intelligence profile of the research participants?
2. Is there a significant difference among the dominant intelligence group of students in the following academic performance?
 - a. MI-inclined seatwork performance;

- b. Laboratory Examination Performance;
 - c. Achievement test; and
 - d. Academic grade
3. What chemistry activity was most appreciated by the participants?

Significance of the Study

The present study investigates the influence of multiple intelligences on chemistry performance. It is anticipated that this study be significant to all the stakeholders. Specifically, this study is expected to be significant to the following:

Teachers might be encouraged to make multiple intelligences profiling to determine what teaching styles and type of activities suit to the preference of the students. Matched teaching styles or activities with learning styles enhance the students' learning.

Researchers might find this study useful in the development of deeper quantitative researches. This descriptive research might bring information which is feasible to be conducted in quantitative design.

Administrators might encourage teachers to conduct varied activities to determine the strength and weaknesses of the students' performance. The identified strength and weakness related to multiple intelligences such as in logical-mathematical or verbal intelligence activities may serve as baseline data on what competition they may like to join and what area must be strengthened.

Writers and authors might be able to accommodate multiple intelligences in writing papers and books. In writing books, incorporating styles that suit with one's dominant intelligence may be a big encouragement for him to like reading.

Students will benefit from the study once more activities in their preference were conducted in the class. Inclination to a particular activity is a motivation itself that makes one to participate with eagerness. The performance of the students will be increased.

Scope and Limitations of the Students

The study was conducted in Manlabong National High School located in Manlabong, Prieto-Diaz, Sorsogon, for the duration of three months, school year 2014-2015. The research participants were 59 Grade 7 students from an intact class. The study used chemistry subject in realizing the objectives of this study. The students' performances were measured through laboratory exam, achievement test, and MI-inclined seatwork activities. The limitations of the study is placed on its inability to draw out the true feelings and perception of the participants because they were written in English and developed in another culture. Meaning one of the instruments, the multiple intelligence assessment tool, will give off cultured bias.

Definition of Terms

For easy understanding, the following terms were defined operationally:

Academic grade. This academic construct pertains to the final grade of the students in the first quarter. The final grade is a teacher-related assessment result.

Achievement test result. It is the result in the achievement test in the form of an equivalent score.

Bodily- kinesthetic intelligence group. It refers to the group of bodily-kinesthetic dominant students who have the gift of physical movement (Wilson, 2014).

This dominance in bodily-kinesthetic intelligence was measured by the MI assessment taken online.

Chemistry Activities. It refers to laboratory activity or experiments and MI-inclined seatwork activities.

Chemistry performance. In this study, it refers to the academic grade, laboratory exam performance, MI-inclined seatwork performance, and achievement test result.

Dominant Intelligence. It refers to the participant's highest rated intelligence in a multiple intelligence assessment tool.

Dominant intelligence group. In this study, it refers to the student groupings based on the highest rated intelligence and whose mean performance were used for statistical purpose.

Interpersonal intelligence group. It refers to the group of students who have dominant social intelligence. They have the ability to communicate with others and easily build relationships (Wilson, 2014). This dominance in interpersonal intelligence was measured by the MI assessment tool.

Intrapersonal intelligence group. It refers to the group of students who have dominant intrapersonal intelligence. They have the ability to be somewhat insulated from one's peers and a strong sense of self (Wilson, 2014). This dominance in intrapersonal intelligence was measured by the MI assessment tool.

Laboratory activities. It refers to the selected or alternative activities in science module for Grade 7 in the first quarter where students had the opportunity to perform a role of their preference during and in the presentation of experiment's result.

Laboratory exam performance. In this study, it refers to the equivalent score of the students obtained from the laboratory exam (paper-and-pencil test).

Linguistic- inclined seatwork. It refers to the seatwork inclined to verbal intelligence. In this study, this includes writing poem on solutions and essay on the reaction of acids with bases.

Logical- inclined seatwork. It refers to the seatwork inclined to logical intelligence. In this study, it includes solving on the concentrations of solutions.

Logical intelligence group. It refers to the group of students who have dominant logical-math intelligence. They were adept in numbers, mathematical operations and analysis (Wilson, 2014). This dominance in logical intelligence was measured by the MI assessment tool.

MI–inclined seatwork performance. It refers to the performance of individual students in seatwork inclined to a particular intelligence. There was verbal-inclined seatwork, logical, visual, and naturalist-inclined seatwork in this study.

Mixed group. It refers to the group of students with different dominant intelligence as they perform laboratory activities.

Musical intelligence group. It refers to the group of students who have dominant musically-rhythmical intelligence. They have skills on humming, rapping, singing and like to learn and do things while listening to music (Wilson, 2014). This dominance in musical intelligence was measured by the MI assessment tool.

Naturalistic- inclined seatwork. It refers to the seatwork inclined to naturalistic intelligence. In this study, it includes classifying elements from compounds and metal, metalloid and nonmetals and acids from bases.

Naturalistic intelligence group. It refers to the group of students who have dominant naturalistic intelligence. They have keen awareness of their surroundings and changes in their environments, even if these shifts are at minute or subtle level. They like classifying objects in nature (Wilson, 2014). This dominance in naturalistic intelligence was measured by the MI assessment tool.

Student perception. It defines in this study as the degree of appreciation of the students in chemistry activities based on their calculation of their likeness to it. It is used in the instrument called “Student Perception Questionnaire” to measure the degree of appreciation of the students in various chemistry activities based on the estimation of their percept feelings.

Verbal intelligence group. It refers to the group of students who have dominant linguistic intelligence. They are equip in linguistic related activities like constructing of essays, readings and comprehension of texts (Wilson, 2014). This dominance in linguistic was measured by the standard MI assessment.

Visual- spatial intelligence inclined seatwork. It refers to the seatwork inclined to visual intelligence. In this study, it includes solving on activities involving analyzing a table of experiment, following electron configuration mnemonics, and combining elements to form compounds.

Visual- spatial intelligence group. It refers to the group of students who have dominant visual-spatial intelligence. They have the ability to perceive images and follow patterns (Wilson, 2014). This dominance in visual-spatial was measured by the MI assessment tool.

Chapter II

REVIEW OF RELATED LITERATURE

The Multiple Intelligence Theory

In 1983, Gardner put forward his theory of Multiple Intelligences in *Frames of Mind*. This is a theory that challenged the dominant definition of intelligence as limited to mathematical and linguistic abilities only. Gardner theorized that multiple intelligences more accurately accounts for the diversity of ways in which people acquire and utilize knowledge. According to Gardner, there are biological and cultural bases for multiple intelligences. Current neurobiological research indicates that learning is an outcome of the modifications in the synaptic connections between cells. Primary elements of different types of learning are found in particular areas of the brain where corresponding transformations have occurred. Thus, various types of learning result in synaptic connections in different areas of the brain.

In addition to biology, Gardner 1983 in Brualdi (1996), also argued that culture plays a large role in the development of the intelligences. All societies value different types of intelligences. The cultural value placed upon the ability to perform certain tasks provides the motivation to become skilled in those areas. Thus, while particular intelligences might be highly evolved in many people of one culture, those same intelligences might not be as developed in the individuals of another (Brualdi, 1996). Although the intelligences are anatomically separated from each other, Gardner in (Brualdi, 1996) claims that the seven intelligences very rarely operate independently. Rather, the intelligences are used

concurrently and typically complement each other as individuals develop skills or solve problems.

Everyone is born possessing multiple intelligences. However, students will come into the classroom with different sets of developed intelligences. This means that each child has his/her own unique set of intellectual strengths and weaknesses. This is commonly referred to as *learning style*. Many learning styles can be found in the classroom. Therefore, it is impossible as well as impractical to accommodate every lesson to all of the learning styles found in the classroom. Nevertheless, the teacher can show students how to use their more developed intelligences to assist in the understanding of a subject which normally employs their weaker intelligences. Teachers, therefore, should think of all intelligences as equally important. This is in great contrast to traditional education systems which typically place a strong emphasis on the development and use of verbal and mathematical intelligences. Thus, the Theory of Multiple Intelligences implies that educators should recognize and teach to a broader range of talents and skills. Another implication is that teachers should structure the presentation of material in a style which engages most or all of the intelligences (Brualdi, 1996).

Salandanan (2002) says that most teaching strategies employed in the past cater to the linguistics only since most of the activities revolve in the word-dominated learning. Another dominant strategy focuses on learning about numbers alone. This strategy forgets sensitivity to other possibly less discovered ability that may go along with math-inclined individuals. Thus, a single strategy alone on math-inclined individuals may ignore their visual-spatial intelligence. Math-inclined students are also good in visual-spatial because numbers are also presented visually through graphs, tables, and symbols. Hence, teachers

should use varied activities that may tap different intelligences that go along with a student's dominant intelligence.

Abaquin (in Chen, 2009) says that at MI schools, the goal of using multiple intelligences in the classroom is to gain understanding. Instead of teaching lessons in eight ways to tap the eight intelligences, the teachers and students are empowered to choose strategies that they prefer most to learn. In this study, the researcher prepared lessons and used strategies that were suited to the topic and interest of the students in a cooperative/collaborative work. The difficulty in using a strategy that will tap the eight intelligences is to use a strategy that will match with the majority's interest, or give a free role among individuals to do their share as part of a group work. The process, nonetheless, would still adhere to the national curriculum content in its principles in encouraging students to apply the knowledge that they have learned from a research-based content.

According to Wilson (2014), the dominant intelligences were: **Verbal/Linguistic** – deals with abilities in the complex acquisition, formation, and processing of language. Thinking symbolically and reasoning abstractly fall under this category as does the ability to create conceptual verbal patterns. They learn by verbalization; **Logical/mathematical** - deals with the ability to think logically; inductively, and to some degree deductively; categorically; to recognize patterns, both geometric and numerical; as well as the ability to see and work with abstract concepts. Children who possess this form of developed intelligence may be constant questioners; they may easily grasp games that involve sophisticated strategies, like chess; or they may devise experimental formats to test their ideas. Also, they may be fascinated with computers or with puzzles involving logic and reasoning abilities; **Musical** – obviously deals with the ability to create or interpret music.

These children may need music while they study, and they are continually humming, singing, tapping out tunes rhythmically, or whistling. They have keen ears for distinguishing sounds and subtle nuances in music and in the sounds in their environments. These children can also be excellent mimics and can easily discern differences in speech patterns or accents; **Spatial Intelligence** –deals with the ability to perceive images. These children think in images and are usually the ones able to find missing objects due to their tremendous powers of visual recall. They may be the first to notice things that have been changed or rearranged. Many are earlier drawers – delighted with shapes, lines and colors. These folks are attracted to jigsaw puzzles and mazes, find the hidden picture puzzles, and love to construct things with blocks. They have an early sense of proportion and perspective. They are also good at reading and constructing maps and discerning objects as they might appear in three-dimensional space.

Further the **Bodily/Kinesthetic intelligence** deals with the gift of physical movement that of both the fine and/or the large muscle systems. These children are the movers of the universe, and frequently they squirm, rock, even fall off their chairs when required to sit still for extended periods of time. These children are adept at creating and interpreting gestures and are often attuned at communicating in, or reading others' body language. They may even have a need to enter the personal space of others or to touch them while communicating. This group of students needs to learn by acting and moving, to learn by haptic experiences; **Interpersonal** – deals with the ability to understand and communicate with others and to facilitate relationships and group processes. The phrase “they can work the room” aptly describes their uncanny abilities to read people. Often, these children are highly empathetic, and they can arbitrate differences between people or

groups. They can easily pick up on the vibrations, the feelings of others. These children enjoy cooperative learning experiences and learn best in cooperative settings; **Intrapersonal** – deals with the ability to be somewhat insulated from one's peers; to have a strong sense of self; to have leadership abilities in reference to making decisions that may not be popular with others. This strong sense of self creates a certain amount of immunity from peer pressure. These children may be what are described as “loners”. They may have gifts out of the ordinary realm of human understanding – strong intuitive feelings, a sense of inner wisdom, or precognition. These children need learning experiences where they can focus on their inner being, and activities that allow them to work by themselves on material and projects of their own choosing.

Lastly, **Naturalistic intelligence** are often keenly aware of their surroundings and changes in their environments, even if these shifts are at minute or subtle levels. This awareness is due to their highly developed levels of sensory perception. Their heightened senses may help them notice similarities, differences, and changes in their surroundings more rapidly than others do. Kids possessing enhanced level of “nature smarts” may be able to categorize or catalog things easily. As children, they often like to collect, classify, or read about things from nature.

Performance in Chemistry

Poor performance in chemistry has several factors. Korau in Nbina (2012) reported that such include the student factor, teacher factor, societal factor, the governmental structure problem, language problem examination body related variables, curriculum related variables, test related variables, textbook related variables and home related

variables. Saage in Nbina (2012) added identified specific variables such as poor primary school background, lack of incentives for test, lack of interest on the part of students, students not interested in hard work, incompetent teachers in the primary school, large classes, fear of the subject psychologically and others. Lawis and Eddy in Nbina (2012) say that in Nigeria, pupils' home upbringing tends to affect their attitudes to authority. It is one co-operation and passive submission. Children seen to have a natural tendency to explore, find out and collect objects. Too much restriction can have a lasting effect on the learner to the extent that he becomes afraid to experiment and explore in chemistry and later in life when encouraged to find out for him or make individual contribution he may be too inhibited to do so. Korau in Nbina (2012) observed that the school population counts in thousand today against the hundreds of the previous years. Schools today are overcrowded in classrooms which make it impossible to talk of an ideal size of a classroom for effective teaching in chemistry. No effective teaching can take place under a chaotic situation where he cannot handle the large number of students effectively. Consciously quantity and quality cannot work together and this can affect students' learning of chemistry and thus perform poorly.

Similarly, Beluso (1993) has findings of generally poor performance in chemistry from the research participants in high school in the city of Roxas due to low level of comprehension which resulted to their inability to analyze and solve problems correctly. She went further that sex, home location, parents' educational attainment, exposure to print media, exposure to electronic media and teacher factor did not influence the performance of the participants in chemistry. She recommends that similar studies be conducted using other variables affecting the performance of students in chemistry. Further, Espinosa, et.al

(2013) expresses his experience and observations that in chemistry, the students appeared to start classes with many expectations, questions and great interest are not sustained because they find the subject too abstract and mathematical; therefore it requires a special way of thinking to be able to learn it. This statement supports the statement in the study of Wright (2004) saying that there were notions that chemistry is a math bias subject.

However, according to Gardner (in Kwen, 2002), using methods or media in presenting the lessons that are mismatched with the students' intelligences profile gives high possibility of failure and difficulties in learning. For instance, students will find it difficult to understand the topic of particle kinetic theory if the teacher presents it by using an audio-visual method alone when the said learners are musically-inclined individuals. For this reason, the appropriate scenario in classrooms is the teaching and learning process where there are active participants among learners because of the varied learning experiences and media or resources given to them.

The MI theory, therefore, as Kwen wanted to emphasize, is to use different strategies that match with the students' preferred ways to learn to assure a higher possibility of passing the subject. This theory, thus, provides additional foundations for the use of different methods and media especially in teaching chemistry where topics offer a wide scope by which they could be presented. In this manner, diverse learners with different dominant intelligence can be assessed in a teaching – learning process. No few or single group is favored while the rest is left behind that the subject may appear so boring and interesting.

Kwen, (2002) suggested list of activities that could be used in teaching chemistry to increase the performance by recognizing multiple intelligences. From the table, each

form of intelligence has corresponding related activities that one could use in the assessment of learning of particular topic in chemistry. The table, therefore, avoids monotonous scenario where logical-mathematical and linguistic groups only will perform.

Some of these suggested chemistry activities that cater multiple intelligences were taken and become the basis of the researcher in conducting lessons and activities. The taken suggested activities were used to find topics in grade 7 chemistry that could be used as seatwork inclined to verbal, logical, visual-spatial and naturalist activities. With this scheme, the performance of the students will be distributed to different MI related activities, thus will lessen the bias of a single or few groups dominating the class. Moreover, in the analysis, it will reveal out what group would perform significantly better in each of this seatwork activities.

The Table 1 on the following page has the list of activities from Kwen, (2002). It served as basis of the researcher in conducting activities in chemistry to his research participants.

Table 1

List of Suggested Chemistry Activities

Form of Intelligence	Learning activities or strategies
Verbal	Read, write, write poetry such as chemical limericks, news reports, fiction stories concerning topics such as environmental pollution, bonding, and Periodic Table.
Logic-Math	Investigate/solve problems/puzzles on environment-related topics (such as haze problems, water shortage). Use computer software to investigate atmospheric pollution.
Visual-spatial	Draw pictures or diagrams of events, phenomena "experienced" or "observed". Make models (atomic, molecular, and kinetic particle). Extract or present information as concept maps, mind maps, charts or diagrams,
Kinesthetic	Use dance, pantomime, or role play to illustrate the effect of pollution on organisms, particle arrangement, and movement during phase changes.
Musical	Create/sing songs, e.g., "Sing a song of atoms", learn tunes, write tunes, and rap songs, create mnemonics, play classical music in background
Interpersonal	Lead/participate in small group discussions, ask clarifying questions, cooperative groups, group games, collaborate with peers.
Intrapersonal	Self-reflection or journal writing, independent study, self-paced instruction, and games in which the opponent is the computer.
Naturalistic	Classify a given group of substances according to whether they are elements, mixtures, or compounds.

Kwen, (2002) in Chemical Education International, Vol. 3, No. 1, AN-6, Received in October 10, 2002

Multiple Intelligence and Performance in Chemistry

There were studies that related multiple intelligences with chemistry performance. Jingchen Xie and Ruilin Lin (2009) conducted a research which aimed at fusing the multiple intelligences theories with the teaching of one chosen course: color theory. Two groups of students from a polytechnic university in central Taiwan were chosen as research subjects, and an experiment was designed and performed to explore the effects of multiple intelligences teaching on the experimental group versus that of the traditional teaching on the control group. Students from the experimental group performed significantly better than students in the control group in actual hands-on design project assignments. Ghazi (2011) conducted a research which aimed to investigate the relationship between students' self-perceived multiple intelligences and their academic achievement. A significant correlation was found between self-perceived verbal/linguistic, logical/mathematical, interpersonal, intrapersonal, naturalistic intelligence and academic achievement. There was insignificant correlation between self-perceived musical intelligence and academic achievement. Results of the study showed that the relationship between self-perceived bodily/kinesthetic intelligence and academic achievement was very weak. On the basis of the conclusions, it was recommended that: student-centered approach should be used in teaching because it provides various opportunities for the students to use their varied forms of intelligence: teachers should care about students' choice and interest when designing activities and tasks for them: and multiple intelligences-based curriculums for students should be developed.

On the other hand, Martinez (2002) conducted a descriptive-correlational research aimed to determine the dominant intelligence of college chemistry students. It sought the

relationship between dominant intelligence score and chemistry achievement scores classified into three cognitive levels: knowledge, comprehension, and application. The study was conducted at De La Salle University-Dasmariñas, Cavite, Philippines with a sample composed of a total of 855 students. These students came from a total of 23 different classes with different courses taking general chemistry. A multiple intelligence inventory test and a multiple-choice chemistry achievement test were used to gather data. Pearson r coefficient of correlation was used to determine if there is a significant relationship between the scores in dominant intelligence and the different cognitive levels of chemistry achievement test. The findings of the study revealed that students possessed different dominant intelligence. The study also showed that interpersonal, naturalistic, intrapersonal, verbal, and logical students performed better compared to other MI groups in chemistry achievement test. Positive correlations were found between dominant intelligence scores and mean scores in knowledge level of interpersonal, intrapersonal, verbal, logical, and visual students. Positive correlations were also found between dominant intelligence scores and mean scores in comprehension level of interpersonal, intrapersonal, verbal, and logical students. Application mean scores had positive correlations with dominant intelligence scores of interpersonal, naturalistic, and logical students. Based on the findings of the study, the following conclusions were made: College students differed in the dominant intelligence they manifest. There was a significant relationship between the scores in dominant intelligence and the scores in each of the three cognitive levels of chemistry achievement test.

Similarly, Napiere (2012) examined the dominant intelligences and learning preference of 232 freshmen in a school in Cagayan de Oro City, Philippines. The dominant

modes of delivery and assessment tools used by 14 instructors in the basic subjects were also examined. Results revealed that the students had dominant musical-rhythmic and spatial-visual intelligences, and they prefer to learn through linguistic and intrapersonal means. The dominant modes of delivery used were intrapersonal and logic based modes, and the assessment tools used were primarily related to the interpersonal and logic-mathematical intelligences. Correlation results showed that students who had strong interpersonal intelligence tend to prefer to learn in linguistic ways. Each mode of delivery used in classes is significantly related to each assessment tool. The study suggested the need for more instructional strategies that will tap the musical and visual intelligences of students, and for more opportunities to demonstrate their learning through active involvement, sound-related activities, and reflection, and reflection-stimulating ways.

Arellano (2010) studied multiple intelligences (MI) in relation to learning preferences of Intermediate Grade students in Selected Schools of Makilala Central District. He found out that there was a significant difference in the level of multiple intelligences and learning preferences of students in selected schools of Makilala Central District except in Saguing Elementary School. It was found out that MI is highly correlated to learning preferences. Curabo (2005) made a research about the multimedia software in chemistry for high school students of varied dominant intelligence. The purpose of the study was to determine the effectiveness and suitability of the multimedia software in chemistry on students with varied dominant intelligences. Specifically, the study focused on finding the dominant intelligence suited for the multimedia software. Eighty students from the cream section of third year class enrolled during the school year 2004-2005 at Biñan National High School were used as samples of the study. These students were

grouped according to their scores in the multiple intelligence assessment developed by Armstrong. The students, based on their dominant intelligence, were grouped as verbal/linguistic intelligence, logical/mathematical intelligence, intrapersonal intelligence, bodily-kinesthetic intelligence, and naturalist intelligence.

The acceptability of the multimedia software was evaluated based on the perceptions of the students with different dominant intelligences. The effectiveness of the multimedia software as a learning resource was evaluated based on the performance of the students in the achievement test. The score in the exercise given after the discussion of each topic in the multimedia software supported the result of the performance of the students in the achievement test. The t-test for correlated means of the gain score was used to determine the suitability of the multimedia software as a learning resource for students with varied dominant intelligences.

The result showed that the use of multimedia software improved the performance of all the intelligence groups in the achievement test. The result of the one-way ANOVA on the means of the gain score showed significant difference in the gain score of verbal/linguistic intelligence, which differed significantly better than other intelligent groups. The verbal/linguistic group obtained the highest mean score in the exercises given after the presentation of each topic. The results confirmed that the multimedia software as an instructional tool was rated within the range of the category of the response “agree” and “moderately agree”. All intelligence groups moderately agreed to the favorable use of the multimedia software in learning chemistry concept.

SYNTHESIS

There were several studies that affect the performance of students in chemistry subject. Among the identified factors were: gender, family upbringing, class size, teacher incompetence, student attitude, quality of textbooks and curriculum, societal issues and language problem.

On the other hand, as mentioned in Wright (2004), chemistry subject has long been regarded as math-logical intelligence bias subject. This notion was pretty well observed by the researcher himself. It seemed to be that those logical-math inclined students could perform better in chemistry subject. In other words, there is a gap between math-logical and other types of intelligences.

As per recommendation of Beluso (1993) that similar studies be conducted using other variables affecting the performance of students in chemistry, this research study aimed to investigate if the dominant intelligence of one's multiple intelligence is also one of the factors in chemistry performance. If it is, this study also sought answer to find out what type of activity among the MI-inclined activities in chemistry can make bridge the gap between math-logical intelligence and other types of intelligences. The study will use some of the suggested MI-inclined chemistry activities of Kwen (2002).

Chapter III

METHODOLOGY

Research Design

This study was conducted using the descriptive research method. Descriptive research is used to obtain information concerning the current status of the phenomena and to describe "what exists" with respect to variables or conditions in a situation (Anastas, 1999). Descriptive research is often used as a precursor to more quantitative research designs with the general overview giving some valuable pointers as to what variables are worth testing quantitatively.

Gay in Albano (2006) defines descriptive research as involving collection of data in order to test the hypothesis or to answer concerning the current status of the subject of the study. It also determines and reports the way things are. This study collects data of the nature of the students in terms of their dominant intelligence and their performance in chemistry. It reports and describes the performance of each identified dominant intelligence.

This study is descriptive in a sense that it sought to find out the influence of the students dominant intelligence in chemistry performance. It also describes the profile of the students as well as their performance in chemistry. This type of research is a design that aims to describe the nature of a situation as it exists at the time of the study (Transverse in Fernandez, 2006).

Research Participants

The research participants were composed of the intact population of Grade 7 students in Manlabong National High School who were enrolled in chemistry during the school year 2014-2015. It used the entire 59 students in one class because they were few in numbers.

The average age profile of the participants was 12 years old. The participants were all residing and schooling in the countryside, a nature-rich environment situated along the shore, facing the island of Rapu-rapu, and seemed to be so close to the school and residences. The location was also at the foot of forests arched in mountainous slope. The mode of transportation from home to school were in the form of single motorcycle (very few), but most students just walk from a range of 20 steps to 3 kilometers. The livelihood of the locals was mostly fishing and copra-processing.

Research Instruments

This section explains how these instruments were selected or developed, what they measure and how were those validated and pilot tested. The sample of validation paper and the validators' profile was placed in appendix C and D consecutively. Further, intra-class correlation was used in order to determine inter-rater reliability (appendix O). Intra-class correlation (ICC) assesses the reliability of ratings by comparing the variability of different ratings of the same subject to the total variation across all ratings and all subjects (<http://www.real-statistics.com/reliability/intraclass-correlation/>). The instruments used in this study were: *MI assessment tool*, *Students' Perception Questionnaire*, *Achievement test* and *Laboratory Exam*.

Multiple Intelligence Assessment Tool

The multiple intelligence assessment tool (Appendix A) is available from literacy.org, which they claimed was from Dr. Terry Armstrong. This instrument is an expert-made assessment of one's multiple intelligences. It also determines dominant intelligence obtained from the highest rated intelligence. It is constructed in the form of a rating scale where statements came from different areas like hobbies, activities, dreams, and family and social interaction. The participants showed their degree of resemblance on each statement that described one's multiple intelligences. The highest rated type of intelligence is one's dominant intelligence.

Table 2

The item placement of the MI assessment tool.

Dominant Intelligence	Item Placement							Total items
Verbal/Linguistic	1	9	17	25	33	41	49	7
Logical/Mathematical	2	10	18	26	34	42	50	7
Visual/Spatial	12	20	21	28	36	44	52	7
Bodily-Kinesthetic	5	13	29	40	45	48	53	7
Musical Rhythmic	3	11	19	27	35	43	51	7
Interpersonal	6	14	22	30	38	46	54	7
Intrapersonal	7	15	23	31	39	47	55	7
Naturalist	4	8	16	24	32	37	56	7

Note. The items of this assessment are equally distributed among the multiple intelligence.

Table 2 contains the item placement of the multiple intelligence assessment tool. From this table, it can be inferred that the distribution of the statements related to a particular intelligence was equal. It is consisted of 56 statements with 7 items pertaining to each of the multiple intelligences.

Based on the pilot test results (table 3) where the test-retest method was employed, the instrument has very high reliability of $r = 0.85$. Pearson r was used in the test-retest reliability. The instrument was administered to the 30 students who consisted the pilot tested sample, and after a week, the same instrument was re-administered to the same sample on the same location. The mean obtained on each category of administration and re-administration of the test was correlated. The test-retest reliability was used to determine stability. It measured how much error in a test was due to problems with test construction.

Table 3

The reliability test of MI assessment in a test-retest design

	I	II	III	IV	V	VI	VII	VIII	Pearson r
Pre	3.01	3	2.9	3.9	3	3.01	2.6	3.4	$r = 0.85$
Post	3.12	2.96	2.6	3.5	3.2	2.91	2.5	3.45	

Note: I- linguistic, II-logical, III-Visual, IV- Movement, V- Musical, VI- Social, VII-Self, & VIII- Naturalist. The data in this table are the mean rating of responses of the pilot tested participants consisted of 30 students.

It can be seen from the reliability test that the data had stability in test-retest design. It can also be seen that data across multiple intelligence remains close to one another after the retest of MI intelligence assessment tool.

Table 4 displays the summary results of experts' validation of the multiple intelligence assessment tool. This instrument was validated based on *content, language used, congruency of statement to DI, suitability to the age of the learners*, and its *usefulness to the study*. It can be seen also from the table that the ratings were high and that almost all areas got very high acceptability. The average weighted mean has high acceptability remarks which gave a high level of confidence that the instrument can really measure what it intends to measure from the participants.

Table 4

Weighted mean of validation for MI assessment

Areas	Weighted Means	Remarks
Content	5.00	Very high acceptability
Language used	3.00	High acceptability
Congruency of statement to DI	5.00	Very high acceptability
Suitability to age of learners	5.00	Very high acceptability
Usefulness to the study	5.00	Very high acceptability
<i>Over-all validity</i>	4.60	High acceptability

By using intra- class correlation to measure the inter rater reliability, a computed of ICC= 0.96 was found. This means that the rate of the three validators from each area of the instrument that has to be validated showed high degree of agreement. The three validators may agree on these rates since the instrument has taken for use from the expert on the field of multiple intelligence.

Students' Perception Questionnaire

The second instrument is the students' perception questionnaire (Appendix B). This was developed by the researcher to measure the degree of likeness of participants to chemistry activities inclined to particular intelligence. The statements that it contains were taken from the activities in chemistry that describe particular intelligence. For example, the statement "*I enjoyed manipulation of apparatus*" describes ones inclination to bodily-kinesthetic, and so forth. Since this is a rating scale, one will use his estimation (perception or sensitivity) to the degree of his percept feeling of likeness to a particular activity.

Table 5

The item placement of the Students' Perception Questionnaire

Multiple Intelligence	Item Placement	Total MI
Verbal/Linguistic	3, 4	2
Logical/Mathematic	6, 11	2
Visual/Spatial	5, 10	2
Bodily-Kinesthetic	2, 15	2
Musical Rhythmic	9, 12	2
Interpersonal	1, 8	2
Intrapersonal	13, 16	2
Naturalist	14, 7	2
Total =Eight (8) MI	16 items	16

Note. The items were equally distributed to eight forms of intelligences.

The Table 5 contains the item placement of this instrument. It also shows the distribution of the items among the forms of intelligence. In this instrument, odd and even items from each row both have statements denoting the same form of intelligence.

To measure the reliability, the researcher administered this instrument to the actual participants. The instrument was constructed in the form where odd and even numbers of statements connote similar type intelligence. The statements connoting particular dominant intelligence were equally distributed in the questionnaire. The process of constructing the instrument is called split-half method. Split-half means giving the test once but similar items were separated in an odd-even technique and correlated afterwards using the statistics for correlation. Split-half reliability was employed in this instrument because the researcher wanted to find out the internal consistency of the instrument. Miller (2012) says that internal consistency concerns the extent to which items on the test or instrument are measuring the same thing. The Table 6 below contains the reliability value of this instrument.

Table 6

Split-half reliability of Students' Perception Questionnaire

Reliability	Computed Value
correlation coefficient	0.57
Spearman-Brown correction	0.68

The process by which this instrument was tested for reliability by split-half was to get the sum of the ratings from odd and even items. The sum from the two sources was

correlated using the statistics for correlation. Since only half of the number of items was used, the reliability coefficient was reduced. To get a better estimate of the reliability of the full test, Spearman-Brown correction was employed. Spearman-Brown formula can be used for Likert scale or other types of items.

It can be gleaned from Table 6 that a result of 0.68 from Spearman-Brown correction of split-half reliability alpha indicates an acceptable reliability. This means that this instrument has high internal consistency. Further, the result of the participants' responses were consistent on each particular chemistry activity with inclination to particular multiple intelligences.

Table 7

Weighted mean of validation of Students' Perception Questionnaire

Areas	Weighted Means	Remarks
Content	4.00	Moderately high acceptability
Language used	3.33	High acceptability
Congruency of statement to DI	4.00	Moderately high acceptability
Suitability to age of learners	4.33	Moderately high acceptability
Usefulness to the study	5.00	Very high acceptability
<i>Over-all validity</i>	4.13	Moderately high acceptability

Table 7 on the other hand, shows the summary of validation for the Students' Perception Questionnaire. The instrument has an over-all validity of moderately high acceptability. A high level of acceptance was obtained, indicating that the instrument could

really measure the degree of appreciation for particular chemistry activities as well as the students' inclination and positively tapped type of intelligence.

Furthermore, when intra-class correlation coefficient was used to measure the degree of agreement of rates between the three raters, an ICC = 0.74 was obtained. This value indicated a high degree of agreement between the raters.

Achievement test

The third instrument is achievement test which is also constructed by the researcher himself. This instrument was constructed with the table of specification. It was pilot tested in Calao National High School. The items in the achievement test were constructed in a way that will accommodate the multiple intelligences of the students. All the intelligence types were accommodated but unequally, because of the difficulty to construct items for other forms of intelligence such as the bodily-kinesthetic and musical intelligence. The items were obtained from chemistry activities like experiment (laboratory activity), MI-inclined seatwork activities and everyday lesson. It covers the topic in chemistry for the first grading period. The sample of the validated achievement test was in the appendix E.

Table 8

Test-retest correlation of achievement test

	Column 1	Column 2
Column 1	1	
Column 2	0.73	1

Note. Column 1 refers to the administration of this instrument; column 2 is the re-administration.

Table 8 indicates that the column 1 refers to administration of this instrument. Column 2 is the re-administration. In a test-retest design at the pilot-tested school, a computed $r = 0.73$ was obtained. This indicates high stability. The lowest scored item was from question no. 6. This is about solving on the concentration of solutions. The item was rephrased. The researcher deleted or rephrased questions based on the result of item analysis (Appendix K).

Table 9

Weighted mean of validation of the achievement test

Areas	Weighted Means	Remarks
Content	4.00	Moderately high acceptability
Congruent to L.C.	5.00	Very high acceptability
Recognizes MI	3.00	Averagely high acceptability
Suitability to age of learners	4.67	Moderately high acceptability
Usefulness to the study	5.00	Very high acceptability
<i>Overall validity</i>	4.33	Moderately high acceptability

Note. The L.C. refers to learning competencies. The items of the achievement test were rated by how it was close to the Learning Competencies.

Table 9 shows that the achievement test was validated in terms of *content*, *congruency to the learning objectives*, *recognizing the multiple intelligence*, *suitability to the grade level* of participants and *its usefulness to the study*. The instrument was presented to the validators with its table of specification. From the table, it can be seen that the weighted mean for *recognizing MI (multiple intelligence)* is only 3.00. This is because, the

achievement test is somewhat lacking of equal recognition to all the MI's. The researcher found it difficult to recognize all multiple intelligences. However, attempts to make the questions as fair as possible to all types of intelligences were done. Moreover, all the MI's had corresponding related items in the achievement test

Further, when the intra-class correlation was used to measure the inter-rater reliability, a computed value of ICC = 0.72 was obtained. This value indicates also that the instrument has high degree of agreement among the validators.

Laboratory Exam

The fifth instrument was the laboratory exam (appendix J) which assessed the influence of the actual laboratory activity on participants' performance. It consists 15 items which were taken from the laboratory activities in chemistry which were actually conducted by the students. The list of activities in chemistry was placed in table 19. It was pilot tested among the Grade 8 students of the participants' school. When test- retest reliability was employed, an r value of 0.71 was obtained. The value indicates high stability. The table 10 has the reliability test of this instrument from a pilot testing.

Table 10

The reliability of laboratory exam

	<i>Column 1</i>	<i>Column 2</i>
Column 1	1	
Column 2	0.71	1

Note. Column 1 refers to the administration of the instrument; column 2 is the re-administration.

Table 11 shows the summary of validation of the laboratory exam. The validators rated this instrument on areas: *content, congruency to learning objectives, recognizes multiple intelligence, suitability to age learners, congruency of items to actual laboratory activities* which were performed by the students and its *usefulness to the study*.

The intra-class correlation of this instrument showed a value of ICC = 0.12. This somewhat shows that the agreement between the raters is low. Nevertheless, by looking at the mean and the average weighted mean, the researcher can conclude that this instrument has moderately high acceptability.

Table 11

Weighted mean of validation of the laboratory exam

Areas	Weighted Means	Remarks
Content	4.00	Moderately high acceptability
Congruent to L.C.	4.33	Moderately high acceptability
Recognizes MI	3.33	Averagely high acceptability
Suitability to age of learners	4.33	Moderately high acceptability
Congruent to actual lab activities	4.33	Moderately high acceptability
Usefulness to the study	4.67	Averagely high acceptability
<i>Overall validity</i>	4.16	Moderately high acceptability

To sum up, all instruments in this study had an established reliability and acceptable validity. This means that the instruments can be used to the research participants in giving valid and reliable data.

Data Research Procedure

The researcher declares that the research study had permission to take study from all the persons in authority. These include letter to superintendent, principals, parents and participants themselves. It has also letter of request permission to use of the MI instrument available online (appendix P for sample of letters).

To explain the data research procedure, the figure 2 on page 43 is a constructed flowchart which gives a clear picture of the scene of the methodology. The flowchart contains six parts: *the development of instruments, validation, reliability testing, administration to actual participants, collection of data, and data analysis*. The parts are the following:

Selection and Development of Instruments

It was based on the need to measure what variables are important to be measured by the instruments. The variables in the study were *dominant intelligence* and *chemistry performance*. Therefore, the researcher has to devise instrument that will measure these two variables from the participants. The dominant intelligence can only be measured by MI assessment tool accurately. For this reason, it was taken online from the expert on multiple intelligence. The chemistry performance can be measured by teacher- made assessments. These assessments were: *achievement test, laboratory exam, and MI-inclined seatwork performance*.

In addition, the sub-problem requires the researcher to find out what MI-inclined chemistry activities were preferred and most enjoyed by the class. This will prove whether the most enjoyed activity of the class is the type of activity where they would excel better and equalize the gap among dominant intelligence group. To measure this variable, another

instrument was developed. This is called *students' perception questionnaire*. This instrument is a form rating scale that measures the degree of enjoyment of the participants to various MI-inclined activities based on their estimated percept of feelings. It was constructed in an odd-even technique for the purpose of establishing its internal consistency by split-half reliability.

Validation of instruments

The instruments were rated by the experts in the field (please see appendix C for sample validation process). These instruments were rated on the following criteria: content (& construct), language used, suitability to the age of the learners, congruency of statement to DI and its usefulness to the study. For achievement test additional criterion was included, this was “recognizes multiple intelligences”. The *content* (& construct) refers to the quality of texts found in instruments. This includes readability and the exactness of the content to what it should measure. The *language* used refers to whether the language is comprehensible to the participants. The instruments in the assessment of multiple intelligence and most enjoyed MI-inclined chemistry activities had English to Bicol language translations to achieve more accurate responses. The *suitability of the instruments to learners* refers to whether the statements from instruments include only activities customarily done by people of their age. The *congruency of statement to DI being described* refers to whether the statements from the instruments accurately matched with the type of intelligence being describe to.

The validators rated these criteria based on the rubrics stated in appendix C. The ratings were 5 – very high acceptability, 4 – moderately high acceptability, 3 – high acceptability, 2 – poor acceptability, and 1– least acceptability. The rubrics and the sample

of validation process is placed in appendix C. The intra class correlation of the raters' weighted mean of rating from each of the instrument was placed in appendix O.

Reliability testing

The instruments were pilot tested in Calao National High School. These instruments were MI assessment and achievement test. The laboratory exam and students' perception was pilot tested in Manlabong National High School.

To estimate the reliability of the result of pilot-testing of MI assessment tool and achievement test, the Pearson product moment correlation was used. This was used to estimate the stability of the instruments. Miller (2012) said that stability is said to occur when the same scores are obtained with repeated testing with the same group of participants. This estimate of reliability can be obtained in instruments which are administered in a test-retest design. The mentioned instruments of this study was re-administered after the period of one week.

Correlation as well as Spearman Brown correction formula was used for Students' Perception Questionnaire that was administered only once but whose design is in odd-even technique. In this instrument, similar statements were split in odd and even items. The sum of their responses in odd and in even items were obtained and correlated with statistic for correlation. Since only half of the number of items was used, the reliability coefficient of the full test, Spearman – Brown correction formula was employed. This instrument was constructed as such, to estimate its internal consistency.

Cronbach, 1951 in Miller (2012) said that internal consistency concerns the extent to which items on test are measuring the same thing. It is estimated after only one test administration.

Administration of the instruments

This stage refers to the administration of the instrument to the actual participants. The instruments were given in the appropriate time within the duration of the study. The *MI assessment* was given at the start of the first grading period and at the end. The *achievement test* was given at the end of the lessons in chemistry in the first grading period. The *students' perception questionnaire* as well as the *laboratory exam* was administered to the participants at the end of the first grading period.

Collection of data

The researcher uses questionnaire for data collection. There were two types of data collected: rating and score.

The students rated the statements in *MI assessment* based on their degree of resemblance on the stated event or scenario. The instrument that contains ratings from each participant was collected and encoded in the internet by the researcher in order to find out the multiple intelligence profile and the dominant intelligence. The *students' perception questionnaire* likewise gave ratings which were tallied by the researcher. From the ratings, the most liked MI-inclined chemistry activity of each dominant intelligence type was determined.

The achievement test and laboratory exam gave a score data. The essay part of the achievement test, likewise, had a scored answer based on the rubrics. These scores were converted into equivalent score.

Analysis of data

The statistical tool used in the data analysis is one-way ANOVA. Santos (2006) said that ANOVA is used to test the hypothesized non significance difference among

several groups. Analysis of variance is a statistical procedure for testing the hypothesized equality of two or more population means.

In order to use ANOVA, the researcher organized the data by combining the performance of the participants that have the same dominant intelligence. It was then that the ANOVA statistical tool in Microsoft Excel and SPSS version 20 were used to find out the non- significance difference in the performance among the group. When the ANOVA indicates a significance difference in the performance, the researcher made a follow up statistical procedure by using *Scheffe post hoc test*. Lewis (2004) said that it is a test to determine particular pair of mean in an analysis of variance that had shown significant differences. This statistical tool is suitable for groups with unequal sizes.

The research procedures that were explained above can be represented by the figure 2 on the next page. It is a flowchart that gives a clear understanding of methodology at an instant.

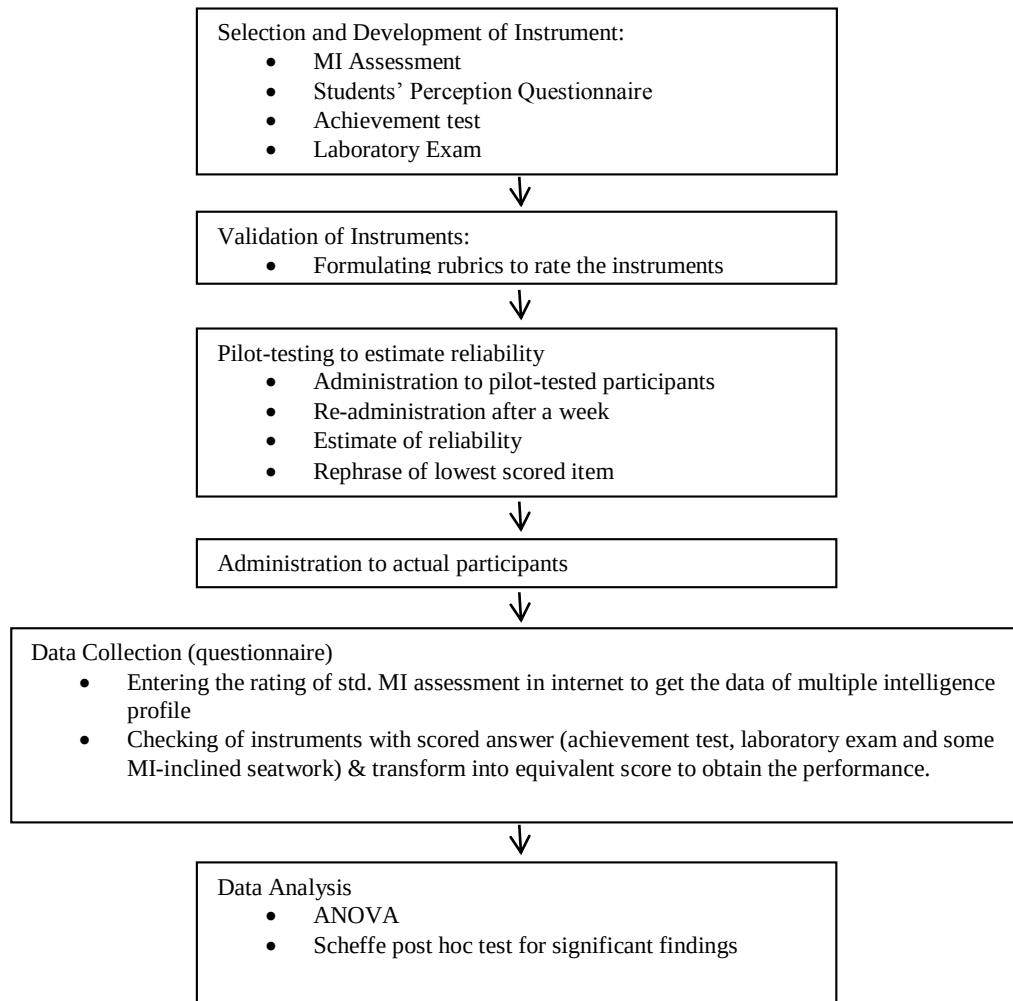


Figure 2 Data Research Procedure Flowchart

Data Analysis

One-way ANOVA was used in data analysis procedures. Santos (2006) said that ANOVA is used to test the hypothesized non-significance difference among several groups. Further, Scheffe hoc post- test was used to determine what particular pair of groups had significance difference. Lewis (2004) said that it is a test to determine significant difference of mean in a direct pairwise comparison. This statistical tool is suitable for groups with unequal sizes.

Chapter IV

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

Dominant intelligence profile of the grade 7 chemistry students.

The identified dominant intelligence among the research participants were: verbal, mathematical-logical, visual-spatial, bodily-kinesthetic, musical-rhythmical, interpersonal and naturalist intelligence. There were unequal numbers of participants in these intelligence types. Most students are naturalistic. There were nineteen participants out of fifty-nine (19/59) in this type of intelligence. Aside from the biological aspect and culture, the most obvious reason of the dominance in naturalistic intelligence may be due to environment. This may be accounted by the fact that participants are located in the midst of nature-rich environment. When Solapur (2014) compared the naturalist students from the rural and urban areas, he found out that naturalistic students from the rural areas were bigger in percentage compared to the counterpart.

The next highest numbers of students in dominant intelligence groups were: logical, bodily-kinesthetic and intrapersonal. Eight out of fifty- nine (8/59) participants belong to these types intelligences. There were five (5/59) participants who have dominance on visual-spatial and musical intelligence. Four (4/59) participants were in interpersonal intelligence.

The group that contains the least number of students was verbal-linguistic group. There were only two (2/59) participants in this type of intelligence.

Furthermore, the actual number of students in identified intelligence types is given by the table 12. This data was taken from the result of the pre-MI assessment (appendix F).

Table 12

The distribution of students in DI group

DI group	# of students	Percentage
Verbal	2	3.39
Logical	8	13.56
Visual	5	8.47
Kinesthetic	8	13.56
Musical	5	8.47
Social	4	6.78
Self	8	13.56
Naturalist	19	32.20
Total	59	100

By looking at the result of the multiple intelligence assessment, the rating of the class on each type of intelligence showed that the participants have dominant naturalistic form of intelligence. The result just confirmed the participants' preference and inclination since they reside in a nature-rich environment.

Nature and nurture, as well as genes affects one's form of intelligence. Actually, Gardner 1983 in Brualdi (1996) says that the development of this forms of intelligence depends on both biological and cultural aspects. Culture varies in different place and it values different forms of intelligence differently. This fact provides the motivation to become skilled or inclined in particular areas.

The table 13 shows the mean rating of the class on the eight identified intelligences. It shows the mean rating of the participants in a pre and post-test of multiple intelligence assessment.

Table 13

Mean rating of responses in pre- and post- Multiple Intelligence Assessment

	I	II	III	IV	V	VI	VII	VIII
Pre	3.01	3.12	2.97	3.07	2.87	3.01	3.18	3.54
Post	3.12	2.96	2.97	3.22	3.00	2.88	3.00	3.45

Note. I-Verbal, II-Logical, III-Visual, IV-Movement, V-Musical, VI-Social, VII-Self, and VIII-Naturalist. The data are the mean rating of the participants in multiple intelligence assessment.

The highest rated intelligence was naturalistic intelligence. The dominant intelligence group which had the next highest rate was bodily- kinesthetic intelligence. The physical activities in the school which they like most, for instance, the “sports program” that was conducted by the teacher-in-charge to reduce the skipping of classes and going home may affect this situation. Moreover, the high level of physical activity where students just walk from about 5 steps to about 5 kilometers in going to school every day makes them agile in endeavors related to bodily- movement.

It was also determined that the visual-spatial intelligence were rated the least. At the start of the first grading period (start of research study period), it was noted that research participants have lowest inclination to visual-spatial intelligence. It can be observed that the mean of strength of each intelligence group was close to one another. The mean rating

just went from rating of 3 to a rating of 4 which have description of “*the statement describes you somewhat*” to a little above “*describing you pretty well*”.

Academic Performance

The succeeding presentation of data includes the *performance* of the participants in various *chemistry activities*. These chemistry activities were: MI-inclined seatwork activities, laboratory exam, and achievement test. In addition, the overall performance of the participants was also find out and explained in terms of their academic grade. As such, this section which presents the performance of the participants in various area is termed academic performance.

MI-inclined Seatwork Performance– this refers to a reinforcement given to students to work on individually after each discussion of lessons. Table 14 has the list of seatwork which showed distinct inclination to particular intelligence. It can be seen that in seatwork alone, the tapped intelligences were naturalist, visual, math, and linguistic but with dominance from two former mentioned intelligences.

The seatwork was grouped into four categories: seatwork inclined to verbal (SW #2 and 9), logical (SW #3), visual (SW #1, 6, and 7), and naturalist (SW #4, and 5). This type of chemistry activities were given to the participants within the time of the study. Seatwork inclined to the same particular intelligence was combined, and the average grade of each group was obtained. This process was done to prepare the data for the establishment of one-way analysis of variance. This analysis was used to determine whether MI- inclined seatwork would make any significant difference on the performance among the groups.

Table 14

The list of seatwork given to students and its identified inclined intelligence

Date	Seatwork	tapped MI
06-09-2014	Identify the types of variables in an experiment	Visual
06-11-2014	Write poems on solutions	Linguistic
06-16-2014	computation of concentration on solution	Math-logical
06-19-2014	classifying/identifying matter as elements or compounds	Naturalist
06-23-2014	classifying elements as metal, metalloids and nonmetals	Naturalist
07-01-2014	Write the electron configuration of elements by following the electron configuration mnemonics	Visual
07-03-2014	form compounds by criss- cross rule	Visual
07-07-2014	Classify household chemicals as acid or base	Naturalist
07-24-2014	What is the importance when acid combines with base?	Linguistic

Seatwork inclined to verbal intelligence – the Figures 3 and 4 is the seatwork related to verbal intelligence. The first figure was about writing poem on solution followed by the essay on neutralization. This kind of seatwork enabled the researcher to see what group would perform significantly better on verbal intelligence inclined seatwork.

Kwen (2002) suggests chemistry activities inclined to verbal intelligence as writing poetry such as chemical limericks and making stories on environmental problems. In this

study, the researcher gave writing of poem on solutions and essay on neutralization. The figures below has the content of the chemistry seatwork for verbal-inclined activities.

Seatwork #2

Make your own poem of solution with the following components :

- Solute
- Solvent
- Concentration
- Saturated
- Unsaturated

Rubrics

10 –all of the components were mentioned and have a very good poem construction

9-all of the components were mentioned and good poem construction

8-all of the components were mentioned but have fair poem construction

7-one component was not included

6-two components were not included

5-three components were not included

4-four components were not included

3- Poem writing really needs improvement

1-2- tried (attempted) to write a poem/not finished

Figure 3: This was seatwork number 2

Seatwork #9

Direction: Construct an essay by answering the question below

"What is the importance when acid reacts with base?"

Note: when acid reacts with base, this is called neutralization.

Figure 4: This was seatwork number 2

Table 15 shows the mean performance of the groups in a verbal-linguistic inclined seatwork activity. It shows that in this type of seatwork activity, the linguistic group has the highest mean performance. This rank in mean performance is followed by the interpersonal group. The least performer group in verbal related seatwork activity is the logical. The rest of the groups seemed to have at par mean performance.

Table 15

The mean performance of the groups on verbal-inclined chemistry seatwork

Group	Mean	N	Std. Deviation
I Verbal	84.50	2	0.71
II Logical	79.38	8	1.90
III Visual	79.60	5	1.64
IV Movement	81.19	8	1.98
V Musical	83.00	5	2.45
VI Social	83.50	4	3.63
VII Self	79.81	8	3.92
VIII Naturalist	82.13	19	2.97
Total	81.35	59	3.00

Note. The mean column refers to the mean equivalent grade of the groups in verbal-logical inclined seatwork activity.

To find if there was significant difference in the performance of the intelligence group, one-way ANOVA was used. Conducting a Scheffe post hoc test was made further to find out the significant differences in particular pair of groups. Lewis (2004) said that it is a test to determine which means or combination of means in an analysis of variance when an overall F-ratio for those means in that analysis was significant and when such differences had not been predicted prior to the analysis. It is suitable for groups of unequal sizes. The table 16 is the summary table of the ANOVA in finding significant difference in the performance of the groups in verbal – inclined seatwork activity.

Table 16

ANOVA on verbal inclined seatwork performance

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	129.19	7	18.46	2.39*	0.03
Within Groups	393.93	51	7.72		
Total	523.13	58			

* significant at 0.05

Unfortunately, based on the result of post hoc analysis (appendix M), not a single pair of group showed significant difference in the performance using among either the post hoc tests: Scheffe, Benferronni and Tukeys hsd test. There are numerous situations where an ANOVA procedure identifies a significant difference but none are identified in post-hoc analysis in any pair of groups. One situation that may arise is when the post-hoc analysis is too conservative. This might come from using something like the Bonferroni test or result from the sample size (e.g. if it's too small and thus yields limited power). The other situation, which is quite common, arises when running a more complex ANOVA - repeated measures, especially. Remember that the ANOVA comparisons, whether between subjects or within, provide comparisons reliant on different means combinations. Therefore, significant differences may appear between the different means combinations but none come-up when performing direct pair-wise comparisons between the individual groups.

However, by looking again at table 15, based on the mean performance the groups; verbal group as well as the interpersonal group outperformed other groups in verbal-

inclined seatwork activity. This result just implies that giving verbal intelligence–related seatwork or verbal-linguistic inclined chemistry activities to the participants would result to a biased performance. The group’s means indicated that verbal, together with interpersonal group, would monopolize the situation.

Even though there was no significantly difference in performance, the table 15 shows noticeable data that the following pair of groups had somewhat great *dissimilarities* in mean performance in verbal-inclined seatwork activities. These pair of groups were: linguistic vs. logical; linguistic vs. visual-spatial; logical vs. musical, logical vs. social; and visual-spatial vs. musical. This difference in the mean was also indicated by the post hoc analysis (appendix M).

The dissimilarities among some pair of groups, based on the mean, can be explained. It may lie in the fact that there were only two participants in this group. It turned out that the two participants had both high score in verbal intelligence related seatwork activities. The chance of getting both high score from the members of the group is high since there were only two of them. Increasing number of members has increasing number of chance to have both low scores and high scores as well. The reason could lie also on the fact that linguistic inclined seatwork activities are the preferred types of activities by the verbal-linguistic group.

There was also obvious difference between: logical vs. musical and visual-spatial vs. musical, in favor of the latter groups. Musical intelligence might be more close to linguistic intelligence when it comes to verbal or word activities than logical intelligence do. Though, the result of the study is quite contradicting to other researches because dominance on logical mathematical necessitates one to be good in language

comprehension. Abedi & Lord (1995) found out that language proficiency is a factor in mathematics performance. On the other hand, West in 1991 in Sword (2011) says that verbal and logical were both associated with the left hemisphere part of the brain. They both process information and questions in a step-by-step process. However, the only reason that a researcher can give is that, the verbal-linguistic seatwork activities given to the participants were about composing of poems and writing essays which are verbal dominating activities. Most inclined in math may be associated with language comprehension but most math- inclined people have difficulty in constructing words. They may have high reasoning ability but this is about on reasoning abstractly and quantitatively. “Mathematical inclined participants may be low in practical fluency”.

Similarly, the obvious dissimilarities in the performance of visual- spatial and musical in favor of the latter group may also lie on the fact that visual spatial is more on picturing the scene but musical inclined people may work like linguistic especially in composing poems. Musical inclined people have high inclination also on rhythmical properties which the poems also possess.

Seatwork inclined to Logical-mathematical intelligence –This type of seatwork activity assesses the students’ inclination to logical-mathematical intelligence. Kwen (2002) suggests solving problems on environment as chemistry activities inclined to logical intelligence. In this study, the researcher gave problems on computation about the concentration of solution. The figure 4 shows the content of this kind of seatwork activity.

Seatwork #3

Read the situation below and answer what is asked on the problem.

The label of the 200-ml rubbing alcohol that Mrs. Herrera bought shows that it contains 40% ethyl alcohol. What is the volume of ethyl alcohol that the rubbing alcohol contains? Show your calculations.

Place your answers here:

Given data: (2 pts) _____ Answer: (2 pts) _____

Formula: (2 pts) _____

Solutions: (4 pts) _____

Figure 5: This was seatwork number 3

Table 17 shows the mean performance of the group in seatwork related to logical-math intelligence. The logical group has the highest mean performance in this type of SW activity. This was followed by the naturalist group.

Table 17

The mean performance of the groups on logical- inclined chemistry seatwork

Group	Mean	N	Std. Deviation
I Verbal	79.00	2	1.41
II Logical	82.50	8	4.14
III Visual	79.80	5	2.05
IV Movement	79.50	8	3.07
V Musical	79.80	5	3.03
VI Social	81.50	4	4.44
VII Self	79.38	8	5.76
VIII Naturalist	81.32	19	4.42
Total	80.64	59	4.07

However, it is also noticeable that there was no great difference among the groups in terms of the mean performance. Most of the groups however, had *developing proficiency* performance. Developing proficiency are ratings of students' performance that ranges from 75 to 79. Although, the mean performance of the group does not deviate much, they have lower ratings in this kind of seatwork activity.

To find out the significant difference in the performance of the group of intelligence in math-logical inclined seatwork activity, one-way ANOVA was used. The result was presented in *Table 18*. It has an F value of 0.62 compare to critical value of 2.19. The result would mean an acceptance of the null hypothesis.

Table 18

ANOVA on logical inclined seatwork performance

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	74.95	7	10.71	0.62	0.74
Within Groups	884.58	51	17.35		
Total	959.53	58			

The table 18 indicates no significant difference among the group in the math-logical inclined seatwork activity. Math-logical seatwork activity brought no gap of performance among the groups. They perform at par with one another when it comes to numerical tasks.

However, looking by looking again at *table 17*, the logical group had highest mean on this kind of seatwork, and naturalist together with interpersonal group followed next. Unfortunately, most groups had low mean performance for the math–inclined seatwork.

The researcher found out that giving math-related seatwork and activities to these students most of the times would result to low performance of the majority of students. Further, the logical –inclined seatwork activities will favor few groups of students, the logical group particularly. It cannot be avoided that topics must be presented in logical-mathematical way as the learning competencies require the teachers to do it. But in order to avoid inactive learning process, the teacher must focus more in other strategies that will neutralize the weakness of the class in this type of seatwork activities. For example, in giving math-inclined activities to this type of MI profile of students, the teacher may have a peer tutoring or pair scheme in the answer. The teacher may also conduct this type of seatwork activity by group to enhance the interpersonal intelligence. Students that are weak in logical-mathematical intelligence may be improved by the coaching and brainstorming within the group.

Seatwork inclined to visual-spatial – The figures 6, 7, and 8 on next page display the seatwork related to visual-spatial intelligence. The visual-related seatwork was all about analysis of graph, following mnemonics, and combining compounds. The first figure is about interpreting/analyzing a table. The second figure is about following mnemonics. The third figure is about crisscross rule.

Seatwork #1				
The table below was Maria's obtained data of her experiment on the three type sugar. Answer the questions below that follow below the table.				
Maria's experiment				
TYPE OF SUGAR	MASS OF SUGAR (in grams)	AMOUNT OF WATER	TEMPERATURE OF WATER	TIME THE SUGAR WAS COMPLETELY DISSOLVED (Comparison)
Refined	5 grams	200ml	Boiling	Was dissolve in short period of time
Granulated	5 grams	200ml	Boiling	Long period of time
Sugar cube	5 grams	200ml	Boiling	Very long period of time
A. Identification: each correct answer has two points. 1. What is the independent variable? _____ 2. What is the dependent variable? _____ 3. What is/are the control/s? _____ B. Essay (maximum of 5 points with rubric below) 5-very good explanation 2-poor explanation 4-good explanation 1- the explanation needs improvement 3-fair explanation Question: What is your interpretation of the result of Maria's experiment? (What happened to the three types of sugar?)				

Seatwork #6

Direction: Write the electron configuration of the listed elements below by following on the electron configuration mnemonics provided.

NOTE:
 $s \leq 2$
 $p \leq 6$
 $d \leq 10$
 $f \leq 12$

ELECTRON DISTRIBUTION MNEMONICS

Elements:

1. ^{12}C	6. ^4C
2. ^3Li	7. ^{13}Al
3. ^{19}K	8. ^{27}Co
4. ^{11}Na	9. ^{16}S
5. ^8O	10. ^{12}Mg

Seatwork #7

Direction: Combine two elements (in ion form) to make compounds. Make maximum of 10 compounds. You can use element more than once in pairing.

Place your answers here:

1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

Figure 6, 7 and 8 are visual-spatial inclined seatwork activities

Seatwork number 7 may seem a logical-math-inclined task, but the researcher decided to consider it as visual-inclined because there was no math operations involved. The students would just basically match two elements and would follow pattern in doing. Numbers would just be put as subscripts in crisscrossing. The students did this seatwork after discussion and with a sample on the board for them to follow.

Table 19 shows the mean performance of the groups in a cluster of seatwork related to visual-spatial intelligence. It can be seen from the table that the visual-spatial group has the highest mean performance. It is noticeable also that all the groups had high mean performance in this type of activities.

Table 19

The mean performance of the groups on visual inclined chemistry seatwork

Group	Mean	N	Std. Deviation
I Verbal	82.00	2	1.41
II Logical	81.50	8	2.65
III Visual	82.80	5	1.19
IV Movement	80.67	8	2.68
V Musical	81.40	5	3.25
VI Social	82.25	4	2.70
VII Self	81.04	8	4.77
VIII Naturalist	82.53	19	3.27
Total	81.82	59	3.10

Surprisingly, all groups got high mean performance from visual-spatial inclined seatwork activities when most of them rated low their inclination to this type of intelligence in standard MI assessment tool. The researcher concluded that following a pattern in doing activity (seatwork in this situation), contribute to having a higher performance. Whether they accept it or not, their visual- spatial intelligence works in order to get correct answer from just following another correct sample.

Compare to other intelligence-inclined seatwork, the mean of each group here were all approaching proficiency (approaching proficiency are grades ranging from 80 to 85 in the Kto12 Curriculum). This result would also imply that most students preferred to do work and activities inclined to visual intelligence. It further implies that the performance

of most students in the class would be higher if they were given visual-inclined seatwork more frequently. The researcher found out that giving seatwork related to visual intelligence would be fair to all students with varied multiple intelligences.

Table 20

ANOVA on visual inclined seatwork performance.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32.27	7	4.61	0.45	0.87
Within Groups	523.58	51	10.27		
Total	555.86	58			

The *Table 20* showed that when one-way ANOVA was employed to determine whether there is a significant difference in the performance of the groups in the seatwork inclined to visual intelligence, the F value of 0.45 compared to F critical of 2.19 was derived. At .05 level of significance, it was found out that there was no significant difference in the performance of the students in seatwork related to visual intelligence. It can be concluded that seatwork related visual-spatial intelligence will bridge the gap in the performance among the groups.

Seatwork inclined to naturalistic intelligence – The figures below are seatwork inclined to naturalist intelligence. They are all about classification of matter as: elements and compounds, metal, nonmetal, and metalloids and acid or base. Kwen, (2002) suggested

activities related to naturalist intelligence. These were: classify objects, events and phenomena according to natural surroundings, find origins and classify a given group of substances according to whether they are elements, mixtures, or compounds.

Seatwork #4

Direction: Classify the list of samples in the box as element or compound by putting them into the appropriate column provided just below it.

Cl	B	HBr
NaCl	Li	HCl
H ₂ O	CuSO ₄	
H	Sc	

Element	Compound

Seatwork #5

Direction: Classify the group of elements inside the box as metal, metalloid or nonmetal by putting (writing) them into the appropriate column provided just below it.

H	Hg	Te
Sc	Ar	O
Cl	As	
Si	S	

Metal	Metallloid	Nonmetal

Seatwork #8

Direction: Classify the listed household chemicals as acid or base.

Lye (lehiya)	Zonrox (bleach)	baking soda
Muriatic	Shampoo	baking powder
	Drain cleaner	Soap
Vinegar	Calamansi extract	

Place your answers here:

Acid	Base

Figure 9, 10 & 11 are seatwork no. 4, 5 and 8 respectively

Table 21 shows the mean performance of the groups in seatwork activity related to naturalistic intelligence. It can be seen from the table that the logical group as well as intrapersonal group have the highest mean performance. Naturalistic group followed third in rank.

Table 21

Mean performance on naturalistic inclined seatwork

Group	Mean	N	Std. Deviation
I Verbal	81.17	2	0.24
II Logical	82.71	8	3.68
III Visual	82.20	5	2.43
IV Movement	80.92	8	2.36
V Musical	80.13	5	5.05
VI Social	80.83	4	2.99
VII Self	82.71	8	3.70
VIII Naturalist	82.60	19	3.56
Total	81.99	59	3.37

It can also be observed from the table (table 21) that all groups had high mean performance in this type of seatwork activity. It is concluded that giving naturalistic inclined seatwork activity will enhance the performance of the students. It bridges the gap between the groups as well. There is a close challenge among the groups in this kind of

seatwork. Meaning, the dominance of a single group was avoided and a fair endeavor was established in the classroom consisting of varied forms of intelligence.

Grade 7 chemistry has lots of topics which can be used to tap naturalistic intelligence of the learners. More of this kind of seatwork ensures higher classroom performance among the participants. If they would be given visual and naturalistic intelligence alone, they could have had higher academic grade. The way the seatwork inclined to naturalistic intelligence went really matched the innate inclination of the learners.

Table 22 shows the summary table of one – way ANOVA in SW related to naturalistic intelligence. At 0.05 percentage or error, it was found out that there was no significant difference among the groups' mean performance. This inferred of the rejection of alternative hypothesis.

Table 22

ANOVA on Naturalistic inclined seatwork performance

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	48.63	7	6.95	0.58	0.77
Within Groups	609.81	51	11.96		
Total	658.44	58			

Overall analysis of seatwork performance

The researcher found out that giving seatwork inclined to naturalist intelligence would enhance the performance of the entire group in Grade 7 chemistry subject as visual

intelligence-inclined seatwork would also do. Chemistry for grade 7 works more on the diversity of materials and the researcher view it as chemistry on our surroundings. There has not been in-depth topics involve in the module. There are great chances that chemistry activities in this level could be presented in naturalistic way.

Silverman (2014) in “*Why all students need Visual Spatial Method*” said that one-third of 750 participants in her study entitled Visual Spatial Identifier were strongly visual-spatial learners, and another 30% were moderately visual spatial. This data strongly supported the result of this study that most students preferred to learn through visual intelligence-inclined activities. This was based on the computed value that the entire groups of DI performed well in visual related seatwork. But visual group had no consistent, very well performance in other intelligence–related seatwork.

One way to be fair in teaching of chemistry for grade 7 is to give visual intelligence-related activities and seatwork more frequently. As mentioned earlier, chemistry for grade 7 can be taught in varied ways involving visual-spatial and naturalistic way because it does not yet involve highly mathematical processes. It was also found out that the naturalist intelligence-inclined seatwork were as good as visual intelligence-inclined seatwork in making the performance of the students become moderately higher compared to other kinds of seatwork. This performance from seatwork may be associated to the class’ high rating on naturalist and visual intelligence in MI assessments.

Laboratory Exam Performance

This refers to the accomplishments of the participants in the laboratory exam (paper-and-pencil test). The items of which were obtained from all the actual laboratory

activities conducted throughout the first quarter. This instrument will present what group would perform significantly better in laboratory exam. The table 23 shows the list of activities. Some of the activities were teacher-made. The procedures of those activities taken from the module can be seen in the teachers' guide for grade 7 science.

Table 23

List of laboratory activities (experiments) performed by the students

Date	Laboratory Activities
06-05-2014	What type of sugar will dissolve faster tap water?
06-06-2014	Which will dissolve in hot and in cold water: Sugar or salt?
06-11-2014	Preparing saturated and unsaturated solution
06-18-2014	Comparing the properties of pure substance and mixtures
07-10-2014	Making eggplant indicator
07-25-2014	^a Cite proper ways of handling strong acids and bases

Note. The procedures for the above listed activities can be seen from the science 7 teacher's guide of grade.

^aTeacher-made activity

The list of activities indicated in the table above were bases of the performances of the groups in actual group experiments. The group is consist of students with different dominant intelligence to attend to various roles such leader, writer, elaborator and the likes which might favor him to learn concepts better by doing work within his interest.

In the presentation of the outputs of the activities, several other intelligences such as linguistic, visual, naturalist, and intrapersonal may also be motivated and contribute to the performance of the group. The roles that these dominant intelligences do includes

writing, leading, classifying, making graphs/tables, drawing, acting, singing, and much more. After all the laboratory activities, the students were given laboratory exam (Appendix L).

Table 24

The mean performance of the groups on laboratory exam

Group	Mean	N	Std. Deviation
I Verbal	80.50	2	3.54
II Logical	81.50	8	6.09
III Visual	82.20	5	2.59
IV Movement	81.75	8	3.88
V Musical	84.80	5	4.55
VI Social	86.50	4	4.20
VII Self	80.63	8	6.14
VIII Naturalist	85.16	19	5.68
Total	83.24	59	5.30

Table 24 shows the mean performance of the groups in the laboratory exam. The interpersonal as well as the naturalistic group had the highest mean performance in laboratory exam. It can also be observed that the mean performance of all groups were high compare to the mean performance in the achievement test. The researcher concluded that the performance will be enhanced if the items were taken from the students' actual experience of performing the experiments, rather than on taught concepts alone.

The summary table of one-way ANOVA in table 25 indicates that at .05 level, the computed F value of 1.27, compared to the F-critical value of 2.19, showed no significant difference in the mean performance of the groups in laboratory exam. The researcher cannot imply that this result was due to the influence of the students' use of their intelligence in social, music, and naturalistic intelligence during the classroom activities such as in the presentation of output. In other words, the number of times, the participants uses their dominant intelligence in an experiment and presentation of output has no direct relation with their mean performance in laboratory exam. In fact, musical intelligence was used rarely in the presentation of the output for the activity. But it turns out that musical intelligence has the highest mean performance in the laboratory exam.

Table 25

ANOVA on laboratory exam performance

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	241.68	7	34.53	1.27	0.28
Within Groups	1385.00	51	27.16		
Total	1626.68	58			

The results of the laboratory activities may be synonymously related to the study of Landsberg (2010) who found that giving supplemental kinesthetic exercises to students did not increase their exam result in chemistry. It can be summed that the utilization of one's strength or skill on a particular intelligence during actual activity would not influence his/her laboratory exam result in chemistry. The researcher in this study just saw the

positive effect of giving multiple intelligence inclined activities as a chance for the students to perform and participate in chemistry class. When the students are interested in what they are doing, there is a greater chance that they will perform the experiments at their best. This situation brings enhanced performance in the class.

Achievement test

The performance obtain from this instrument refers to the equivalent grade of the students from the result of their achievement test. It was noted, however, that the achievement test had average acceptable validity in recognizing the multiple intelligences of the students. However, it can be a basis in determining what group performs significantly better in chemistry subject regardless of how the questions in the test were constructed with respect to particular intelligence.

Table 26 shows the mean performance of the groups in the achievement test. It can be seen that there were great *dissimilarities* in the mean performance of some groups. The interpersonal group had the highest mean performance in the achievement test. This rank was followed by the logical-mathematical and naturalistic group. By looking again at the mean performance of the groups on achievement test presented in *table 26*, the following pair of groups showed noticeable *dissimilarities* in performance. These are: Logical vs. kinesthetic; visual-spatial vs. social, kinesthetic vs. social; kinesthetic vs. naturalist, and intrapersonal vs. naturalist.

The table 26 was presented next of this page. The mean difference between these pair of groups can be seen in appendix N.

Table 26

The mean performance of the groups in achievement test

Group	Mean	N	Std. Deviation
I Verbal	80.50	2	3.54
II Logical	81.13	8	2.95
III Visual	78.60	5	1.82
IV Movement	77.13	8	3.04
V Musical	80.20	5	2.39
VI Social	82.50	4	1.29
VII Self	77.25	8	5.06
VIII Naturalist	81.32	19	3.83
Total	79.90	59	3.78

Based on the results of the one-way ANOVA shown in *Table 27*, a computed F value of 2.39 compared to F critical of 2.23 means that there were significant differences in the achievement result of the dominant intelligence group. At .05 level of significance, it can be observed that interpersonal intelligence was the group that performed well over other DI groups based on the mean.

Next from interpersonal group, the most active intelligence group were naturalist and visual-spatial group among chemistry experiments (laboratory activities) and seatwork activities. Analogously, they are also the group that perform well in the achievement test based (based on table 26). This could only signify that MI inclined seatwork and other chemistry activities would affect achievement. In this study, doing activities inclined to

any particular intelligence more often, such as in laboratory activities and seatwork activities would mean a possibility of increased achievement test performance. The result in this study is in contrast with the study of Landsberg (2010) where he found that giving supplemental kinesthetic exercises to students did not increase their exam result in chemistry. The researcher in this study saw the positive effect of giving multiple intelligence-inclined activities to the students a chance to be attentive to what they were doing because it is within their scope of interest. This kind of situation is thought to help students understand more of the concept in lessons. In the recommendation, the correlation of these variables (*most used dominant intelligence in chemistry activities and performance*) was encouraged to be correlated and investigated in an experimental method.

Table 27

ANOVA ON achievement test performance

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	204.54	7	29.22	2.39*	0.03
Within Groups	622.86	51	12.21		
Total	827.39	58			

***significant at 0.05**

Unfortunately, when Scheffe post hoc test (Appendix N) was conducted, there were no significant differences in the performance between any pair of groups. Again, the result might have arisen from too many unequal sample size of groups which gave high errors. The significant difference in the performance of the groups in achievement is too low (F

value of 2.39) and may just a coincidence of too many unequal sample size thus when post hoc was conducted, no significant difference of performance from pairwise was obtained.

Academic grade

This refers to the final grade of the students for the first quarter which was obtained from four components of the grading system. The academic grade was investigated in the same way because this is the result of the performance of the participants in the entire endeavor in chemistry subject. The table 28 shows the academic grade of the groups in chemistry.

Table 28

The mean performance of the groups in academic grade

Group	Mean	N	Std. Deviation
I Verbal	78.00	2	5.66
II Logical	80.13	8	4.45
III Visual	78.00	5	2.55
IV Movement	77.13	8	3.48
V Musical	79.60	5	3.78
VI Social	82.00	4	1.41
VII Self	76.75	8	5.73
VIII Naturalist	80.95	19	3.73
Total	79.36	59	4.18

The Table 28 shows the mean academic grade of the group when all the components of the grading system were summed up. Interpersonal group had the highest mean academic grade. This is followed in rank by naturalistic. The least performer is the intrapersonal (self) and bodily-kinesthetic groups. The visual group had low mean performance probably due to the fact that their inclination can only be seen in written activities.

To determine if there was a significant difference in the academic grade among the groups of dominant intelligence, one-way ANOVA was employed. The *table 29* shows the summary table of one-way ANOVA in finding significant difference in the academic grade among the groups. The result shows that the computed F-value of 1.66 at .05 estimate of error indicates that there was no significant difference in achievement among the students in the groups of dominant intelligence.

Table 29

ANOVA of academic grade performance

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	188.13	7	26.88	1.66	0.14
Within Groups	825.40	51	16.18		
Total	1013.56	58			

According to Wright (2004), there are several studies that explored the nature of abilities that contribute to learning chemistry. Ability in logical-mathematical thinking and linguistic proficiency, as well as the ability to visualize spatial relationships, seems to be

the key to achieving in chemistry. Another study was by Martinez (2002) who found out that interpersonal, naturalist, intrapersonal, verbal, and logical students performed better in chemistry achievement compare to other intelligences

However, by looking again at the *table 28*, it revealed that when different roles were allowed in activities by mixed students within the group, the gap between the intelligences groupings in terms of their academic grade were reduced. When students show interest in what they are doing, this will affect their performance and grade positively. The dominance of a single or few groups were diminished. In this study, in addition to the findings that utilization of one's dominant intelligence during experiments and in presentation of output increased achievement test, the researcher also perceived that doing such things within their interest will make an individual gain added performance that make his grade to be at par (competitive) with other intelligences. It might be true that there was significant difference in the performance among the group in the achievement test in favor of interpersonal group particularly, but surprisingly the academic grade did not show any significant difference. This result may be due to the opportunity that the researcher has given to all forms of intelligence to perform in other aspects within and outside their inclination, thus is fair to all.

Most Appreciated MI-inclined Activity

The researcher investigated on what MI-inclined chemistry activities were most appreciated by the class. To make this happen, the students' perception questionnaire was used. The obtained data can be very helpful in planning of what chemistry activities have to be given to the actual participants in the future. This can also be a basis in conducting

similar study in other classes. They rated these activities based on the degree of their likeness or appreciation based on their estimation of their feelings.

The ratings of each MI-inclined chemistry activity have shown that the activities inclined to visual-spatial intelligence were mostly appreciated. This is followed by activities inclined to interpersonal intelligence. As to interpersonal-inclined activity, the students appreciated the group activity where they could perform cooperatively. The lowest rating of appreciation belongs to mathematical- logical inclined chemistry activities.

The Table 23 shows the mean rating of the participants in various MI-inclined chemistry activities. As may be gleaned from the table, the chemistry activities inclined to visual intelligence had the highest mean rating of 7.44. This finding implies that the most appreciated activity and lesson inclined to visual intelligence. This result is in consonance with the findings of Silverman (2014) who found out that one-third of his 750 student-participants were strongly visual-spatial, and another 30% were moderately visual-spatial.

Table 30

The mean rating of most appreciated MI inclined chemistry activities

DI	I	II	III	IV	V	VI	VII	VIII
Ratings	6.78	6.20	7.44	6.37	6.61	7.12	6.39	6.83

Note: the data were the mean rating of 59 students for: I-verbal, II-logical, III-visual, IV-kinesthetic, V-musical, VI-social, VII- intrapersonal and VIII-naturalistic inclines chemistry activities.

The results also showed that the chemistry activities inclined to naturalist intelligence had very high mean rating. It contradicts however, on the result of standard MI

assessment because the statements describing the visual-spatial intelligence from the said instrument were the least rated.

Based on the actual result of *students' perception on chemistry activities* (instrument), the majority of the class really liked visual-spatial intelligence inclined chemistry activities. As a whole, fifteen (15) of the fifty-nine (59) students like this type of activities in chemistry which include watching video clips and following the patterns in periodic table among others. The mentioned activities were inclined to visual-spatial intelligence.

Moreover, there were eleven (11) students who liked naturalistic intelligence inclined activities. Some of these activities include classifications of matter like classification of elements vs. compounds; metal, nonmetal and metalloid; acids vs. bases and so forth. Ten (10) students liked chemistry activities inclined to linguistic intelligence. These activities include writing poems and reading and writing journals and essays. Seven (7) students liked musical intelligence inclined chemistry activities. They sing or rap before the presentation of their laboratory activity as a form of motivation, ice-breaker or introduction. Five (5) students liked logical intelligence inclined chemistry activity and another five (5) liked kinesthetic inclined activities. Respectively, these activities include solving on problems in chemistry and manipulation of apparatus during experiments. The intrapersonal intelligence inclined activities got the lowest number of students. There were only two (2) students who liked this kind of chemistry activity. It includes thinking for one's own growth as influenced by chemistry activities.

Looking at different view could give us knowledge that even if one's dominant intelligence is identified, his preference of chemistry activities might be different. When it

was investigated what type of chemistry activities was preferred per group of dominant intelligence, the following results were obtained:

The linguistic group preferred musical inclined activities. There were only two participants in this group. The two of them liked chemistry activities related to musical. Majority of the logical group and visual-spatial group preferred visual-spatial intelligence inclined activities. Six (6) of eight (8) from kinesthetic groups preferred the activities inclined to visual-spatial intelligence too. Musical group preferred doing musically inclined activities in chemistry. Interpersonal group was halves into doing logical-mathematical and naturalistic intelligence inclined activities. Intrapersonal likes visual-spatial and kinesthetic inclined activities. Majority of the naturalist group liked naturalist intelligence inclined activities. This is followed by a number of students from the same group who liked verbal intelligence inclined activities. The data just proved that these multiple intelligence rarely act independently of each other.

Gardner (2011) says that these intelligences complement each other. That is, though a person has dominant logical intelligence, he may prefer using his visual intelligence in the understanding of numbers which he likes most. Another way to put this is graph analysis helps one see the solutions for math problems. Furthermore, the students did not show any great difference in their performances in the various assessments like seatwork and paper-and-pencil tests. This was confirmed by the post hoc test that the significant result of the ANOVA on some performances was just by chance due to high errors brought by the large unequal sample size of the groups.

It is true that in some seatwork inclined to particular MI, there was a significant difference in the performance among the groups, but according to the researcher's point of

view, the differences in most chemistry activities, when look at the means, were not great. This result may be attributed to the fact that the students were not highly skilled yet in their dominant intelligence. The MI assessment measured their highest preference or inclination to a particular intelligence, and this became the basis of the researcher in determining their dominant intelligence. However, this does not mean that they were as equipped personally as what the statements in MI assessment were saying. The dominant intelligence of the students were not yet fully developed or honed. It was just the intelligence that mostly emerged after the MI assessment.

Teaching and assessing learners to a broader range of talents and skills are ideal especially when the students are really heterogeneously skilled and have already shaped their dominant intelligence. However, unless the goal is to shape the students in their most preferred skill, doing so with learners who have yet to improve their dominant intelligence would result in a low class performance. It must be done in MI schools.

If the goal is to achieve active participants, the teacher must look for a common strategy where majority of the class would perform equally well. This would eliminate dominance of a single or few groups. The students may vary in dominant intelligence, but they can have a common way of accumulating learning. They can have common way of showing learning, as according to Gardner, these multiple intelligences are interdependent (dependent of each other).

Implication to teaching

One way to be fair to students with varied multiple intelligence is to give them activities where all of them perform, far from the dominance of a single or few groups.

The researcher

It was seen that the participants perform their best if allowed to do what they prefer to do in an activity. With varied activities in which they can perform his inclination to a particular intelligence, their performance becomes competitive. This means that they can participate in the class in their unique ways so that not only logical-mathematical or few groups of DI would be actively dominating the class. What the students do in the class contributes to the accumulation of learning, thus will affect the academic grade. Therefore, the insignificant difference in achievement and performance came from the reduction of discrimination or gap between the logical-mathematical intelligence and other intelligences in chemistry class. This result contradicts some studies and notion that logical-mathematical intelligent individuals perform and achieve significantly better in chemistry than students with other intelligences.

Moreover, in giving seatwork, the teacher must choose an activity that most students prefer or have an inclination to it. In this way, the failure of most students in chemistry subject would be reduced. The participants in this study showed preference to learn through visual approach in seatwork activities. West in Silverman (2014) quoted that the 21st century employees will require strong visual skills: ready recognition of larger patterns, intuition, and a sense of proportion, imaginative vision, the original and unexpected approach, and the apt connection between apparently unrelated things. This idea from West matches the result of this study that showed higher mean grade for visual-related seatwork performances of the students. In sum, educators should focus more on the preference of the learners in learning and on what the future requires from them. Working with visuals and games they like, probably are the most suited strategies nowadays.

Chapter V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the summary of the study, findings, conclusions, and recommendations.

Summary of Findings

This study aimed to investigate the influence of the chemistry activities on students' academic performances when they were grouped according to dominant intelligence using the standard MI assessment in pre- administration.

Based on the sub-problems, the following findings were obtained:

1. The Dominant Intelligence Profile of Participants

Using the Multiple Assessment, the percentage of students in the group of dominant intelligence were as follows: Verbal, 3.4%; Logical, 14%; Visual, 8.5%; Movement, 14%; Music, 10.2%; Social, 6.8%; Self, 14%; and Naturalist, 34%.

The intelligence that had the highest mean rating was the Naturalistic intelligence. Its strength remained regardless of two assessments: the MI assessment tool and the students' perception questionnaire. This dominance of the participants in Naturalistic intelligence may be attributed to the location which is a nature-rich environment. As mentioned previously, the research participants' location faces seas and islands and is situated in the foot of arched mountains.

2. Academic Performance

2.1 MI-inclined Seatwork Performances

2.1.1 Verbal inclined seatwork activities- There were significant differences in the performance of the groups in verbal intelligence inclined seatwork activities. The verbal group outperformed other groups of students. The reason could lie in the number of students in verbal group. There were only two (2) students in this group and may, by chance, get higher equivalent scores. However, Scheffe hoc post-test in Appendix M showed no significant differences in the performance between any pair of groups.

2.1.2 Logical-Math inclined seatwork activities- There were no significant differences in the performance of the groups in math-logical inclined seatwork activities. However, most of the groups, other than the logical, have lower performance based on the mean.

2.1.3 Visual-Spatial intelligence inclined seatwork activities- There were no significant differences in the performance of the groups in visual-spatial inclined seatwork activities. It was also observed that most of the groups got higher mean performance. Visual-spatial inclined activities seemed to be the key of how the majority of the participants would perform better in chemistry despite of their dominant intelligence.

2.1.4 Naturalistic inclined seatwork activities- There were no significant differences in the performances in the group of participants in naturalistic inclined chemistry activities. Likewise, this type of activity in chemistry

may be used often to reduce the gap among the dominant intelligences in the class.

2.2 Laboratory Exam- there were no significant differences in the performance of the group of participants in laboratory exam. When a student participates in performing chemistry activities because he has interest in doing it, the performance may become competitive. This is because when someone is part of doing a particular task he will remember how it was done, the materials in doing it, and so forth. During the laboratory exam (paper-and-pencil test), he will remember everything of it. The research participants got high scores in laboratory exam.

2.3 Achievement test result- There were significant differences in the performances in the group of participants in achievement test. The study showed that interpersonal group outperformed some other groups of intelligences. However, Scheffe post hoc test showed no significant differences in the performance between any pair of groups (appendix N).

2.4 Academic Grade- There were no significant differences in the performance of the group of participants in academic grade. Mixed grouping that allows students to do what his chosen role in chemistry activities may contribute to his competitive performance in class.

3. The highest rated MI-inclined chemistry activities in Students' Perception towards Chemistry Activities questionnaire are the activities inclined to visual-spatial intelligence.

Conclusions

Based on the obtained data and results of the study, the following conclusions were drawn:

1. Naturalistic is the participants' dominant intelligence.
2. Doing the preferred role in group activities gives one a competitive grade performance and at par laboratory exam result. Similarly, the class' common preferred chemistry activities are those related to visual-spatial intelligence. It brings competitiveness and bridges the gap of performance among the students with different dominant intelligence.
3. Visual-spatial inclined chemistry activity is the most appreciated and liked type of activities by the research participants.

Recommendations

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

1. The MI profile be conducted in the class using the standard assessment and use it for triangulation purposes in a study involving dominant intelligence and chemistry performance.
2. Conduct a study whether most tapped DI is a factor in chemistry performance.
3. Giving more MI-inclined activities suitable to the identified MI profile of the class is encouraged to make the students participate more actively in the class.

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Appendix A

MULTIPLE INTELLIGENCE ASSESSMENT TOOL

(from Dr. Terry Armstrong and made available online by literacy.org)

Name: _____ Grade & Section: _____

Instructions: Read each statement carefully. Choose one of the five buttons for each statement indicating how well that statement describes you.

Instruksyon: Maingat na basahon an kada pigsasabi. Pili-on an saro sa mga bilog sa kada in sasabi na nagpapaimod kun gaanu ini tumutukoy sa saimo.

1 = Statement does not describe you at all (*An pigsasabi dai tumutukoy sa saimo*)

2 = Statement describes you very little (*An pigsasabi tumutukoy saimo ke diit*)

3 = Statement describes you somewhat (*An pigsasabi tumutukoy saimo*)

4 = Statement describes you pretty well (*An pigsasabi tumutukoy saimo ke marhay*)

5 = Statement describes you exactly (*An pigsasabi saktong tumutukoy nanggad sa saimo*)

Statements/Mga ginsabi	1	2	3	4	5
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1. I pride myself on having a large vocabulary. ☐ ☐ ☐ ☐ ☐

Ipinagmamalaki ko an pagkakaigwa ko nin malawak na mga tataramon (bokabularyo).

2. Using numbers and numerical symbols is easy for me. ☐ ☐ ☐ ☐ ☐

An pag-gamit kan mga numero asin mga simbolo kaini ay masay sako.

3. Music is very important to me in daily life.

☐ ☐ ☐ ☐ ☐

An musika ay napaka-importante sakuya sa uro-aldaw na buhay.

4. I always know where I am in relation to my home.

☐ ☐ ☐ ☐ ☐

Aram ko kun sain an sakuyang kamugtakan sa samong harong.

5. I consider myself an athlete.

☐ ☐ ☐ ☐ ☐

Kinukunsidira ko an sakuyang sadire na sarong atleta.

6. I feel like people of all ages like me.

☐ ☐ ☐ ☐ ☐

An mga tawo sa palibot ko garo kaedad ko lamang sa sakong pamate.

7. I often look for weaknesses in myself that I see in others.

☐ ☐ ☐ ☐ ☐

Pirme ko pighihiling an sakuyang kaluyahan garo sa paghiling ko saiba.

8. The world of plants and animals is important to me.

☐ ☐ ☐ ☐ ☐

Importante sakuya an mundo san mga pananum asin mga hayop.

9. I enjoy learning new words and do so easily. ☐ ☐ ☐ ☐ ☐

Naoogma ako sa mga bag-ong tataramon asin naiintindihan ko an mga initulos.

10. I often develop equations to describe relationships and/or to explain my observations. ☐ ☐ ☐ ☐ ☐

Pirme ako nakahimo sin mga equations sa pagpapaliwanag kan mga relasyon asin obserbasyon.

11. I have wide and varied musical interests including both classical and contemporary. ☐ ☐ ☐ ☐ ☐

Igwa ako ke dakula asin iba-iba nahilig sa musika kaiba an parehong classical asin contemporary (uso ngunyan).

12. I do not get lost easily and can orient myself with either maps or landmarks. ☐ ☐ ☐ ☐ ☐

Dai tulos ako nawawara asin kaya ko hanapon an sakuyang sadire gamitang mapa o kaya mga palatandaan.

13. I feel really good about being physically fit. ☐ ☐ ☐ ☐ ☐

Magayon an namamatean ko sa pagkaka-igwa nin makusog na hawak (lawas).

14. I like to be with all different types of people. ☐ ☐ ☐ ☐ ☐

Muya ko na kaiba ako kan intero na klase kan tawo.

15. I often think about the influence I have on others. ☐ ☐ ☐ ☐ ☐

Pighuhurop-hurop ko pirme an sakuyang maitata-o na impluwensya sa ibang tawo.

16. I enjoy my pets. ☐ ☐ ☐ ☐ ☐

Naoogma ako sa sakong mga atamang hayop.

17. I love to read and do so daily. ☐ ☐ ☐ ☐ ☐

Muya ko an pagbabasa asin ginigibo ko ini uro-aldaw.

18. I often see mathematical ratios in the world around me. ☐ ☐ ☐ ☐ ☐

Pirme ko nahihiling an mga mathematical na ratio sa mundong nakapalibot sa sako.

19. I have a very good sense of pitch, tempo, and rhythm. ☐ ☐ ☐ ☐ ☐

*Igwa ako ke sarong mar-hay napandangog sa pitch, tempo,
at ritmo.*

20. Knowing directions is easy for me. ☐ ☐ ☐ ☐ ☐

Masay sa sakuya an pag-aram ke mga direksyon.

21. I have good balance and eye-hand coordination and ☐ ☐ ☐ ☐ ☐

enjoy sports which use a ball.

*Igwa ako ke mar-hay na balanse asin mata-sa-kamot na
pagsusunud-sunuran asin naoogmaako san mga karawat na
ginagamitan ke bola.*

22. I respond to all people enthusiastically, free of bias or ☐ ☐ ☐ ☐ ☐

prejudice.

*Minasimbag ako sa gabos na tawo sa paagi ke maogma,
wara ke daya o paghusga.*

23. I believe that I am responsible for my actions and who I am. ☐ ☐ ☐ ☐ ☐

Nagtutubod ako nasakuya an responsibilidad san sakong mga gibo asin sakung anu ako.

24. I like learning about nature. ☐ ☐ ☐ ☐ ☐

Muya ko an pag-aadal na may kinaaraman sa kalikasan.

25. I enjoy hearing challenging lectures. ☐ ☐ ☐ ☐ ☐

Naoogma ako pag minaka-dangog ke mga nakaka-ganyak na leksyon o tataramon.

26. Math has always been one of my favorite classes. ☐ ☐ ☐ ☐ ☐

An math an dati pa man na saro sa sakuyang mga paboritong subjects.

27. My interest in music and singing began when I was a child and still continues today. ☐ ☐ ☐ ☐ ☐

An pag-aadal ko ke musika, nagpoon kan ako aki pa asin nagpapadagos sagkod ngunyan.

28. I have the ability to represent what I see by drawing or painting. ☐ ☐ ☐ ☐ ☐

Igwa ako nin kakayahan na ipahiling sa paagi ninpag-guhit o pagpinta an sakuyang mga nahihiling.

29. My outstanding coordination and balance let me excel in high-speed activities. ☐ ☐ ☐ ☐ ☐

An sakuyang dai matatawadan na koordinasyon asin balanse an nagta-o sa sakuya nin matibay na pagibo ke mga masisigkat na mga aktibidadis.

30. I enjoy new or unique social situations. ☐ ☐ ☐ ☐ ☐

Naoogma ako kan mga bag-o o kakaibang pag-iiribahan na sitwasyon.

31. I try not to waste my time on trivial pursuits. ☐ ☐ ☐ ☐ ☐

Pig-pipirit ko na dai nin oras na masasayang sa mga bagay na daing kabuluhan.

32. I enjoy caring for my house plants. ☐ ☐ ☐ ☐ ☐

*Naoogma ako sa pag-aataman nin sakuyang mga pananum
sa harong.*

33. I like to keep a daily journal of my daily experiences. ☐ ☐ ☐ ☐ ☐

*Muya ko na magka-igwa nin journal/suraton sa mga uro-
aldaw na pangyayari nin sakuyang buhay.*

34. I like to think about numerical issues and examine ☐ ☐ ☐ ☐ ☐
statistics.

*Ikina-oogma ko an paghuhuop-huop kan mga numero na
usapon asin paghiling sa statistics.*

35. I am good at playing an instrument and singing. ☐ ☐ ☐ ☐ ☐

*Matibay ako manungod sa pagkawat kan mga
instrumentong pang-musika asin sa pagkanta.*

36. My ability to draw is recognized and complimented by ☐ ☐ ☐ ☐ ☐
others.

*Ansakuyang kakayahan sa paguhit ay pig-mimidbid asin
pig-oomaw kan iba.*

37. I like being outdoors, enjoy the change in seasons, and ☐ ☐ ☐ ☐ ☐

look forward to different physical activities each season.

*Muya ko pirme sa luwas, naoogma sa pagbabag-o kan
panahon asin sa pag-aantisipar san iba-iba na pwede na
karawat sa kada panahon.*

38. I enjoy complimenting others when they have done well. ☐ ☐ ☐ ☐ ☐

*Naoogma ako sapag-oomaw sa iba pag sinda nakagibo ke
marahay.*

39. I often think about the problems in my community, state, ☐ ☐ ☐ ☐ ☐

and/or world and what I can do to help rectify any of them.

*Pirme ko pig-iisip an mga problema kan sakuyang
komunidad, bansa at/o mundo asin sakuyang pwede magibo
para mabawasan an arin man sa mga ini.*

40. I enjoy hunting and fishing. ☐ ☐ ☐ ☐ ☐

*Naoogma ako sin pagdakop ke mga hayop sa bulod o
pagkuwa ke sira sa dagat.*

41. I read and enjoy poetry and occasionally write my own. ☐ ☐ ☐ ☐ ☐

*Naoogma ako sa pagbabasa asin sa paminsan-minsang
pagibo ke mga tula.*

42. I seem to understand things around me through a ☐ ☐ ☐ ☐ ☐
mathematical sense.

*Parang nasasabutan ko an mga bagay sa sakuyang palibot
sa paagi kan mathematical na pamate.*

43. I can remember the tune of a song when asked. ☐ ☐ ☐ ☐ ☐
Natatandaan ko an tono kan mga kanta pagpighahapot.

44. I can easily duplicate color, form, shading, and texture in ☐ ☐ ☐ ☐ ☐
my work.

*Madali lang sa sakuya na doblehon an kulay, porma
shading asin texture san sakuyang pig-tatrabaho.*

45. I like the excitement of personal and team competition. ☐ ☐ ☐ ☐ ☐
*Muya ko an pamate sa mga personal asin pang grupong
pakawat.*

46. I am quick to sense in others dishonesty and desire to control me. ☐ ☐ ☐ ☐ ☐

Madali kong mamatian an bako na tapat asin muya na kontrolon ako.

47. I am always totally honest with myself. ☐ ☐ ☐ ☐ ☐

Pirme akong tapat sa sakuyang sadire.

48. I enjoy hiking in natural places. ☐ ☐ ☐ ☐ ☐

Naoogma ako sa pagtukad ke mga bulod asin saiba pang natural na mga lugar.

49. I talk a lot and enjoy telling stories. ☐ ☐ ☐ ☐ ☐

Maistoryahon ako asin naoogma sagibong ini.

50. I enjoy doing puzzles. ☐ ☐ ☐ ☐ ☐

Naoogma ako kan pagigibo nin puzzles nakawatan.

51. I take pride in my musical accomplishments. ☐ ☐ ☐ ☐ ☐

Pigmamalaki ko an sakuyang mga naku-a na mga karangalan sa musika.

52. Seeing things in three dimensions is easy for me, and I ☐ ☐ ☐ ☐ ☐
like to make things in three dimensions.

*Madali sa sakuya an paghiling sa paagi nin tulong
dimension nabagay. Siring man an pagibo sini.*

53. I like to move around a lot. ☐ ☐ ☐ ☐ ☐
Muya ko an pirmeng paglibot-libot.

54. I feel safe when I am with strangers. ☐ ☐ ☐ ☐ ☐
*Namamatian ko an ligtas na pamate pag ako nasa dai
midbid na tawo.*

55. I enjoy being alone and thinking about my life and ☐ ☐ ☐ ☐ ☐
myself.
*Naoogma ako na mapag-saro asin sa paghuhurop-hurop sa
sakuyang buhay.*

56. I look forward to visiting the zoo. ☐ ☐ ☐ ☐ ☐
Inaantisipar ko na maka-duman sa sarong zoo.

Appendix B

STUDENTS' PERCEPTION QUESTIONNAIRE TOWARDS THEIR ACTIVITIES IN CHEMISTRY (GRADE 7 SCIENCE)

Name: _____ Grade & Section: _____

Direction: Read each statement carefully. Encircle one of the ratings for each statement indicating how much have you felt about it after the delivery of lessons and activities in chemistry for grade 7 science.

Direksyon: Basahon nin mayad an kada ginsasabi. Bilugan an saro sa mga ratings sa kada ginsasabi na nagpapa-imod kun gaano an saimong pamate sa kada saro bilang epekto nin pagtukdo asin mga giribo sa chemistry na pang-7 grado.

1 = poorly felt (diit na namatian)

2 = somewhat/fairly felt (namatian nin dakol sa diit)

3 = averagely felt (sakto lang na namatian)

4 = much felt (namatian ke dakol)

5 = very much felt (talagang sobrang dakol an namatian)

1. I enjoyed group discussion/brainstorming in chemistry for gr 7 <i>Naoogma ako kan mga grupong diskusyon sa chemistry na pang-7 grado.</i>	1	2	3	4	5
--	---	---	---	---	---

2. I enjoyed manipulating apparatus or working with laboratory apparatus in doing group activities. <i>Naoogma ako ke pag-aayos kan mga apparatus sa laboratory sa pagigibo kan mga pang-grupong mga aktibidadis.</i>	1	2	3	4	5
3. I enjoyed reading and writing journals in science (chemistry). <i>Naoogma ako sa pagbabasa asin pagsusurat nin journals sa science (chemistry)</i>	1	2	3	4	5
4. I enjoyed reading poems on solutions. <i>Naoogma ako sa pagbabasa nin mga tula manungod sa solutions.</i>	1	2	3	4	5
5. I enjoyed looking at/using periodic table of elements in locating metals, metalloids and nonmetals. <i>Naoogma ako sa paghiling o paggamit kan Periodic Table of Elements sa paghahanap kan mga metals, metalloids asin nonmetals.</i>	1	2	3	4	5
6. I enjoyed solving problems on solutions (like concentration of solutions) <i>Naoogma ako nin mga tinu-turuos manungod sa solutions (halimbawa manungod sa concentration nin solutions).</i>	1	2	3	4	5
7. I enjoyed classifying mixtures as homogenous or heterogenous.	1	2	3	4	5

<i>Naoogma ako kan pagka-klasipikar kan mixtures bilang homogenous o heterogenous.</i>					
8. I enjoyed group works/activities. <i>Naoogma ako kan mga giribong pang-grupo.</i>	1	2	3	4	5
9. I related some of the topics in chemistry 7 (example are the poems in solutions) to my favorite songs. <i>Naitatni ko an ibang mga leksyon sa chemistry (halimbawa na an mga tula sa solutions) sa sakuyang mga paboritong kanta o ritmo.</i>	1	2	3	4	5
10. I enjoyed watching video clips in chemistry for gr. 7 especially about mixtures <i>Naoogma ako sa paghihiling nin video clips sa chemistry na pang gr 7. Lalo na an manungod sa mixtures.</i>	1	2	3	4	5
11. I enjoyed balancing the equations on neutralizations and the combination of metal or nonmetal oxide with water. <i>Naoogma ako sa pagbabalanse nin mga equations manungod sa neutralisasyon asin sa kombinasyon nin metal o nonmetal oxide sa tubig.</i>	1	2	3	4	5
12. I enjoyed singing or rapping before group presentation. <i>Naoogmaako mag-kanta o kaya rap bag-o an samuyang presentation sa inutan kan klase.</i>	1	2	3	4	5

13. I think I improved a lot in terms of intellectual (knowledge) and social aspects after of every activity. <i>Namamatian ko an pag-uswag kan sakuyang tali asin pakiuropod –upod sa kapwa pakatapos kan kada saro na aktibidadis sa klase.</i>	1	2	3	4	5
14. I enjoyed grouping of elements of the same vertical line because this indicates of sameness of valence electron. <i>Naoogma ako sa pag-grupo grupo kan mga elements na nasa kaparehong linya ta ini nagpapa-imod ke kaparehong valence electron.</i>	1	2	3	4	5
15. I enjoyed going around in doing our group investigation to see that things are in order and to look for the needed materials. <i>Naoogma ako sa paglilibot-libot habang nagkakaigwa nin grupong gibihon. Ini dahil sa muya ko hilingon kun mayad na an mga bagay-bagay asin kung anu an kulang pa.</i>	1	2	3	4	5
16. I want to become a chemist, pharmacist, doctor or chemistry teacher because of the influence of the learning that I get in studying chemistry. <i>Muya ko na maging chemist, pharmacist, doctor o guro na chemistry sa subject dahil sa impluwensya san ako mga na-arman sa pag-aadal nin chemistry.</i>	1	2	3	4	5

Prepared by: **ALBERTO V. ESPENIDA**

Appendix C

SAMPLE VALIDATION

Instrument: Achievement test

I. Area to be validated: Congruency to learning objectives

Rating:

5 – very high acceptability-if the item is very close to learning objectives.

4 – moderately high acceptability- if the item is moderately close to learning objective.

3 – averagely high acceptability- if the item is averagely close to learning objectives.

2 – poorly acceptability- if the item is poorly close to learning objectives.

1 – least acceptability- if the item is least close to learning objective

Direction: The italicized words refer to the questions in achievement test and the words written in normal texts (erect) refer to the learning objectives. Please shade the circle corresponding to your rating of how close are the two.

questions in achievement test and LC	5	4	3	2	1
--------------------------------------	---	---	---	---	---

1. Describe what is meant by a fair test. ☐ ☐ ☐ ☐ ☐

1. Which of the following statements described that Fay conducted a fair test?

2. Recognizes that the design of an investigation should show ☐ ☐ ☐ ☐ ☐

fair testing.

2. Which of the variables will ensure that the experiment of

Fay provide a fair result?

3. Identify the variables in an experiment. ☐ ☐ ☐ ☐ ☐

3. Which is the independent variable?

4. Investigates the factors that affect the solution. ☐ ☐ ☐ ☐ ☐

4. What factor that affects solubility of solute is clearly stated

and mentioned from the poem?

5. Identifies and explains the factors affecting solubility. ☐ ☐ ☐ ☐ ☐

5. The last line from the poem implies that the solution is still

_____.

6. Explains the difference b/n % by weight and % by volume. ☐ ☐ ☐ ☐ ☐

6. The concentration of the solution may be expressed in

terms of % by Weight and % by Volume. % by Volume

expresses the volume of solute in 100 ml of solution while %

by Weight expresses the mass of solute in _____
of solution.

7. Recognizes that a substance has a unique set of properties. ☐ ☐ ☐ ☐ ☐

7. Distilled water boils at fixed temperature (100 degrees Celsius) while seawater may start boiling at about 80 degrees Celsius and goes higher. Which is correct concept based on the previous statement?

8. investigates the properties of mixtures at varying ☐ ☐ ☐ ☐ ☐
concentrations.

8. Compare to the refreshments made by Nina that has 5 grams per 100 ml of solution, the drinks made by Lito has 20 g per 100 ml of solution. The one prepared by Lito is expected to taste _____.

9. Recognizes that substances are classified into elements and ☐ ☐ ☐ ☐ ☐
compounds.

9. The two classifications of substance are:

- a. Metal and nonmetal
- b. Elements and compounds

c. Homogenous and heterogenous

d. Suspension and colloids

10. Recognizes that compounds consist of specific elements. ☐ ☐ ☐ ☐ ☐

10. Salt is a compound consisting of elements _____
and _____.

11. Gather information about common elements such as ☐ ☐ ☐ ☐ ☐
names, symbols and whether it is a metal or nonmetal.

11. Group IA is located on the left side of the zigzag border
line of the Periodic Table of Elements. Elements in this group
are classified as _____.

23 to 24

Elements	Symbol	Location (ref. zigzag line)	Classified as:
23 Iodine			
24 Californium			

12. Identify the different properties of metals and nonmetals ☐ ☐ ☐ ☐ ☐
such as luster, malleability and conductivity.

12. Which of the following materials have lustrous property?

13. Recognizes that elements considered as metals and those ☐ ☐ ☐ ☐ ☐
that are nonmetals.

13. Which of the following elements is actually a gas but considered metal because it behaves like one in most chemical reactions?

14. Recognizes common acids and bases. ☐ ☐ ☐ ☐ ☐

14. Which of the above listed products is a common acid to kitchen and food preparation?

15. Recognizes the concept of pH. ☐ ☐ ☐ ☐ ☐

15. Which among the listed products is MOST Basic?

16. Which is a neutral substance?

16. Investigates properties of acids and bases using natural ☐ ☐ ☐ ☐ ☐
indicator.

17. Using an eggplant indicator, the baking soda dissolved in water makes it turns light yellow green. What does this indicate?

17. Investigates properties of acids and bases using natural ☐ ☐ ☐ ☐ ☐

indicator.

18. *Acid + Metal produces rust: : Acid + base produces*

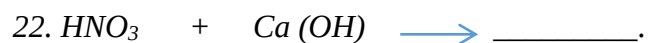
_____.

18. Investigates actions of bases on metals and nonmetals. ☐ ☐ ☐ ☐ ☐

19. *When HCl reacts with NaOH, the resulting product is*

_____.

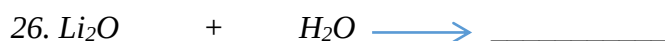
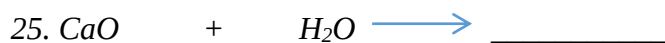
19. Investigates neutralization of acids and bases. ☐ ☐ ☐ ☐ ☐



20. Practice safe handling of acids and bases. ☐ ☐ ☐ ☐ ☐

20. *Which of the following shows proper/correct way of handling and treatment of acids before disposal?*

21. Investigates the reaction of metal oxide with water ☐ ☐ ☐ ☐ ☐



22. Investigates the reaction of nonmetal oxide with water ☐ ☐ ☐ ☐ ☐

27. CO_2 + H_2O $\longrightarrow$ _____.

28. N_2O_3 + H_2O $\longrightarrow$ _____.

23. Describe the reaction of acid and base in litmus paper ☐ ☐ ☐ ☐ ☐

29. Metal oxide in water turns the color of _____

litmus paper to _____.

30. Nonmetal oxide in water turns the color of
_____ litmus paper to _____.

24. Groups/periods ☐ ☐ ☐ ☐ ☐

31 to 35 (5 pts) Lithium is in group no. 1 and
will combine with chlorine that is in group no. 7. The
product of the chemical reaction is LiCl.

Question for essay:

Explain how is LiCl is formed.

Please use the same procedures for the following areas of achievement test to be validated

II. Area to be validated: Content

5- very high acceptability if the content is very much within chemistry topics
for grade 7

4- moderately high acceptability if the content is moderately high related
within chemistry topics for grade 7

3- averagely high acceptability if the content is averagely related within the chemistry topics for grade 7

2- poor acceptability if the content is poorly related within chemistry topics for grade 7

1- Least acceptability if the content is least related within chemistry topics for grade 7

III. Recognizes MI

5 – Very high acceptability if the question accommodates/cater particular multiple intelligence very highly

4 – moderately high acceptability if the question accommodates/cater particular multiple intelligence moderately high

3 – averagely high acceptability if the question accommodates/ cater particular multiple intelligence averagely high (somewhat)

2 – poor acceptability if the question accommodates/cater particular multiple intelligence poorly.

1 – least acceptability if the question accommodates/cater particular multiple intelligence the least

IV. Suitability to age learners

5 – very high acceptability if the question is very much acceptable to be given to the learners of their age

4 – moderately high acceptability if the question is moderately high acceptable to be given to the learners of their age

3 – averagely high acceptability if the question is averagely acceptable to be given to the learners of their age

2 – poor acceptability if the question is poorly acceptable to be given to the learners of their age

1 – least acceptability if the question is least acceptable to be given to the learners of their age.

V. Usefulness to the study

5 – very high acceptability if it is very much needed in the study

4 – moderately high acceptability if it is moderately needed in the study

3 – averagely high acceptability if it is averagely needed in the study

2 – poor acceptability if it is poorly needed in the study

1 – least acceptability if it is not needed in the study.

Appendix D

VALIDATORS'S PROFILE

1. Dr. GERRY S. DIGO

Assistant Professor IV/

College Dean

College of Education

Sorsogon State College

Address: Lot 14, Block 7, St. Rafael Subdivision, Pangpang West District,

Sorsogon City

Contact no. 0926-644-4313

Email add: digogerry@yahoo.com

Doctor' Degree: Doctor of Education

Major in Educational Management

Bicol University

2010

Master's Degree: Master of Arts in Chemistry Education

Major in Chemistry

2001

2. Mrs. JANET P. LADISLAO

Student Affairs Coordinator

St. Louise de Marillac College of Sorsogon

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Email add: janetpilapilladislao@yahoo.com

Master' Degree: Master in Chemistry Education

Major in Chemistry

Bicol University

2010

Bachelor's Degree: Bachelor of Science in Biology

Major in Biology

Bicol University

1999

3. Mrs. SUSAN S. JANER

Associate Professor I

Sorsogon State College

Had been the director for Research, Development and Evaluation Department for five years

Address: OLV, Bibingcahan, Sorsogon City

Contact no.: 0908-999632 / 0917-8832844

Email Add: sihjaner@janer@yahoo.com

Doctor's Degree: Doctor of Philosophy

Major in Educational Foundations

Bicol University

1995-2012

Dissertation title: Assessment Practices of Science Teachers in Teacher
Education Institutions

Master's Degree: Master in Chemistry Education

Major in Chemistry

Bicol University

2003-2009

Master's Degree: Master of Arts in Education

Major in Administration and Supervision

Bicol University

1990-1995

Appendix E

SAMPLE ITEMS OF ACHIEVEMENT TEST

From Part I. Knowledge

For items no 4 to 5, please refer to the poem below. (It is in the tune of Are you Sleeping?)

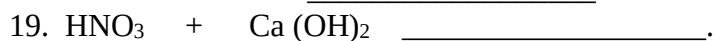
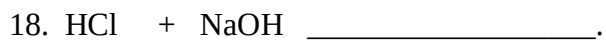
I am solute (2x)
In solvent (2x)
I dissolve in water
With constantly stirring
Add me more (2x)

4. What factor that affects solubility of solute is clearly stated and mentioned from the poem?
 - a. Temperature of solute
 - b. Stirring
 - c. Nature of solute
 - d. Amount of solute
5. The last line from the poem implies that the solution is still _____.
 - a. Unsaturated
 - b. Saturated
 - c. Supersaturated
 - d. Concentrated
6. The concentration of the solution may be expressed in terms of % by Weight and % by Volume. % by Volume expresses the volume of solute in 100 ml of solution while % by Weight expresses the mass of solute in _____ of solution.
 - a. 100 g
 - b. 100 ml
 - c. 1L
 - d. 1000 g
7. Distilled water boils at fixed temperature (100 degrees Celsius) while seawater may start boiling at about 80 degrees Celsius and goes higher. Which is correct concept based on the previous statement?
 - a. Substance has fixed (definite) boiling point while mixture has boiling point range.

- b. Substance has boiling point range and mixture has a fixed boiling point.
- c. Substance and mixture both have a boiling point range.
- d. Substance and mixture both have a fixed (definite) boiling point.

Part 2: Process

A. Give the product of NEUTRALIZATION



B. Fill-up the blanks with the ELEMENTS' information

Elements	Symbol	Location based on zigzag Border line	Classification (metal or Nonmetal)
20. Iodine	<u> </u>	Right	<u> </u>
21. Californium	<u> </u>	Left	<u> </u>

Part 3 Understanding:

Lithium is in group no. 1 and will combine with chlorine that is in group no. 7. The product of the chemical reaction is LiCl.

Explain how the chemical formula for lithium chloride comes out.

Appendix F

PRE-MI GROUP FROM PRE-TEST OF MULTIPLE INTELLIGENCE TOOL

I. Verbal (2)	II. Logical (8)	III. Visual (5)	IV. Movement (8)	
# 23	# 9	# 7	# 2	
# 57	# 13	# 15	# 10	
	# 44	# 18	# 16	
	# 46	# 25	# 20	
	# 49	# 42	# 21	
	# 53		# 24	
	# 55		# 26	
	# 58		# 48	
V. Music (5)	VI. Social (4)	VII. Self (8)	VIII. Naturalist (19)	
# 30	# 28	# 1	# 3	# 61
# 41	# 47	# 11	# 4	# 35
# 43	# 52	# 12	# 5	# 36
# 50	# 56	# 14	# 6	# 37
# 59		# 27	# 8	# 38
		# 31	# 17	# 40
		# 39	# 19	# 45
		# 60	# 22	# 51
			# 29	# 54
			# 32	

Appendix G

POST MI RESULT OF MULTIPLE INTELLIGENCE ASSESSMENT TOOL

I. Verbal (8)	II. Logical (6)	III. Visual (1)	IV. Movement (10)	
# 2	# 13	# 29	# 7	# 53
# 8	# 22		# 9	# 59
# 15	# 26		# 12	
# 17	# 32		# 21	
# 25	# 42		# 36	
# 35	# 45		# 40	
# 43			# 41	
# 52			# 48	
V. Music (7)	VI. Social (1)	VII. Self (8)	VIII. Naturalist (18)	
# 6	# 11	# 1	# 3,	# 38
# 16		# 14	# 4,	# 44
# 23		# 19	# 5,	# 46
# 24		# 31	# 10,	# 47
# 27		# 49	# 18,	# 51
# 39		# 55	# 20,	# 54
# 50		# 57	# 28,	# 56
		# 60	# 30	# 58
			# 37	# 61

Appendix H

DOMINANT INTELLIGENCE RESULT OF POST ONLY INSTRUMENT B

I. Verbal (10)	II. Logical (5)	III. Visual (15)		IV. Movement (5)
# 16	# 58	# 44	# 43	# 13
# 9	# 28	# 53	# 48	# 49
# 59	# 52	# 7	# 1	# 25
# 39	# 31	# 15	# 14	# 2
# 5	# 45	# 18	# 36	# 19
# 6		# 10		
# 8		# 20		
# 17		# 21		
# 51		# 24		
# 54		# 26		
V. Music (7)	VI. Social (4)	VII. Self (2)	VIII. Naturalist (11)	
# 23	# 42	# 55	# 46	# 29
# 57	# 3	# 11	# 30	# 32
# 41	# 40		# 47	# 35
# 50	# 60		# 56	# 37
# 12			# 4	# 61
# 27			# 22	
# 38				

Appendix I

RUBRICS USED IN PERFORMANCE

- (indicator A) presentation of output
- (Indicator B) cooperation among the members of the group
- (Indicator C) completeness of the materials in performing the activity
- (Indicator D) displayed proper behavior in conducting an activity (works quietly and systematically)/ does not disturb other groups
- (Indicator E) conducted the activity within the allotted time period.
- (Indicator F) performance of one's role in an activity (average on group)

Scale in each indicator:

5 points –Excellent

3 points –Satisfactory

1 point – Poor

Indicators	Group 1	Group 2	Group 3	Group 4	Group 5
A					
B					
C					
D					
E					
F					

Appendix J

LABORATORY EXAM

First Quarter

Name: _____

Direction: Encircle the letter of the correct answer.

For items 1 to 4, please refer to the statements below.

Our experiment on solubility was summarized in the table below. Analyze and answer the questions that follow.

Type of sugar	Amount of sugar	Dissolve in ___ml of water	Temperature of water	Time the sugar completely dissolved
Refined sugar	1 gram	100 ml	Same	?
Granulated sugar	1 gram	100 ml	Same	?
Sugar cube	1 gram	100 ml	Same	?

1. Which dissolved the fastest/easiest in the tap water?

- a. Refined sugar
- b. Granulated
- c. Sugar cube
- d. None of the above

2. Which is the solute in the experiment?

- a. Sugar
- b. Water
- c. 100 ml
- d. Same

3. Which is the independent variable?

- a. Type of sugar
- b. Sugar cube
- c. 5 grams of sugar
- d. 100 ml of water

4. Which is the dependent variable?
- Type of sugar
 - Amount of sugar
 - Volume of water
 - Time the sugar was dissolved
5. _____ dissolved faster in hot water?
- Sugar
 - Salt
 - Stone
 - None of the above
6. _____ dissolved the faster in cold water?
- Sugar
 - Salt
 - Stone
 - None of the above
7. The solution that contains a maximum amount of solute that a solvent can hold at a given temperature is called _____.
- Saturated
 - Unsaturated
 - Supersaturated
 - None of these
8. If the juice drinks has too light taste and still needs plenty of powder juice to be added and be dissolved, that solution is called _____.
- Saturated
 - Unsaturated
 - Supersaturated
 - None of these
9. Which is/are common properties of solutions?
- Uniform appearance
 - 1 phase
 - The components cannot be separated by filtration
 - All of these
10. What is the difference in boiling distilled water and seawater?
- Seawater has boiling point range

- b. Distilled water has fixed boiling point
 - c. Distilled water has boiling point range
 - d. A and B
11. The indicator that we prepared that indicated the acidity and basicity of several samples was made of _____.
- a. Camote peel
 - b. Mayana leaves
 - c. Eggplant peelings
 - d. Baston ni San Jose
12. What was added in pinch amount in preparing “that” right after the solution has set aside to stabilize the extract?
- a. Salt
 - b. Sugar
 - c. Tawas/alum
 - d. Flour
13. Adding drops of prepared/alternative indicator in a cup of vinegar turns the solution into a pale red color. This indicated that vinegar is _____.
- a. Strong acid
 - b. Weak acid
 - c. Strong base
 - d. Weak base
14. What is the laboratory apparatus used in boiling liquid samples?
- a. Flask
 - b. Graduated cylinder
 - c. Beaker
 - d. U tube
15. What is the proper way of handling strong acids/bases?
- a. Use fumehood
 - b. Wear gloves and other protected gear
 - c. Dispose the liquid chemicals without treatment
 - d. A and B

Appendix K

ITEM ANALYSIS OF ACHIEVEMENT TEST

The rephrasing of questions in the achievement test depends on the validation. The researcher also took item analysis of the pilot testing as basis to rephrase the items.

Item No.	Correct Answer
1	25
2	24
3	27
4	28
5	27
6	22
7	22
8	16
9	29
10	26
11	27
12	25
13	27
14	27
15	29
16	29
17	25
18	26
19	24
20	23
21	21
22	23
23	30
24	30
25	22
26	20
27	24
28	29
29	26
30	28

Appendix L

ITEM ANALYSIS OF LABORATORY EXAM

The item analysis of the laboratory exam during the pilot testing. The researcher used this also as bases in rephrasing the question in the lab exam

Item No.	Correct answer
1	26
2	23
3	27
4	27
5	26
6	23
7	25
8	28
9	28
10	27
11	28
12	24
13	25
14	27
15	27

Appendix M

SCHEFFE POST HOC OF VERBAL-INCLINED SEATWORK PERFROMANCE

Multiple Comparisons							
Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Verbal inclined SW	S c h e f f e	1.0 2.0	5.1250	2.1972	.609	-3.488	13.738
		3.0	4.9000	2.3253	.725	-4.215	14.015
		4.0	3.3125	2.1972	.939	-5.301	11.926
		5.0	1.5000	2.3253	1.000	-7.615	10.615
		6.0	1.0000	2.4069	1.000	-8.435	10.435
		7.0	4.6875	2.1972	.712	-3.926	13.301
		8.0	2.3684	2.0661	.987	-5.731	10.468
	2.0	1.0	-5.1250	2.1972	.609	-13.738	3.488
		3.0	-.2250	1.5844	1.000	-6.436	5.986
		4.0	-1.8125	1.3896	.972	-7.260	3.635
		5.0	-3.6250	1.5844	.633	-9.836	2.586
		6.0	-4.1250	1.7019	.560	-10.797	2.547
		7.0	-.4375	1.3896	1.000	-5.885	5.010
		8.0	-2.7566	1.1713	.598	-7.348	1.835
	3.0	1.0	-4.9000	2.3253	.725	-14.015	4.215
		2.0	.2250	1.5844	1.000	-5.986	6.436
		4.0	-1.5875	1.5844	.994	-7.799	4.624
		5.0	-3.4000	1.7577	.804	-10.291	3.491
		6.0	-3.9000	1.8644	.733	-11.209	3.409
		7.0	-.2125	1.5844	1.000	-6.424	5.999
		8.0	-2.5316	1.3969	.852	-8.008	2.945
	4.0	1.0	-3.3125	2.1972	.939	-11.926	5.301
		2.0	1.8125	1.3896	.972	-3.635	7.260
		3.0	1.5875	1.5844	.994	-4.624	7.799
		5.0	-1.8125	1.5844	.987	-8.024	4.399
		6.0	-2.3125	1.7019	.965	-8.984	4.359
		7.0	1.3750	1.3896	.995	-4.072	6.822
		8.0	-.9441	1.1713	.999	-5.536	3.648

5.0	1.0	-1.5000	2.3253	1.000	-10.615	7.615
	2.0	3.6250	1.5844	.633	-2.586	9.836
	3.0	3.4000	1.7577	.804	-3.491	10.291
	4.0	1.8125	1.5844	.987	-4.399	8.024
	6.0	-.5000	1.8644	1.000	-7.809	6.809
	7.0	3.1875	1.5844	.770	-3.024	9.399
	8.0	.8684	1.3969	1.000	-4.608	6.345
6.0	1.0	-1.0000	2.4069	1.000	-10.435	8.435
	2.0	4.1250	1.7019	.560	-2.547	10.797
	3.0	3.9000	1.8644	.733	-3.409	11.209
	4.0	2.3125	1.7019	.965	-4.359	8.984
	5.0	.5000	1.8644	1.000	-6.809	7.809
	7.0	3.6875	1.7019	.696	-2.984	10.359
	8.0	1.3684	1.5289	.997	-4.625	7.362
7.0	1.0	-4.6875	2.1972	.712	-13.301	3.926
	2.0	.4375	1.3896	1.000	-5.010	5.885
	3.0	.2125	1.5844	1.000	-5.999	6.424
	4.0	-1.3750	1.3896	.995	-6.822	4.072
	5.0	-3.1875	1.5844	.770	-9.399	3.024
	6.0	-3.6875	1.7019	.696	-10.359	2.984
	8.0	-2.3191	1.1713	.785	-6.911	2.273
8.0	1.0	-2.3684	2.0661	.987	-10.468	5.731
	2.0	2.7566	1.1713	.598	-1.835	7.348
	3.0	2.5316	1.3969	.852	-2.945	8.008
	4.0	.9441	1.1713	.999	-3.648	5.536
	5.0	-.8684	1.3969	1.000	-6.345	4.608
	6.0	-1.3684	1.5289	.997	-7.362	4.625
	7.0	2.3191	1.1713	.785	-2.273	6.911

Appendix N

SCHEFFE POST HOC TEST OF ACHIEVEMENT TEST PERFORMANCE

Multiple Comparisons

Multiple Comparisons								
				Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Dependent Variable	(I) Group	(J) Group						
Achievement	Sc he ff e	1.0	2.0	-.6250	2.7628	1.000	-11.455	10.205
			3.0	1.9000	2.9239	1.000	-9.562	13.362
			4.0	3.3750	2.7628	.981	-7.455	14.205
			5.0	.3000	2.9239	1.000	-11.162	11.762
			6.0	-2.0000	3.0265	1.000	-13.864	9.864
			7.0	3.2500	2.7628	.985	-7.580	14.080
			8.0	-.8158	2.5979	1.000	-11.000	9.368
		2.0	1.0	.6250	2.7628	1.000	-10.205	11.455
			3.0	2.5250	1.9923	.976	-5.285	10.335
			4.0	4.0000	1.7473	.632	-2.850	10.850
			5.0	.9250	1.9923	1.000	-6.885	8.735
			6.0	-1.3750	2.1401	1.000	-9.764	7.014
			7.0	3.8750	1.7473	.670	-2.975	10.725
			8.0	-.1908	1.4729	1.000	-5.965	5.583
	3.0	1.0	-1.9000	2.9239	1.000	-13.362	9.562	
			2.0	-2.5250	1.9923	.976	-10.335	5.285
			4.0	1.4750	1.9923	.999	-6.335	9.285
			5.0	-1.6000	2.2102	.999	-10.264	7.064
			6.0	-3.9000	2.3443	.901	-13.090	5.290
			7.0	1.3500	1.9923	1.000	-6.460	9.160
			8.0	-2.7158	1.7565	.931	-9.602	4.170
	4.0	1.0	-3.3750	2.7628	.981	-14.205	7.455	
			2.0	-4.0000	1.7473	.632	-10.850	2.850
			3.0	-1.4750	1.9923	.999	-9.285	6.335
			5.0	-3.0750	1.9923	.932	-10.885	4.735
			6.0	-5.3750	2.1401	.513	-13.764	3.014
			7.0	-.1250	1.7473	1.000	-6.975	6.725
			8.0	-4.1908	1.4729	.344	-9.965	1.583

	5.0	1.0	- .3000	2.9239	1.000	-11.762	11.162
		2.0	-.9250	1.9923	1.000	-8.735	6.885
		3.0	1.6000	2.2102	.999	-7.064	10.264
		4.0	3.0750	1.9923	.932	-4.735	10.885
		6.0	-2.3000	2.3443	.995	-11.490	6.890
		7.0	2.9500	1.9923	.945	-4.860	10.760
		8.0	-1.1158	1.7565	1.000	-8.002	5.770
	6.0	1.0	2.0000	3.0265	1.000	-9.864	13.864
		2.0	1.3750	2.1401	1.000	-7.014	9.764
		3.0	3.9000	2.3443	.901	-5.290	13.090
		4.0	5.3750	2.1401	.513	-3.014	13.764
		5.0	2.3000	2.3443	.995	-6.890	11.490
		7.0	5.2500	2.1401	.544	-3.139	13.639
		8.0	1.1842	1.9225	1.000	-6.352	8.721
	7.0	1.0	-3.2500	2.7628	.985	-14.080	7.580
		2.0	-3.8750	1.7473	.670	-10.725	2.975
		3.0	-1.3500	1.9923	1.000	-9.160	6.460
		4.0	.1250	1.7473	1.000	-6.725	6.975
		5.0	-2.9500	1.9923	.945	-10.760	4.860
		6.0	-5.2500	2.1401	.544	-13.639	3.139
		8.0	-4.0658	1.4729	.384	-9.840	1.708
	8.0	1.0	.8158	2.5979	1.000	-9.368	11.000
		2.0	.1908	1.4729	1.000	-5.583	5.965
		3.0	2.7158	1.7565	.931	-4.170	9.602
		4.0	4.1908	1.4729	.344	-1.583	9.965
		5.0	1.1158	1.7565	1.000	-5.770	8.002
		6.0	-1.1842	1.9225	1.000	-8.721	6.352
		7.0	4.0658	1.4729	.384	-1.708	9.840

Appendix O

INTRA-CLASS CORRELATION OF RATERS' SUMMARY OF RATINGS

Please refer to <http://www.real-statistics.com/reliability/intraclass-correlation/> for the formula of computation of intra class correlation to determine inter-rater reliability

Intra class Correlation (ICC)

Instrument: MI Assessment

Area	Rater 1	Rater 2	Rater 3
Content	5	5	5
Language used	3	4	3
Congruency to DI	5	5	5
Suitability to age of learners	5	5	5
Usefulness to the study	5	5	5
ICC	0.96		

Instrument: Student Perception

Area	Rater 1	Rater 2	Rater 3
Content	4	4	4
Language used	3	3	4
Congruency of statement to DI	4	4	4
Suitability to age learner	4	5	5
Usefulness to the study	5	5	5
ICC	0.74		

Instrument: Achievement test

Area	Rater 1	Rater 2	Rater 3
Content	4	4	4
Congruency to learning objectives	5	4	5
Recognizes MI	3	3	3

Suitability to age learner	5	4	4
Usefulness to the study	5	4	5
ICC	0.72		

***Instrument: Laboratory Exam**

Area	Rater 1	Rater 2	Rater 3
Content	4	4	4
Congruency to learning objectives	4	4	4
Recognizes MI	3	4	4
Suitability to age learner	4	4	4
Congruency of items to actual lab act	3	5	5
Usefulness to the study	4	5	5
ICC	0.12		

*The ICC is low for laboratory exam because rater 1 has no significant correlation for rater 2 and 3. There is only significant correlation between rater 2 and 3 at 0.01 level of significance shown by the table below.

Correlations				
		Rater1	Rater 2	Rater 3
Rater1	Pearson Correlation	1	-.250	-.250
	Sig. (1-tailed)		.316	.316
	N	6	6	6
Rater 2	Pearson Correlation	-.250	1	1.000**
	Sig. (1-tailed)	.316		.000
	N	6	6	6
Rater 3	Pearson Correlation	-.250	1.000**	1
	Sig. (1-tailed)	.316	.000	
	N	6	6	6

**, Correlation is significant at the 0.01 level (1-tailed).

Appendix P

SAMPLE LETTER OF PERMISSION

A. Letter to Conduct Research Study

May 09, 2014

RUBY S. ABUNDABAR, Ph.D.

Schools Division Superintendent
Department of Education
Division of Sorsogon

Madam;

In partial fulfillment of the requirements for the degree Master of Arts in Science Education with specialization in Chemistry, I am requesting your good office a permission allowing me to conduct a study in Manlabong National High School. The title of my study is *Students' Dominant Intelligence and Performance in Chemistry*.

Enclosed herewith is my study proposal for your perusal.

Thank you

Respectfully yours,

ALBERTO V. ESPENIDA
Researcher

RUEL A. AVILLA
Adviser

ANTRIMAN V. ORLEANS, Ph.D.
Adviser

Recommending Approval:

Approved:

ARLEN E. HUERTO
School Head

RUBY S. ABUNDABAR, Ph.D.
Division Schools Superintendent

b. Letter of Permission to Use the Instrument

May 27, 2014

To: Literacynet.org Management
pheavens@literacyworks.org

Sir;

Greetings!

I have browsed your Multiple Intelligence for Adult Literacy and Education site and found the Multiple Intelligence Assessment that you cited was from Dr. Terry Armstrong. I see that you strongly support and advocate for the Multiple Intelligences in education. In view thereof, may I have the honor to use the online multiple intelligence assessment for my graduate studies? In the difficulty of my students to access the internet, may I just be allowed to copy the MI assessment?

Your favorable response regarding this request will contribute much to our school and my studies.

Rest assured that no part of the assessments will be changed except for turning it into a hardcopy and language translation.

Thank you very much.

Respectfully yours,

ALBERTO V. ESPENIDA
Researcher

**Teacher I @ Manlabong National High School
Manlabong, Prieto-Diaz, Sorsogon, Philippines, 4711**

c. Letter to the School Principal where the study was conducted

June 02, 2014

ARLEN E. HUERTO
T-III/TIC
Manlabong National High School

Madam;

Greetings!

I have the honor to request your approval on the conduct of my thesis entitled **“Students’ Dominant Intelligence and Performance in Chemistry”**. May I be allowed also to conduct the instruments in this study to be administered to grade 7 students in our school.

Attached herewith are the samples of the actual instruments.

Thank you.

Respectfully yours,

ALBERTO V. ESPENIDA
Researcher

Approved:

ARLEN E. HUERTO
School Head

d. Letter of Permission to the Parents of the participants

June 02, 2014

Dear Parent,

Greetings!

The undersigned would like to conduct a study on ***“Students’ Dominant Intelligence and Performance in Chemistry”*** in grade 7 students of Manlabong National High School. He would like to ask permission to allow him collect data through questionnaires from your son/daughter studying in the said school. The researcher oaths to keep the data collected safe and confidential. He further assures that questions were properly examined to avoid delicate issues that may affect the students’ personal, emotional and psychological aspects.

By signing to this letter you agreed that the researcher has the right to give the questionnaires to your son/daughter.

Attached herewith are sample of the questionnaires.

Thank you.

Respectfully yours,

ALBERTO V. ESPENIDA
Researcher

Signature above the printed name
of the parent/guardian

Signature above the printed
of the student

e. Letter of Permission to the School Head of the pilot tested school

June 09, 2014

Mr. PEDRO U. HIMOR
Secondary School Principal I
Calao National High School
Calao, Prieto-Daiz, Sorsogon

Sir;

Greetings!

May I be allowed to use the grade 7 class in your school to dry run/pilot test my First Quarter Examination and Multiple Intelligence Assessment tool? The said assessments are my instruments in my thesis entitled ***“Students’ Dominant Intelligence and Performance in Chemistry”***.

Attached herewith is the sample of the exam.

Your kind consideration and permission will highly contribute to my thesis writing and studies.

Thank you.

Respectfully yours,

ALBERTO V. ESPENIDA
Researcher

Approved:

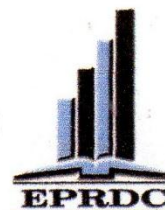
Mr. PEDRO U HIMOR
Secondary School Principal I

Appendix Q

CERTIFICATION OF LANGUAGE EDITING



Philippine Normal University
The National Center for Teacher Education
EDUCATIONAL POLICY RESEARCH AND DEVELOPMENT CENTER
Taft Avenue, Manila 1000, Philippines
Tel/Fax: (632) 527-0366 e-mail: eprdc@pnu.edu.ph



CERTIFICATION

This is to certify that **Alberto V. Espenida's** thesis entitled *Students' Dominant Intelligence and Performance in Chemistry* underwent language editing.

This certification is issued on April 22, 2015 for whatever legal purpose it may serve Mr. Espenida.



Ma. Victoria C. Hermosisima

Appendix R

CERTIFICATION OF SCANNING FOR ANTI-PLAGIARISM