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Number Sense, Problem Solving Skills and Multiple Intelligences Among High School Students

Raynor N. Mendizabal

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Number Sense, Problem Solving Skills and Multiple Intelligences Among High School Students

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NUMBER SENSE, PROBLEM SOLVING SKILLS AND MULTIPLE INTELLIGENCES AMONG HIGH SCHOOL STUDENTS

A Seminar Paper
Presented to the Faculty of the
College of Graduate Studies and Teacher Education Research
Philippine Normal University
Manila

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts in Teaching
Mathematics

by
RAYNOR N. MENDIZABAL

APPROVAL SHEET

This special project entitled, “**NUMBER SENSE, PROBLEM SOLVING SKILLS AND MULTIPLE INTELLIGENCES AMONG HIGH SCHOOL STUDENTS**” prepared and submitted by **RAYNOR NACHOR MENDIZABAL** in partial fulfilment of the requirements for the degree **Master of Arts in Teaching Mathematics** has been examined and recommended for acceptance.

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DEDICATION

This work

is

lovingly dedicated

to my beloved daughter,

Precious Formoso Mendizabal,

to my beloved wife,

Judy Formoso Mendizabal

to my parents,

to my sisters,

to all

mathematics teachers

and

students.

RAYNOR NACHOR MENDIZABAL

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Quezon City Mayor **Herbert M. Bautista** and **Alay Kay Inay ng Lungsod Quezon Foundation, Inc.** for their financial help.

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And most of all, the writer is thankful to his family, especially his wife **Judy** and daughter **Precious** who inspired and encourage him to make this a reality.

Finally, to the **Divine Providence**, for all that has been, for what it is this piece of work and for whatever will still be.

RAYNOR NACHOR MENDIZABAL

ABSTRACT

Name : RAYNOR N. MENDIZABAL

**Title : NUMBER SENSE, PROBLEM SOLVING SKILLS AND
MULTIPLE INTELLIGENCES AMONG HIGH SCHOOL
STUDENTS**

**Key Concepts : Number Sense, Problem Solving Skill, Multiple
Intelligence**

Degree : Master of Arts in Teaching

Specialization : Mathematics

Adviser : DR. RENE R. BELECINA

The main purpose of this study was to describe students' number sense, problem solving skills and multiple intelligences and to determine whether mathematics attributes are related to each other. Three research instruments were utilized to describe these variables namely: Number Sense Test adapted from McIntosh, Reys and Reys (1997), Problem Solving Skills Test adapted from Usiskin and Shenk (1982), TIMSS, IEA (1995-2011), Ohio Mathematics Achievement Test (2011) and Krulik and Rudnick (1989), lastly, MI Inventory Test adapted from Chislett and Chapman (2005-2006).

Two Hundred Thirty Seven (237) Third Year Students of San Bartolome High School, Division of Quezon City during the School Year 2013-2014 were the participants of the study. The result revealed that students found to possess poor number sense and were inadequately skilled in problem solving. When

classified according to multiple intelligences (MI), whether academic oriented or non-academic oriented. And about two thirds of them belonged to the latter. A comparison of number sense and problem solving skills between the two groups of MI clusters revealed that academic oriented group has significantly better number sense and problem solving skills than the non-academic group. Furthermore, there is no significant relationship between students' number sense and their problem solving skills. The study confirmed the prevalence of poor number sense and inadequate problem solving skills among students at the public high school level.

Therefore, it is recommended that school administrators and teachers conduct remediation measures to assist those students with inadequate math skills to enable them to cope up with their lessons and to improve performance in math. In addition, encourage math teachers to explore viability of effective and innovative strategies considering their students' multiple intelligences based from the results of the MI Inventory to improve learning and to remedy the low achievement in math.

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CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Introduction

Based from the DepEd K to 12 curriculum, Mathematics is one subject that pervades life at any age in any circumstance. Thus, its value goes beyond the classroom and the school. Mathematics as a school subject; therefore, must be learned comprehensively and with much depth. The twin goals of mathematics in the basic education levels are critical thinking and problem solving. These two goals are to be achieved with an organized and rigorous curriculum content and a well-defined set of high-level skills and processes. One of the five content areas in the curriculum as adopted from the framework prepared by MATHTED and SEI (2010) is number sense, while problem solving is one of the specific skill and process to be developed. Number sense as a content area includes concepts of numbers, properties, operations, estimation and their applications. Most mathematics educators agree that developing number sense is important, yet there is no single definition that is unanimously accepted. Number sense is highly personalized and thought to develop gradually. It includes self - regulation, an ability to make connections in number patterns and an intuition regarding numbers. Number sense refers to a person's general understanding of number and operations along with the ability and inclination to use this understanding in flexible ways to make mathematical judgments and to develop useful strategies for handling numbers and operations (McIntosh, Reys and Reys,1992). On the other hand, Problem solving

as cited by Polya's, (1945 & 1962) definition that mathematical problem solving is finding a way around a difficulty, around an obstacle and finding a solution to a problem that is unknown. Problem solving is said to be the cornerstone of school mathematics. The main reason of learning mathematics is to be able to solve problems. Mathematics is a powerful tool that can be used to solve a vast variety of problems in technology, science, business and finance, medicine and daily life. It is strongly believed that most efficient way for learning mathematical concepts such as number sense is through problem solving. Of course, there are techniques that should help to become a better problem solver and should show how to develop their problem solving skills. In his book entitled, *How to Solve It*, Polya identified a four- step process that formed the basis of any serious attempt at problem solving. Both number sense and problem solving are promoted as two of the major areas of emphasis in mathematics education as evidenced in major curriculum documents. Thus, there is an urgent need to answer question such as how do they relate to each other? While there have been many studies relating to the two aspects independently, on number sense (Facun and Nool et. al, 2012). There is a lack of research which focuses on the relationship between the two. Unfortunately, one possible reason for lack of a combined number sense and problem solving research could be due to the difficulty of divorcing one from the other. Both the terms number sense and problem solving have suffered many diverse definitions. The controversy stems mainly from the fact that number

sense is akin to common sense which is a necessary tool for solving any problem, (Louange and Bana, 2005).

The students' ability to use numbers effectively and to reason well to recognize and solve problems involves logical-mathematical intelligence. Howard Gardner (1983) proposed the new view of intelligence that is rapidly being incorporated in school curricula. In his Theory of Multiple Intelligences, Gardner defined the logical-mathematical intelligence as consisting of the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking.

As the education system has stressed the importance of developing logical- mathematical intelligence, teachers must seek to assess the students' learning needs in ways which will provide a clear picture of the their strengths and weaknesses. It is important for teachers to consider students' multiple intelligences which will enable them to determine different instructional practices that can aid their students to harness their potential. Develop their abilities and utilize their talents while addressing the curriculum standards.

The MI issue has remained a concern for many mathematics educators and the need for studies in this context have already gained ground abroad. In the Philippines; however, this issue has long been set aside. Thus, the study into its link to number sense and problem solving are needed. There is a lack of research to elucidate the difference between number sense and the problem solving ability among high school students of varied dominant intelligences. Indeed, if efforts to improve math education in the

country are to be properly guided. The present study is quite important and valuable.

Given the consistent poor performance of Filipinos in mathematics where students consistently scored below international and local standard (Nebres and Chua, 2004) served as the impetus of this study to quantify their number sense, problem solving skills and assess their multiple intelligences that brings hope to mathematics educators that students' learning and achievement can be improved. Therefore, this study is deemed timely and necessary to describe the relationship of the public high school students in terms of their number sense and problem solving skills and to determine whether these mathematics attributes and learner trait has relationship across the students' multiple intelligences.

Conceptual Framework

This study was anchored on the number sense framework of McIntosh, Reys and Reys (1992). They developed a framework for examining number sense based on studying and reflecting on the literature associated with number sense, estimation and mental computation. The framework formulated six number sense strands namely: 1) understanding and use of the meaning and size of numbers, 2) understanding and use of equivalent forms and representations of numbers, 3) understanding the meaning and effect of operations, 4) understanding and use of equivalent expressions, 5) computing and counting strategies and 6) measurement benchmarks.

1. *Understanding and use of the meaning and size of numbers (Number Concepts)*

This strand includes understanding of the base 10 number system (whole numbers, fractions and decimals) includes patterns and place value which provide clues to the meaning/size of a number (e.g. $\frac{5}{6}$ is a fraction less than one, it is close to one because of the relationship between the numerator and denominator or 1000 is a large number if they are referring to the population of a school but a small number if they are referring to the population of a town). It could involve relating and/or comparing numbers to standard or personal benchmarks. It includes comparing the relative size of numbers within a single representational form.

2. *Understanding and use of equivalent forms and representations of numbers (Multiple Representations)*

This strand includes recognition that numbers take many different numerical and representational forms (e.g. fraction as a decimal, a whole number in expanded form or a decimal on a number line) and can be thought about and manipulated in many ways to benefit a particular purpose. It also includes the ability to identify and/or reformulate numbers to produce an equivalent form. The use of decomposition and recomposition to reformulate numbers for ease in

processing relating and/or comparing size of number(s) to a physical referent (e.g. collection of items, shaded region or position on a number line) and crossing among various representational forms.

3. Understanding the meaning and effect of operations (Effect of Operations)

This strand includes understanding the meaning and effect of an operation either generally or as it relates to a certain set of numbers (e.g. Division means breaking a number into a specified number of equivalent sub-groups or Multiplying by a number less than 1 produces a product less than the other factor). It includes judging the reasonableness of a result based on understanding the numbers and operations being employed.

4. Understanding and use of equivalent expressions (Equivalent Expressions)

This strand includes the translation of expressions to equivalent forms often to re-evaluate and/or more efficiently process a computation. It includes understanding and use of arithmetic properties (commutativity, associativity and distributivity) to simplify expressions and to develop solution strategies (e.g. the use of the distributive property to multiply 7×52).

5. Computing and Counting Strategies

This strand involves applying various number sense components previously described in the formulation and implementation of a solution process to a counting or computation (estimation, mental computation, paper/pencil, calculator) situation (e.g. Is 29×38 more or less than 400? or How many birds do you estimate in the picture?)

6. Measurement Benchmarks

This strand includes applying various number sense components previously described in the formulation and implementation of a solution process to a measuring situation. It requires an understanding and use of standard, non-standard and/or personal benchmark units of measure (e.g. a textbook weighs about a kilogram or the angle is slightly less than a right angle so it must be about 85 degrees). It involves measuring attributes such as mass, length, capacity, volume, time and angles.

Polya's Problem Solving Principles

Likewise, the study was based on Polya's Problem Solving Principles. In 1945 George Polya published the book entitled, *How To Solve It* which quickly became his most prized publication. It sold over one million copies and has been translated into 17 languages. In this book, he identified four basic principles of problem solving.

Polya's First Principle: Understand the problem

Obviously if one doesn't understand a problem, one won't be able to

solve it. So, it is important to understand what the problem is asking.

This requires one reads slowly the problem and carefully understands the information given to the problem. In some cases, drawing a picture or a diagram can help understand the problem.

Polya's Second Principle: Devise a plan

There are many different types of plans for solving problems. In devising a plan, think about what information one knows, what information one is looking for and how to relate these pieces of information. The following are few common types of plans: $\infty \Rightarrow$ Guess

and test: make a guess and try it out. Use the results of

one's guess as guide, 2) Use a variable, such as x , $\ni \Rightarrow$ Draw a

diagram or a picture, $\triangle \Rightarrow$ Look for a pattern, $\nabla \Rightarrow$ Solve a simpler

problem or problems first. This may help see a pattern one can use and 6) Make a list or a table.

Polya's Third Principle: Carry out the plan

This step is considered to be the hardest step. If one gets stuck, modify plan or try a new plan. Monitor own progress: if stuck, is it because one hasn't tried hard enough to make the plan work? Or is it time to try a new plan? Don't give up too soon. Students sometimes think that they can only solve a problem if they've seen one just like it before, but this is not true. One's common sense and natural thinking abilities are powerful tools that will serve well if one uses them.

Polya's Fourth Principle: Look back

This step helps in identifying mistakes, if any. Check if the answer is plausible. For example, if the problem is to find the height of a telephone pole, then answers such as 2.3 feet or 513 yards are unlikely. It would be wise to look for a mistake somewhere. Looking back also gives an opportunity to make connections. Have you seen this type of answer before? What did you learn from this problem? Could you use these ideas in some other way? Is there another way to solve the problem? Thus, when one looks back, one has an opportunity to Learn from one's own work.

Gardner's Multiple Intelligences

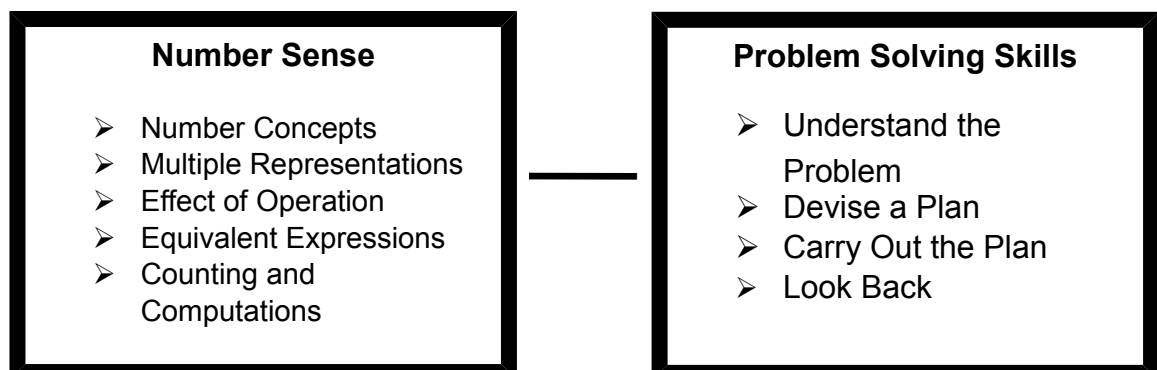
Finally, the study was based on the theory of Howard Gardner's **Logical/**

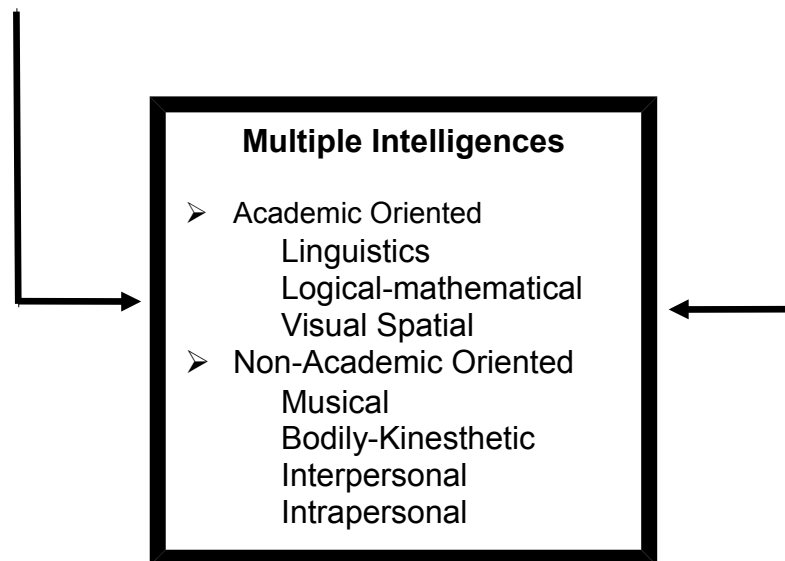
Mathematical Intelligence, Frames of Mind (1983). The logical/ mathematical intelligence is often associated with what is called scientific thinking or deductive

reasoning. The ability of the students to observe and understand details as part of a general pattern is the inductive reasoning on the other hand, is their ability to make objective observations and from the observed data, draw conclusions, make judgments and formulate hypotheses.

Logical/Mathematical intelligence is the students' ability to use numbers effectively and to reason well, to recognize and solve problems using logical patterns, to categorize, infer, make generalizations and test hypotheses. It involves their capacity to recognize patterns, to work well with abstract symbols such as numbers, geometric shapes and to distinguish relationships or see relationships/connections between separate and distinct pieces of information. In other words, these students are often referred to as Number Smart.

Based on the concepts, insights gained and cited, the research framework was structured.





Conceptual Paradigm
Figure 1

The research paradigm illustrated the relationship between number sense competency level of students and the problem solving skills acquired by the students. The link or association was assessed in the light of potential influences of the students multiple intelligences grouped as either academic or non-academic oriented.

NCTM, (2000) pointed out that both number sense and problem solving proficiency are crucial to the learning of math. Number sense and problem solving are linked through assessment which incorporates consideration of both the thinking process and the final solution of the students. Gardner, (1983) claimed that intelligence is comprised of multiple types. Out of these seven MIs, he proposed that linguistics and logical-mathematical are the "coin of the realm" and the ones that have been typically valued in school. Recognizing that

students have different strengths and weaknesses, therefore, during assessment procedures, number sense and problem solving associated to intelligence types should be taken into consideration.

Statement of the Problem

This study attempted to describe the relationship between the students' number sense and problem solving skills across multiple intelligences among high school students.

Specifically, the study sought answers to the following questions:

1. How may the students be described in terms of

1.1 Number Sense,

1.2 Problem Solving Skills and

1.3 Multiple Intelligences?

2. Is there a significant difference between the students' number sense and problem solving skills when grouped according to Multiple Intelligences?

3. Is there a significant relationship between the students' number sense and problem solving skills?

Hypotheses

The following hypotheses were tested in this study.

1. There is no significant difference between the student number sense and problem solving skills when grouped according to Multiple Intelligences.

2. There is no significant relationship between students' number sense and problem solving skills?

Significance of the Study

This study will be beneficial to the following persons.

Students are provided with an aid to better understand their strengths and weakness that will lead them to create an atmosphere of learning where their skills and abilities will best be honed and developed to the fullest.

Teachers are given insights to help improve instruction and implement effective and innovative teaching strategies suited to the students' individual needs, interests, strengths and potentials to remedy the students' low achievement in Mathematics.

School Administrators will use the results of this study as baseline data to improve the Mathematics programs with consideration to students varied intelligences for school achievement.

Department of Education Officials will be given understanding of the real picture of Mathematics performance of the students so that remedial measures will be adopted to ensure effective instruction for improved Mathematics achievement level of students.

Curriculum Planners will help the school administrators and teachers to appraise the existing program in terms of the students' needs and abilities and make intervention or changes as required.

Parents will be informed on their children's weaknesses, strengths and potentials associated to mathematics learning. They are also provided a strong

basis that their role is very significant in enhancing the mathematical abilities of their children and helped them choose the right career suited to them.

Future researchers are provided some guides and references in similar studies on mathematics achievement and to have a deeper study to identify different factors related to Mathematics achievement of the students.

Scope and Delimitation of the Study

This study aimed to describe the relationship between the students' number sense, problem solving skills across multiple intelligences among students in the public high school.

The focus of the study on number sense comprised 5 strands namely: number concepts, multiple representations, effect of operations, equivalent expressions, counting and computation based on the number sense framework by McIntosh, Reys and Reys (1992).

While on problem solving skills covered geometry topics from the 1st to 2nd quarter as prescribed by the Secondary Education Curriculum for Mathematics III namely: Geometry of Shape and Size, Geometric Relations, Triangle Congruence, Quadrilaterals and Similarity.

The basis for the students' dominant multiple intelligence is obtained from the MI Inventory taken from Chislett and Chapman (2005-2006).

The study was conducted during the school year 2013-2014. Two Hundred Thirty Seven (237) third year students of San Bartolome High School, Division of Quezon City were selected as participants of the study.

To provide explanations for whatever results of the survey is not the concern of this study. The students' assessed dominant intelligences limited the comparison of the Mathematics relevant attributes. For the purpose of this study, the students' assessed dominant intelligences have been grouped into either academic or non-academic oriented.

Definition of Terms

The following terms are conceptually and operationally used for purpose of the discussion in the entire course of the study.

Multiple Intelligence. This refers to seven different ways (Linguistic Intelligence, Logical-Mathematical Intelligence, Musical Intelligence, Visual-Spatial Intelligence, Bodily- inesthetic Intelligence, Interpersonal Intelligence, Intrapersonal Intelligence) to demonstrate intellectual ability. It is how to learn best. As used in this study, this pertains to the students' assessed dominant intelligence in the MI Inventory grouped as academic or non-academic oriented.

Number Sense. This refers to a person's general understanding of number and operations along with the ability to use this understanding in flexible ways to make mathematical judgments and to develop useful strategies for solving complex problems. As used in this study, this pertains to the scores of students in the Number Sense Test.

Problem Solving Skill. This refers to the ability to analyze a situation and then form a workable solution. As used in this study, this pertains to the scores of the students in the Problem Solving Skills Test.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter presents the review of conceptual and research literature which are relevant to the study. These are presented to strengthen the framework and background of the study

Number Sense and Its Meaning

Number sense is similar to common sense. It refers to an intuitive ability regarding numbers and their applications. This sense is based on an understanding of patterns, relationships and the magnitude of numbers. There is a high ability to construct meaning and develop strategies to solve mathematical

problems. Number sense is not necessarily the ability to quickly recall basic facts due to memorization. It is a sense of what the applications mean. Number sense can be developed over time with skill development. As Berch, (2005) had pointed out that no two researchers define number sense in exactly the same way. What makes this situation even more problematic; however, is that cognitive scientists and math educators defines the concept of number sense in very different ways after perusing the relevant literature in the domains of mathematical cognition development and mathematics education.

Rudolph (2010) had a working definition of number sense. She broke it down into three major categories: Number Systems, Mathematical Operations and Flexibility in Mathematical Situations. The Number System refers to recognizing different types of numbers, place value, relative magnitude of numbers and different representations of them. Mathematical Operations encompasses addition, subtraction, multiplication, division and the relationships between them. It also includes understanding the effect of these operations on different types of numbers and the rules of arithmetic that govern operations. Flexibility in mathematical situations is the ability to recognize multiple ways to work with numbers/data and identify the most efficient method with which to proceed. It also includes the ability to recognize the reasonableness of answers and when an answer requires an estimate versus an exact answer.

Mohini and Jacinta, (2010) described number sense as good intuition about numbers and their relationships. Individuals with good number sense tend to exhibit the following characteristics when performing mental computations,

sense-making approach, planning and control, flexibility and appropriateness sense of reasonableness.

Pilmer, (2008) believed that number sense is grounded in a sound understanding of number and operations and is exhibited by students when they operate flexibly with number utilizing numerous standard and non-standard approaches. Number sense develops gradually and is characterized by both its highly intuitive and personal nature. Number sense involves judgment and interpretation and is dependent upon a complex interaction among an individual's knowledge, an individual's skills, the nature of the problem and the expected performance on a particular problem. When attempting to judge the nature of number sense possessed by an individual one should observe that individual completing items from the four major components of number sense, number magnitude, mental computation, estimation and reasonableness of answers.

Based on the work of past researchers, Pilmer, (2008) cited three critical common components for defining number sense that can be identified.

(1) Number sense is a sound understanding of numbers and operations. This means that students can move between number representations (e.g. decimals, fractions, percents, scientific notation) recognize number magnitude and relate number, symbols and operations.

(2) Number sense is the ability to operate flexibly with number. This means that students do not feel compelled to use algorithms rather they are occupied with finding the most useful, efficient and sometimes even unconventional approach to handling the problem.

(3) Number sense is characterized by its intuitive nature. Some students display an almost effortless ability to gain insight into a problem and identify which strategy or strategies could be used.

If one considers the three criteria above as the bare bones of number sense according to Pilmer (2008) the following traits, though not mentioned by all researchers contribute to a richer understanding of the term.

(1) Number sense develops gradually. If students possess the inclination and are provided opportunity to explore numbers both in their formal and informal education and number sense can likely be fostered. Number sense is possessed at different levels for different individuals; however, these levels have the potential for constantly expanding reflecting the new experiences they encounter and the new insights they obtain. Number sense also develops and matures with experience and knowledge. This does not mean however that with time alone all students will develop number sense.

(2) Number sense is highly personal. Not only is related to what ideas about number that have been established but also on how those ideas were established. The statement implies that the nature of classroom instruction and activities is critical in the development of number sense. Number sense develops

as a result of exploring numbers, visualizing them in a variety of contexts and relating them in ways not limited by traditional algorithms and that is to build on students' natural insights and convinces them that mathematics makes sense. This statement suggests that traditional teaching practices are not always conducive to developing number sense. Number sense is a by product of teaching for understanding. If students experience number rather than simply work with number, they gain insight and meaning and make connections. This opportunities draw from a child's informal knowledge and in turn fosters number sense.

(3) Number sense is dependent on a complex interaction among an individual's knowledge, an individual's skills, the nature of the problem and the expected performance on a particular problem. Number sense also involves judgement and interpretation which provides greater elaboration to notion of flexibility with number.

(4) Number sense can yield multiple methods and/or solutions. This statement can be expanded upon by saying that students relate numbers in ways not limited to traditional algorithms. One may see that different methods were employed by students even though the same solution was obtained. The thinking strategies employed by individual students vary in efficiency and elegance depending on the sophistication of the student's understanding .

Way, (2007) stated the term number sense as a relatively new one in mathematics education. It is difficult to define precisely, but broadly speaking, it refers to a well organized conceptual framework of number information that enables a person to understand numbers and number relationships and to solve mathematical problems that are not bound by traditional algorithms. According to Way, The National Council of Teachers identified five components that characterize number sense, number meaning, number relationships, number magnitude, operations involving numbers and reference for numbers and quantities.

Berch, (2005) compiled a list of presumed features of number sense, it reveals that number sense reputedly constitutes an awareness, intuition, recognition, knowledge, skill, ability, desire, feel, expectation, process, conceptual structure or mental number line. Possessing number sense ostensibly permits one to achieve everything from understanding the meaning of numbers to developing strategies for solving complex math problems from making simple magnitude comparisons to inventing procedures for conducting numerical operations and from recognizing gross numerical errors to using quantitative methods for communicating, processing and interpreting information. With respect to its origins, some considers number sense to be part of their genetic endowment; whereas others regard, it as an acquired skill set that develops with experience.

Yang, Hsu, and Huang, (2004) referred number sense to a person's general understanding of numbers and operations and his ability to handle daily

life situations that include numbers. This ability entails the usage of useful, flexible and efficient strategies such as mental computation and estimation to handle numerical problems.

Number sense implies meaningful learning and understanding; therefore, it has been extensively discussed and is widely accepted in mathematics education (Yang et. al, 2005). However, no two researchers in the research fields define number sense in exactly the same way (Berch, 2005). Due to its importance, number sense has produced many discussions and studies from different fields, such as mathematics educators, researchers, educational psychologists and so on (Verschaffel et. al, 2009).

Carboni, (2001) said that number sense describes a cluster of ideas such as the meaning of a number ways of representing numbers, relationships among numbers, the relative magnitude of numbers and skill in working with them. Number sense is not a discrete set of skills to be taught for several weeks or something that only those that are good at math have. It is a part of children's daily mathematical lives and slowly grows and develops over time.

Number sense essentially refers to a student's fluidity and flexibility with numbers (Gersten & Chard, 2001). He/She has sense of what numbers mean, understands their relationship to one another and is able to perform mental math, understands symbolic representations and can use those numbers in real world situations. In her book, *About Teaching Mathematics*, Marilyn Burns described students with a strong number sense in the following way: They can think and

reason flexibly with numbers, use numbers to solve problems, spot unreasonable answers, understand how numbers can be taken apart and put together in different ways, see connections among operations, figure mentally and make reasonable estimates.

NCTM, (1989) defined number sense as an intuition about numbers that is drawn from all the varied meanings of number. It has five components: (1) having well- understood number meanings, (2) developing multiple relationships among numbers, (3) understanding the relative magnitudes of numbers, (4) developing intuitions about the relative effect of operating on numbers, (5) developing references for measures of common objects (pp. 39–40).

Importance of Number Sense

According to Way, (2013) number sense skills are considered important because they contribute to general intuitions about numbers and lay the foundation for more advanced skills. Researchers have linked good number sense with skills observed in students proficient in the following mathematical activities: mental calculation, computational estimation, judging the relative magnitude of numbers, recognizing part-whole relationships and place value concepts and problem solving.

Mohini and Jacinta, (2010) believed that number sense is a very important skill to be mastered by every individual to enable them to handle numerical problems in their daily life. Students rarely face problems with algorithms.

Burns, (2007) asserted that number sense is important because it encourages students to think flexibly and promotes confidence with numbers.

They make friends with numbers as Carlyle and Mercado charmingly refer to it in their book, entitled, *Teaching Preschool and Kindergarten Math*. Students come to understand that numbers are meaningful and outcomes are sensible and expected. Conversely, students who lack a strong number sense have trouble developing the foundation needed for even simple arithmetic much less more complex math.

Studies on Number Sense

Mohini and Jacinta, (2010) showed that students have poor understanding in making sense on numbers when tested on their competency in number sense component. Their study aimed to investigate that there is a relationship between student performance in number sense and mathematics achievement and explored the components of number sense that students are weak.

In a recent study of 180 seventh graders conducted by the University of Missouri, researchers found that those who lagged behind their peers in a test of core math skills needed to function as adults were the same kids who had the least number sense or fluency way back when they started first grade. (Neergaard, 2013). This is particularly sobering when one considers that 1 in 5 U.S. adults lacks the math competency of a middle school student leaving them unqualified for most jobs(Math Solutions,2009).

Sare and Hande, (2012) examined number sense on the subject of decimal numbers of the secondary stage students in Turkey. They described number sense as well-understanding of numbers and calculation is one of the main focus of mathematical education. When students improve their number

sense which are ability to estimate mental computations and analytical thinking that will increase their use of mathematics in daily life. So as to measure students' number senses about decimal numbers, a test called Number Sense Test about decimal numbers which were prepared by the researchers was applied to secondary students from the different regions in Turkey. Later on, in order to find out the possible solutions students were interviewed. As a result of the study, students' number senses on decimal numbers turn out to be very low. Root causes of these can be considered as the use of rule based solution techniques, imperfect knowledge and mis-information about decimal numbers. This type of sense has a good correlation with students' ages; however, it turns out that there is no correlation between genders of the students and their number senses. In addition to this moderate level correlation was found out between mathematical achievement and number sense on decimal numbers. They believed that after the importance of number sense is acknowledged the problems of failure will be prevented.

Facun and Nool, (2012) found out that students had difficulties in Number Sense test in the various mathematical strands. Analysis of qualitative and quantitative results revealed that pupils obtained a very low percentage of correct responses. The pupils were not able to make appropriate and sufficiency of information. They did not have a reasonable understanding of fractions and decimals and operations and they did not utilize useful and efficient strategies, like estimation and number relationships, for managing numerical situations. Their over-reliance on algorithms maybe attributed to their teachers' much

emphasis on drill and practice without profound understanding of mathematics concepts.

Lunsford and Poplin, (2011) conducted a study to determine factors that would possibly predict student success in an introductory statistics course. Their results were similar to Johnson and Kuennen, (2006). They found out that students' basic mathematical skills were a significant predictor of student success in the course. They also found a significant professor effect. These results have prompted them to evaluate and modify the teaching of their introductory statistics course.

Gallo and Johnson, (2008) concluded from their study that students with strong elementary math skills perform significantly better in applied contexts. They also found that taking more math classes in college improves a student's ability to apply mathematics substantially. Interestingly, the results suggest that students with greater personal financial responsibility in funding their education possess significantly better math skills.

Howell and Kemp, (2005) discussed the need for assessing number sense in the first year of school. The participants agreed that skills like one to one correspondence, matching numeracy, rote counting to five, cardinal value within a counting range, more than rote counting to ten, addition of 1 or 2 to any other number and its effect, subtraction by three, combining visual images, additive composition and order relevance were essential upon entry into kindergarten. All in all, these researchers agreed on a great need for the skills required for

good number sense to be adequately defined and shared with professionals. If there was no consistent definition of skills, it was hard to adequately teach what needs to be taught.

Yang, Li and Lin, (2007) investigated the performance of number sense and its relationships with mathematics achievement of Taiwanese students who had just completed the 5th grade mathematics curriculum. The study concluded that students perform best on recognizing relative number size and perform worst on judging the reasonableness of estimates of computed results. This finding is consistent with previous studies. It showed that students in Taiwan seem quite poor on judging the reasonableness of estimates of computed results. Female students on average have higher scores on recognizing the relative number size than male students even though only a small effect size is found. Lastly, the achievements of the students in mathematics are significantly correlated with their number sense as measured by the average grade for the academic year of 5th grade students.

Studies on Number Sense and Problem Solving

Louange and Bana, (2005) found out that compared to problem solving number sense seems to have proved to be the most difficult to define. Like common sense, a number sense is valued but difficult notion to characterise and has stimulated much discussion among mathematics educators (including classroom teachers, curriculum writers and researchers) and cognitive psychologists. Thus, while there seems to be general agreement by mathematics

educators on a definition of a problem, it is not possible to define number sense in such a straight forward manner.

A problem is generally regarded as a situation where both the solution and method of solution are not obvious. However, number sense is best described by a comprehensive list of characteristics. Without listing them here, they would venture that number sense could be considered as the ability to make sound estimates since this ability necessarily incorporates the list of number sense attributes that are usually identified.

Carboni, (2001) found that in a problem-centered mathematics curriculum, number sense is closely tied to problem solving, as the children described in her study showed. These children have learned, over time, that they are capable of solving problems and that they can played with numbers to make sense of a problem. They have used their growing number sense to develop strategies to help them solve problems.

Problem Solving Skills and Its Importance

Mathematics is a subject with two components: knowledge and skills. Mathematical knowledge is the ability to understand concepts pertaining to the spatial and numerical relationships between objects while mathematical skill is the ability to derive correct answers to mathematical problems. Therefore,

improving the mathematics achievement levels of students requires the focus on the students' retention, understanding, comprehension and problem solving abilities.

An important part of intelligence is the ability to quickly and creatively solve problems. This is an excellent skill for students to have in their everyday life, in the school, and in general. After all, problems present themselves unexpectedly and in a variety of contexts. If students can train their brain in the raw, foundation level skills needed to solve problems. They will increase their general problem-solving ability regardless of whether the problem is at home, at school or somewhere in between.

Students often know how to perform the operations necessary to solve problems in mathematics. They know the steps to solving straightforward addition, subtraction, multiplication and division problems. Higher level questions that involve real world mathematics can be more challenging. The key is to understand what the problem is asking to make a plan and then to solve the problem.

NCTM, (2000) asserted that problem solving means engaging in a task for which the solution method is not known in advance. To find a solution, students must draw on their knowledge and through this process. They will often develop new mathematical understandings. Solving problems is not only a goal of learning mathematics but also a major means of doing so. Students should have frequent opportunities to formulate, grapple with and solve complex problems that require a significant amount of effort. They should then be

encouraged to reflect on their thinking. Problem solving is an integral part of all mathematics learning.

In his classic monograph, *On Problem Solving*, the Gestalt psychologist Karl Duncker defined a problem as follows: A problem arises when a living creature has a goal but does not know how this goal is to be reached. Whenever one cannot go from the given situation to the desired situation simply by action, then there has to be recourse to thinking. Such thinking has the task of devising some action which may mediate between the existing and desired situations.

According to Mayer and Wittrock, (2006) problem solving is cognitive processing directed at achieving a goal when no solution method is obvious to the problem solver. This definition consists of four parts: (1) problem solving is cognitive that is problem solving occurs within the problem solver's cognitive system and can only be inferred from the problem solver's behavior, (2) problem solving is a process that is problem solving involves applying cognitive processes to cognitive representations in the problem solver's cognitive system, (3) problem solving is directed that is problem solving is guided by the problem solver's goals, and (4) problem solving is personal, that is, problem solving depends on the knowledge and skill of the problem solver. In sum, problem solving is cognitive processing directed at transforming a problem from the given state goal when the problem solver is not immediately aware of a solution method.

Mayer and Wittrock, (2006) identified students need of knowledge in order to be successful problem solvers. Facts: knowledge about characteristics of

elements or events such as 100 cents in a dollar. Concepts: knowledge of a categories, principles or models, such as knowing what place value means in arithmetic. Strategies: knowledge of general methods such as how to break a problem into parts or how to find a related problem. Procedures: knowledge of specific procedures such as how to carry out long division. Beliefs: cognitions about one's problem-solving competence (such as I am not good in math) or about the nature of problem solving (e.g. if someone can't solve a problem right away, the person never will be able to solve it). Facts and concepts are useful for representing a problem, strategies are needed for planning a solution. Procedures are needed for carrying out the plan, and beliefs can influence the process of self-regulating.

Mueller, (2008) believed that virtually everything humans do can be thought of as a problem to be solved, a question to be answered or a task to be completed. Thus, their success in life also depends upon developing skills which enhance their capacity to successfully approach, analyze and complete tasks. Such skills include: Problem-solving Skills including the abilities to identify a Problem, determine knowledge and skills necessary or helpful to solve the problem or complete the task, apply appropriate knowledge, rules and strategies to the problem; generate possible solutions, evaluate the feasibility and effectiveness of possible solutions given relevant constraints, determine best possible solution(s).

NCEE,IES, (2012) reported that students who develop proficiency in mathematical problem solving early are better prepared for advanced

mathematics and other complex problem-solving tasks. Unfortunately, when compared with students in other countries, students in the U.S. are less prepared to solve mathematical problems. Problem solving involves reasoning and analysis, argument construction and the development of innovative strategies. These abilities are used not only in advanced mathematics topics such as algebra, geometry and calculus but also throughout the entire mathematics curriculum beginning in kindergarten as well as in subjects such as science. Moreover, these skills have a direct impact on students' achievement scores as many state and national standardized assessments and college entrance exams to include problem solving.

Mabilangan, Limjap and Belecina, (2012) referred to problem solving skills and strategies as consisting of a utilization of the appropriate basic thinking skills and higher order thinking skills needed to solve the problem. This includes flexibility in the choice of the strategy to be employed, openness to try different strategies and self regulation while solving the problem.

Culaste, (2011) stated that problem solving is an important component of mathematics education because of its practical role to the individual and society. By learning problem solving in Mathematics, students should acquire the ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that will serve them well outside the mathematics classroom (NCTM, 2000).

Mayer and Wittrock, (2006) said that a major goal of education is to help students learn in ways that enable them to use what they have learned to solve

problems in new situations. In short, problem solving is fundamental to education because educators are interested in improving students' ability to solve problems. A problem exists when a problem solver has a goal but does not know how to accomplish it. Specifically, a problem occurs when a situation is in a given state, a problem solver wants the situation to be in a goal state and the problem solver is not aware of an obvious way to transform the situation from the given state goal.

Dendane, (2009) referred to mathematical problem solving as one of the most important topics to learn and also one of the most complex to teach. The main goal in teaching mathematical problem solving is that students develop a generic ability to solve real life problems and apply mathematics in real life situations. Problem solving can also be used as a teaching method for a deeper understanding of concepts. Successful mathematical problem solving depends upon many factors and skills with different characteristics. In fact one of the main difficulties in learning problem solving is the fact that many skills are needed for a learner to be an effective problem solver.

Grattoni, (2007) stated that problem solving is viewed as a skill that students must develop in order to succeed in an academic setting. But within an academic setting, problem solving becomes even more relevant in a mathematics classroom because by its very nature the study of this subject focuses on solving clearly defined problems in an axiomatic system. While problem solving skills might be an implicit benefit in other subjects, mathematics overtly demands the presence of these abilities. Whether in a group setting or an

individual testing situation the students must exhibit an ability to solve problems in order to succeed in any math class.

Limjap, (2003) stated that problem solving for instance acquires a functional understanding of mathematics needed to cope with the demands of a society. School mathematics of the twenty first century is viewed by educators to be that which should engage a learner in problem solving and reasoning. It should also foster deep understanding and develop the learner's critical and analytical thinking. Instruction should not be limited to plain mastery of algorithms or the development of certain mathematical skills. It should involve learners in investigation through exploring, conjecturing, examining and testing (NCTM, 2000). It should be tailored to promote reflective thinking among students.

It is believed that the acquisition of mathematical knowledge and problem solving will develop students' higher order thinking skills and decision making which they can apply in their future encounters. In fact, problem solving is endorsed as a standard in the school mathematics curriculum by the National Council of Teachers of Mathematics (NCTM, 2000).

Schoenfeld, (1992) believed that problem solving is often seen as one of number of skills to be taught in the school curriculum. According to this view, problem solving is not necessarily seen as a unitary skill, but there is a clear skill orientation. Putting problem solving in a hierarchy of skills to be acquired by students leads to certain consequences for the role of problem solving in the

curriculum. Distinctions are made between solving routine and non-routine problems. That is, non-routine problem solving is characterized as a higher level skill to be acquired after skill at solving routine problems (which, in turn, is to be acquired after students learn basic mathematical concepts and skills). It is important to note that even problem solving is seen as a skill in its own right.

Studies on Problem Solving Skills

Although problem solving is an integral part of all Mathematics, many students struggle with solving problems. Research shows that students' ability to solve word problems falls far below their ability to compute because children do not know how to choose the correct operation to apply to the problem (Burns, 2007).

Numerous research studies in the past decades have studied ways to enhance students' problem solving skills (Lawson & Chinnappan, 2000 and Lee (2001). They reviewed studies in mathematics education and noted the increasing interest in the area of problem solving.

Lee, (2001) believed that the acquisition of problem solving heuristics is assumed to assist students to think critically and analytically and hence; enhancing the understanding of concepts and skills in other topics of mathematics. These higher order thinking skills are essential and provide a firm foundation that will later help the students to pursue higher levels of mathematics.

Azlan and Lui, (2000) found out that students have fairly good command of basic knowledge and skills but did not show the use of problem solving strategies as expected. Generally, these students have a low command on

problem solving skills. Most of the students were unable to use correct and suitable mathematical symbols and vocabulary in providing reasons and explanations for certain problem solving procedures.

Multiple Intelligences and its Importance

Analyzing the results of students' multiple intelligence test can reveal a great deal of their strengths, weaknesses and natural inclinations. Every person's brain is wired differently and any given task can be tackled in a wide variety of ways. Becoming aware and embracing their strengths can help students realize more productive strategies for tackling areas which they struggle. Understanding their results will lead to a greater understanding of themselves and may lead to a more efficient self.

The theory behind Howard Gardner's multiple intelligences, (1983) is that students are not a blank slate that is capable of learning any skill presented before them but that students have varied intelligences or strengths. This idea brings forth the notion that all of them are capable of learning but each learns in a different way according to which intelligences are their strengths or weaknesses. Gardner's list includes linguistic, logical mathematical, musical, bodily-kinesthetic, visual-spatial, interpersonal, intrapersonal and naturalist. Students can use these intelligences in order to maximize learning for each type of learner. Each lesson in schools should hit upon its intelligence.

Gardner suggests that the traditional notion of intelligence, based on IQ testing is too limited. Instead he proposed a number of intelligences to account

for a broader range of human potential in children and adults. Each of these intelligences was identified with a different part of the brain. Gardner's research involved working with brain damaged people to identify how parts of the brain operated in the learning process, he defined intelligence in the following ways: the ability to create an effective product or offer a service that is valued in a culture, a set of skills that make it possible for a person to solve problems in life, the potential for finding or creating solutions for problems, which involves gathering new knowledge.

Gardner's theory has been particularly influential in America where its philosophy is used to redesign the way children are being educated. The theory of MI proposes a major transformation in both teaching and learning, its importance is such it alone informs one principle of the Highland Learning and Teaching Policy. If a teacher is experiencing difficulty in teaching a pupil using the more traditional linguistic or logical way of instruction, then the theory of multiple intelligences suggests several other different potential pathways to learning.

Points Arising from Research

- All human beings possess all nine intelligences in varying amounts.
- Each person has a different intellectual composition.
- They can improve education by addressing the multiple intelligences of their students.
- These intelligences are located in different areas of the brain and can either work independently or together.

- In an IQ test, even a genius could gain a low score.
- The context in which they learn is very important and cultural/environmental factors influence how their intelligences develop.
- People do not learn in the same way at the same time.
 - There is evidence that MI based approaches can raise academic achievement.

Studies on Multiple Intelligences

Ajogbeje Oke and Ojo Amos, (2012) found out that a significant relation existed between mathematical problem solving and intellectual abilities (verbal, induction and numerical abilities) of the students. Thus, teachers should provide avenue for students to improve their intellectual abilities of verbal, induction, numerical, retention and other abilities. This could be done by enriching the learning environment using different instructional techniques, materials and activities in the classroom.

Alkan, Ozgen and Lu, (2011) had identified pre-service mathematics teachers' multiple intelligence domains and learning style profiles and to establish relationships between them, the results showed that most of the pre-service mathematics teachers preferred the converger and assimilator learning styles. The study also revealed that the pre-service teachers had logical mathematical and visual-spatial as their dominant intelligence domains. Most of the pre-service teachers tested were found to possess moderate and advanced levels of intelligence domains. Level differences observed in non-learning styles and

intelligence domains were assumed to indicate individual differences. In the study, a high level correlation was not found between learning style dimensions and multiple intelligence domains.

Kaplan, Calp and Ozdemir, (2011) investigated visually impaired students' multiple intelligences dimensions and their relationship among gender, sight level and math achievement. The results revealed that visually impaired students were mostly good at interpersonal intelligence and expectedly poor on visual spatial intelligence. The outcomes of the study likewise showed a significant relationship between the students' math achievement and their logical mathematical, intrapersonal, spatial and linguistic intelligence dimensions.

Havola, (2010) considered the learning styles and basic skills as background information to better understand the engineering students' learning processes. According to the results, students have many gaps in mathematics when working with symbolic fractions, logarithms and trigonometric expressions. Results of the learning styles questionnaire showed that most of the engineering students tend to be visual and sensing learners whereas in the active/reflective and sequential/global scales results were evenly distributed. No strong correlation was found between the results of the basic skills test and learning styles.

Parmjit, (2009) concluded that the high school students faced great difficulty in understanding basic number concepts as shown with the low scores in all the five strands namely: number concepts, multiple representation, effect of operations, equivalent expression and counting and computation. The study

found out that male students seemed to perform better than their female counterparts across the ages (all levels) although the difference was only significant among the 13 year old students. This result does not concur with the findings of recent research. The study seemed to indicate an existence of a gap between the ability to do paper and pencil calculations and intuitive understanding. Majority of the students involved in this study obtained a grade for their year end school examination but there seems to be a vast disparity between the grade scores and the number sense test as the low score indicates. The probable reason for this is inadequate mathematical instructions in schools and this results in many students having inadequate understanding of number sense of mathematical concepts.

Ghazali et.al, (2007) have indicated that students are good at computational skills and once they understand these procedures and practice that will help them become confident and competent in using them. However, research indicates that if students memorize mathematical procedures without understanding is difficult for them to go back later and build intuitive understanding. When students memorize without understanding, they may confuse methods or forget steps and is believed that the scenario among students is a cause for concern as to the direction of these students mathematics learning process in schools.

Ebru, (2009), concluded that academic achievement scores are found to be effective on students multiple intelligences. It is found that the students who have lower academic achievement level have lower verbal-linguistic ability and

have lower logical-mathematical ability and have lower interpersonal and intrapersonal ability than the others. This result supports the notion that these abilities are school valued ones. Self - estimations of intelligence can have a self-fulfilling nature; thus, influencing the academic success of students who overestimate their intelligence that may not develop the strategies and other skills needed to learn because they do not perceive the need to plan and monitor their activities. Likewise, students who underestimate their intelligence may not take initiative in the academic domain, considering themselves less able to begin with.

Yang, Li and Lin, (2007) investigated the performance of number sense and its relationships with mathematics achievement of Taiwanese students who had just completed the 5th grade mathematics curriculum. It showed that female students on average have higher scores on recognizing the relative number size than male students even though only a small effect size is found.

Temur, (2007) revealed that teaching activities which are designed according to the Multiple Intelligence Theory have significant positive effects on the students' success in mathematics on their retention and on the knowledge learned.

Johnson and Kuennen, (2006) found out that the most important determinants of student performance include gender, GPA, ACT science score and score on a quiz of basic math skills. Of interest to them was the fact that the basic skills and mathematics score was consistent as a predictor of success even when controlling for course format and professor.

Shearer, (2006) concluded that high math skill is most directly related to the logical math and intrapersonal intelligences and to a lesser degree the linguistic intelligence. This is true for students at all skill levels except for the linguistic intelligence which is stronger for the High Math group, but equal for the moderate and low math groups.

Loori, (2005) investigated the differences in intelligence preferences of male and female students learning English as a second language. Results of the study showed significant differences between males' and females' intelligence preferences. According to the results, male students preferred learning activities involving logical and mathematical intelligence; whereas, female students preferred learning activities involving intrapersonal intelligence. In addition, the most preferred intelligence was interpersonal intelligence, second was logical mathematical, the third highest was linguistic and the fourth one was bodily-kinesthetic, the least preferred one was intrapersonal intelligence.

Synthesis

All the studies and literature presented are all relevant to the present study. The review of literature stressed the significant relationship of number sense, problem solving skills across multiple intelligences among students.

These studies are synonymous to the present study by the researcher. It only differs on the respondents and subject undertaken. Most of the studies reviewed were conducted in a foreign setting. While there have been many studies conducted relating number sense and problem solving independently the study conducted by Louange and Bana, (2005) are closely related to the present

study as it is also the intent of the researcher to assess the students' sense and compare these across problem solving ability. However, this study tried to find out whether students' number sense is related to the students' acquisition of essential problem solving skills according to Multiple Intelligences group.

These literature and studies are very necessary in the conduct of this research because they provided insights and guidelines on the relationship of students' number sense, problem solving skills across multiple intelligences among high school students. Hence, all the literature and studies presented are relevant to the present study.

CHAPTER III

METHODOLOGY

This chapter presents the research design, locale of the study, participants of the study, research instruments, data gathering and the data analysis procedure used in the study.

Research Design

The nature of this study was exploratory and employed the descriptive method. Gay, (1976) defines descriptive research as involving collection of data in order to test hypothesis or to answer questions concerning the current status of the subject of the study. A descriptive study determines the way things are and it can only measure what already exists.

It is believed to be the most effective method of study which could best ascertain the characteristics (number sense, problem solving skills, multiple intelligences) of the subjects being studied. A descriptive study is one in which information is collected without changing the environment (i.e., nothing is manipulated). Sometimes these are referred to as correlational or observational studies. Descriptive study is defined as any study that is not truly experimental. In human research, a descriptive study can provide information about the naturally occurring health status, behavior, attitudes or other characteristics of a particular group. Descriptive study is so conducted to demonstrate relationships between things in the world around them.

Descriptive study can involve a one time interaction with groups of people or a study that might follow individuals over time. Descriptive study in which the researcher interacts with the participant may involve surveys or interviews to collect the necessary information. Descriptive studies in which the researcher does not interact with the participants include observational studies of people in an environment and studies involving data collection using existing records. Descriptive study is usually the best method for collecting information that will demonstrate relationships and describe the world as it exists. Thus, the present study required the use of descriptive design.

Research Locale

The study was undertaken at San Bartolome High School located at 67 Sinforosa St., San Bartolome, Novaliches, Quezon City. San Bartolome High School was established in 1992 as an annex of Novaliches High School. Eight years later in 2000 it became an independent public secondary school. Its mission is to produce disciplined, skilled and talented Bartolomenians who are responsible and productive members of the society. Its vision is a caring functional institution that transforms into actualities, nurtures intelligence with values and radiates wisdom in discovering new horizon.

As one of the performing schools in Quezon City, San Bartolome High School is creating a promising and rising public school across Novaliches which is now developing its facilities and increasing its faculty for better quality education it offers.

Participants of the Study

The participants of this study were the Two Hundred Thirty Seven (237)

third year students of San Bartolome High School, Novaliches, Quezon City. They were enrolled for the school year 2013 – 2014.

Five sections with at most 54 students were used to complete the number of respondents. The five sections were handled by the researcher.

Table 1 shows the distribution of the students by according to section.

Table 1
Distribution of the Students by Section

Section	Total Number of Students	Percent
Agoncillo	54	22.78
Aquino	46	19.41
Jaena	47	19.83
Laurel	48	20.25
Recto	42	17.72
Total	237	100

Table 2 shows the distribution of respondents by MI group. Eighty Four (84) or 32% of the respondents are academic oriented and 175 or 68% are non- academic oriented.

Table 2
Distribution of the Students by Multiple Intelligences Group

Academic Oriented Group	N	Non-Academic Oriented Group	N
Linguistic	27	Bodily-Kinesthetic	88
Logical-Mathematical	25	Musical	58
Visual-Spatial	13	Intrapersonal	16
		Interpersonal	10

Total	65	Total	172
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Research Instruments

The instruments used in the study were the Multiple Intelligence Inventory Test, Number Sense Test and the Problem Solving Skills Test. These were modified based on already existing instruments of similar nature that have been used in earlier studies. The modifications were done to make the materials more suitable for the purpose of this study. The Number Sense Test and Problem Solving Skills Test were validated by three professors from the Philippine Normal University and three master teachers from San Bartolome High School. The instruments were tried out in a third year section not handled by the researcher. Copy of these instruments including the key to corrections are appended (refer to Appendices).

Number Sense Test

The Number Sense Test was adapted from McIntosh et. Al, (1997) that was used and cited by Parmjit, (2009). It was administered to determine students' number sense. This 50 item multiple-choice test comprises five number sense strands based on the number sense framework by McIntosh, Reys and Reys, (1992). The number sense strands are number concepts, multiple representations, effect of operations, equivalent expression and counting and computation with 14, 7, 10, 8 and 11 numbers of items, respectively.

Table 3
Number Sense Items Distribution by Strand

Strand	Number of Items	Item Placement
Number Concepts	14	1,3,4,6,9,10,15,18,19,22,25,29,36,39
Multiple Representations	7	7,8,13,14,30,31,40
Effect of Operations	10	16,17,20,21,24,27,28,38,48,49
Equivalent Expressions	8	11,23,26,32,33,34,37,45
Counting and Computation	11	2,5,12,35,41,42,43,44,46,47,50

Some modifications were made in the Number Sense Test items such as changing some words and some choices of the items that are fitted to Philippine setting.

Problem Solving Skills Test

The Problem Solving Skills Test has two parts. Part I of the tests was adapted from Entering Geometry (EG) Test of CDASSG Project of Usiskin and Shenk, (1982). This 20 items Multiple Choice questions assessed the students' level of geometry concepts and skills.

Part II was taken from TIMSS, IEA, (1995 – 2011), Ohio Mathematics Achievement Test (2011) and Problem Solving Handbook, Krulik and Rudnick, (1989). This 20 items structured questions assessed the students' level of

problem solving skills in geometry covering topics from the 1st to 2nd Quarter as prescribed by the Secondary Education Curriculum for Mathematics III. A scoring guide for the Part II was adapted from TIMSS. The items used were taken from the Problem Solving Tests sourced from the internet.

Table 4

Problem Solving Skills Test Item Distribution by Category

Category	Number of Items	Item Placement
Part I Assess the students' level of geometry concepts and skills	20	1,2,3,4,5,6,7,8,9,10, 11,12,1,3,14,15,16,17,18,19,20
Part II Assess the students level of problem solving skills	20	1,2,3,4,5,6,7,8,9,10, 11,12,13,14,15,16,17,18,19,20

Multiple Intelligences Inventory

The items in the MI Inventory were taken from Chislett and Chapman, (2005-2006), based on Gardner's MI model. The MI Inventory was administered to determine the dominant intelligences of the respondents. It consists of 35 statements in each intelligence domain namely linguistic, logical mathematical, musical, visual - spatial, bodily - kinesthetic, interpersonal and intrapersonal intelligence.

A separate scoring guide for the MI Inventory was developed for the students after accomplishing the MI Inventory for easy scoring. The MI domain with the highest score was considered as their dominant intelligence. Where

there are tied highest scores, the MI domains were taken as their dominant intelligences.

Data Gathering Procedure

The study involved three phases consist of the preparation of research instruments and request letters and gathering of data. The table below presents the activities done during the conduct of the study.

Phase I involved the preparation of the research instruments. This includes the modification of existing MI Inventory, Number Sense Test and Problem Solving Skills Test followed by a validation.

Phase II was the preparation of request letters addressed to the school principal of San Bartolome High School allowing the researcher to conduct this study.

Phase III was the actual administration of the three instruments. The three research instruments were administered in three separate days before the third periodic examination.

The first instrument administered was the MI Inventory followed by Number Sense Test and lastly the Problem Solving Skills Test. A maximum of 30 minutes allowed for MI instrument, 45 minutes for Number Sense Test and Problem Solving Skills Test. In MI Inventory, the scoring sheet was given to the students only after they had accomplished the test to avoid bias on scores. In the scoring sheet, students were asked to place again a check mark on each item they had checked and write the total on the space provided in each intelligence

domain to determine their dominant intelligences. The dominant intelligences the students are columns which have the highest scores.

In the Number Sense Test, students were allowed to answer the questions in 45 minutes. During the administration of Problem Solving Skills Test, the students were not allowed to use calculators or any gadget for computation. They were asked to present their solution fully and shortcut computation were not allowed.

After the administration of each instrument, checking was done right after the retrieval of each test answer sheets to determine the students' dominant intelligences, number sense and problem solving skills competency.

Table 5
Time Table of the Study

Phase	Activity	Instrument Used	Output
I	Modification and Validation of Research Instruments	Existing Instruments of Number Sense Test , Problem Solving Skills Test and MI Inventory	Final Form of Number Sense Test, Problem Solving Skills Test and MI Inventory
II	Permission to Conduct the Study	Request Letters	Approved Request Letters
III	Actual Administration of the Three Instruments	Validated MI Inventory, Number Sense Test and Problem Solving Skills Test	Completed results of MI Inventory, Number Sense Test and Problem Solving Skills Test

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Data Analysis Procedure

The following were the description of some statistical procedures used in the study.

Based on their individual scores in the Number Sense Test, the competency level of the respondents was determined. Frequency counts were done and the percentage of the students' correct answers in each strand of the test were computed to find out in which strands where the students were weak or strong.

Problem Solving skills of the students were measured based on their individual scores in the Problem Solving Skills Test. Frequency counts were also done and the percentage of the students' correct answers were computed to determine the level of geometry concepts and skills as well as problem solving skills where the students were weak or strong.

The students' responses to the Multiple Intelligence Inventory were individually scored. The number of points in each MI domain was totalled to determine the dominant intelligence/s of the student. The MI domain with the highest score was the student's identified dominant intelligence, where there ere more than one MI domain with equal highest scores. All of these were considered dominant intelligences. The students were then grouped based of their identified dominant intelligence/s. The two groups were academic oriented (linguistic, logical-mathematical, and visual-spatial intelligences) and non-academic

oriented (musical, bodily-kinesthetic, intrapersonal and interpersonal intelligences).

Descriptive statistics on students in the two test scores were computed by group based on clustered MI. The groups (academic oriented versus non-academic oriented) were then compared in terms of their test scores.

Pearson Product Moment Correlation Coefficient was used to determine the relationship between students' number sense and problem solving skills. According to Reyes, (1999) the researcher used the Pearson r , if the two variables to be correlated were both interval measurements and have a linear relationship. Furthermore, all values on one variable and the distribution of values on the other variable is approximately normal and equal in variability. The interpretation of the coefficient; however, depend very much upon the problems of the study, the reasons why it was computed. The nature of the variables being correlated, and the variability of the MI groups being studied.

The t – test for independent samples was applied to determine if there was significant difference in the students' number sense and problem solving skills when grouped according to Multiple Intelligences. The said test was used on the basis of the following assumptions: 1) The two MI groups were normal, 2) the variances of the two groups were equal, 3) The groups were independent samples, 4) Data are interval in nature, (Reyes, 1999).

CHAPTER IV

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter presents the data which were gathered from this study. The data were presented in corresponding tables in the order and sequence of the questions posited in Chapter I.

Students' Number Sense

The students' performance in the number sense is presented in two subsections. The first sub-section is the students performance in the number sense test by strand including their overall performance in the test and the last sub-section is the comparison of students' number sense by Multiple Intelligence groups.

The summary statistics on respondent students' performance in the different Number Sense Test Strands is presented in Table 6.

Table 6
Students' Mean Scores on Number Sense According to Strand

Strand	Mean	Percent of Correct Responses	Standard Deviation
Number Concepts	3.86	27.61	1.81
Multiple Representations	2.32	33.15	1.25
Effect of Operations	3.72	37.22	1.94
Equivalent Expressions	2.59	32.44	1.47
Counting and Computation	3.79	34.44	1.84

The low average percentage of correct responses in each strand is depicted in the table. As shown in the table, generally, the students perform better on effect of operations strand and least on the number concepts strand with the lowest percentage of correct responses. The standard deviation on effect of operations strand suggests that students scores showed a great variation of spread and least on multiple representations strand. The overall mean of 16.22 suggests that students have very poor number sense and had difficulty in the number sense test as also manifested in the lowest score of 4 and a highest score of only 38. This result is in agreement with the result of the number sense studies conducted by Facun and Nool et.al, (2012) found out that students had difficulties in Number Sense test in the various mathematical

strands. Analysis of qualitative and quantitative results revealed that students obtained a very low percentage of correct responses.

Comparison of Students' Number Sense Across Multiple Intelligences Groups

Table 7 shows the summary of data in the number sense test by Multiple Intelligences groups.

Table 7
Students' Mean Scores on Number Sense
According to Multiple Intelligences Groups

Multiple Intelligences Group	N	Mean	Standard Deviation
Academic Oriented	65	18.54	6.45
Non-Academic Oriented	172	15.42	4.59
Overall	237	16.27	5.34

In terms of MI groupings, the academic oriented group obtained a slightly higher mean than the mean of the non-academic oriented group. As expected, this suggests that students who are academically inclined perform better than those who are not as also evident in the highest and lowest scores obtained by the two groups in favor of academic oriented group. This result is in agreement with the result of the study conducted by Shearer, (2006) concluded that high math skill is most directly related to the logical math and intrapersonal intelligences and to a lesser degree the linguistic intelligence. This

is true for students at all skill levels except for the linguistic intelligence which is stronger for the High Math group but equal for the moderate and low math groups.

Table 8 shows the summary statistics for the t- test of the difference between number sense means across MI Groups.

Table 8

T – test of Difference Between Number Sense Test Score Means

Across Multiple Intelligences Groups

Multiple Intelligence s Group	Mean	Standard Deviation	T	Df	p-value	Interpretation
Academic Oriented	18.54	6.45	3.72	64	0.0004	Significant
Non- Academic Oriented	15.42	4.59				

The results revealed that there is a significant difference in the number sense means between the academic oriented group and the non - academic oriented group, it is found out that the academic oriented group has a significantly better number sense than the non-academic oriented group. Therefore, the hypothesis is rejected and the null hypothesis is accepted.

Students' Problem Solving Skills

This section presents the students' performance in the problem solving skills test by category including their overall performance in the test. This also presents the comparison of students' problem solving skills by MI groups.

Students' Performance by Category in the Problem Solving Skills Test

Table 9 shows the summary of the data on students' performance in each problem solving skills category.

Table 9
Students Mean Scores on Problem Solving Skills Category

Category	Mean	Percent of Correct Responses	Standard Deviation
Part I Assess the students' level of geometry concepts and skills	9.54	47.45	3.34
Part II Assess the students' level of problem solving skills	7.59	18.95	7.02

Generally, as evident in the table the students performed better in geometry concepts and skills. On the other hand, the students performed least in problem solving skills with the lowest percent of correct response.

The overall mean suggests that students had only met the mean percentage score of 34.30 which shows that most students obtained scores of far below half of the items. The poor result in the number sense test is being reflected on the poor foundation of the students on the problem solving skills as evident in the results. This suggests that students have inadequate skills

and had great difficulty in problem solving. This result is in agreement of the result of the studies conducted by Burns,(2003) that students ability to solve word problems falls far below their ability to compute because children do not know how to choose the correct operation to apply to the problem. Azlan and Lui, (2000) found out that students have a low command on problem solving skills. Most of the students were unable to use correct and suitable mathematical symbols and vocabulary in providing reasons and explanations for certain problem-solving procedures.

Comparison of Problem Solving Skills Across Multiple Intelligences Groups

Table 10 below shows the descriptive statistics on students' performance in problem solving skills test by MI groups.

Table 10
Students' Mean Scores on Problem Solving Skills
According to Multiple Intelligences Groups

Multiple Intelligence Group	Mean	Standard Deviation
Academic Oriented	23.18	9.84
Non-Academic Oriented	14.87	7.63
Overall	17.15	9.07

In terms of MI groupings, the academic oriented group obtained a higher mean as compared to the mean of the non - academic oriented group. As also

expected, this suggests that students who are academically inclined perform better in problem solving skills test than those who are not. The standard deviation of the academic oriented group suggests that the scores of the group are more spread than the scores of non-academic oriented group. This result is in agreement of the result of the study conducted by Ajogbeje Oke and Ojo Amos, (2012) that a significant relationship existed between mathematical problem solving and intellectual abilities (verbal, induction and numerical abilities) of the students.

Table 11 shows the summary of t – test statistics on the difference in problem solving skills test scores by MI groups

Table 11
T-test of the Difference Between Problem Solving Skills Means
Across Multiple Intelligences Groups

MI Group	Mean	SD	T	Df	p-value	Interpretation
Academic Oriented	23.18	9.84	2.32	64	0.0238	Significant
Non-Academic Oriented	14.87	7.63				

The results revealed that there is significant difference in the problem solving skills means between the academic oriented and non-academic oriented groups. This suggests that academic orientation is a necessary factor to

acquire essential problem solving skills; hence, the hypothesis is rejected, on the other hand, the hypothesis is accepted.

Correlation among Students' Number Sense, Problem Solving Skills and Multiple Intelligences Groups

Table 12 shows the summary statistics of the computed Pearson r correlation coefficients and interpretation between number sense with problem solving skills and MI groups.

Table 12

Correlation Among Students' Number Sense, Problem Solving Skills Across Multiple Intelligences Groups

Variables	Pearson r	P-value	Interpretation
Number Sense and Problem Solving Skills	0.12	0.71	Not significant at $p < 0.05$

The statistics presented in Table 12 shows that Number Sense scores of the students are only slightly related to their problem solving skills test scores. Also depicted in the table is that in general, there is no significant relationship between the students' number sense and their problem solving skills across

multiple intelligences among the students in which the hypothesis is accepted. This result differs to the results of the study conducted by Louange and Bana, (2005) that there is quite a strong correlation between the number sense and problem solving proficiency of Year 7 students. The evidence points towards a relationship in which problem solving performance depends upon number sense proficiency more than the latter depending on the former. While according to Ebru, (2009) he concluded that academic achievement scores were found to be effective on students multiple intelligences. It was found that the student who have lower academic achievement level have lower verbal-linguistic ability and have lower logical-mathematical ability.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

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

Summary

The main purpose of this study was to describe students' number sense, problem solving skills and multiple intelligences. This is determined whether mathematics attributes are related to each other. Three research instruments were utilized to describe these variables namely: Number Sense Test adapted from McIntosh, Reys and Reys(1997), Problem Solving Skills Test adapted from Usiskin and Shenk (1982), TIMSS,IEA (1995-2011), Ohio Mathematics Achievement Test (2011) and Krulik and Rudnick (1989); lastly, MI Inventory Test adapted from Chislett and Chapman (2005-2006).

Two Hundred Thirty Seven (237) third year students of San Bartolome High School, Division of Quezon City during the School Year 2013 - 2014 were the participants of the study. Five sections with at most 54 students were used to complete the number of participants. The five sections were handled by the researcher.

Findings

Based on the data gathered and analyzed, the study yielded these findings.

1. As shown in the results of the study, the students' performance in the number sense test is very poor as reflected in the overall mean. The low average percentage of correct responses in each 5 strands of the Number Sense Test indicates that students had great difficulty on number sense. It is quite alarming that none of the strand wherein the students got at least 50% of correct responses. This basic math skills are crucial for the students to perform well in the problem solving skills test and considered as the reason why the students had poor problem solving skills.

2. The results of the problem solving skills test revealed that students had only obtained far below 50% of correct responses in the test as reflected in the mean score. This indicates that students do not have a strong foundation and inadequately skilled in problem solving.

3. The results of the MI Inventory revealed that when students are classified according to Multiple Intelligences whether academic oriented or non-academic oriented about two thirds of them belonged to the latter.

4. A comparison of number sense and problem solving skills between the two groups of MI clusters revealed that the academic oriented group has a significantly better number sense and problem solving skills than the non-academic group as shown in the result.

5. Generally, there is no significant relationship between students' number sense and their problem solving skills.

Conclusions

Based on the above findings, these conclusions were made.

1. Multiple intelligences are factors that affect students' number sense and problem solving skills.

2. Academic oriented students are proven to be better in terms of number sense and problem solving skills as compared to their non-academic counterparts.

3. Number sense is not related to the problem solving skills among high school students.

4. The prevalence of poor number sense and inadequate problem solving skills among public high school students.

Recommendations

The following recommendations drawn from the findings and conclusions are

made by the researcher.

1. It is recommended that at the start of the school year, diagnostic tests including the MI Inventory be administered on content areas and the specific skills to be developed among high school students.

2. It is recommended to assist those identified with inadequate math skills, remediation measures be conducted to enable them to cope up with their lessons and to improve performance in math.

3. It is recommended to improve students' learning in math, encourage mathematics teachers to explore viability of innovative strategies considering their students' multiple intelligences based from the results of the MI Inventory.

4. It is recommended that respondents to make them aware on issues pertaining to number sense, problem solving skills and varied intelligences in relation to math learning, seminars or workshops be conducted for mathematics teachers.

5. It is recommended that similar studies be conducted across year level and gender differences adopting the Deped K to 12 curriculum on the relationship between other content areas (e.g. Patterns and Algebra) and math skills and processes even among high school students in the private schools as well.

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CURRICULUM VITAE

A. PERSONAL INFORMATION

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B. EDUCATIONAL ATTAINMENT

Graduate

2014 : Master of Arts in Teaching Mathematics
Philippine Normal University
Taft Ave., Manila

College

- 2008 : Certificate in Teaching Mathematics
Philippine Normal University
Taft Ave., Manila
- 1995 : Bachelor of Secondary Education
Mathematics (Units)
University of Saint Anthony
Iriga City
- 1986 : Bachelor of Science in Commerce
Accounting
Technological Institute of the Philippines
Manila
Sec. Guillermo De Vega Memorial Scholar

High School

- 1982 : E. Rodriguez Jr. High School
Mayon Ave., Quezon City
Journalist of the Year

Elementary

- 1978 : Lucas R. Pascual Mem. Elementary School
Baesa, Quezon City
Valedictorian

C. WORKING EXPERIENCES

- November, 1999 – Present : Teacher I
San Bartolome High School
67 Sinforosa St., San Bartolome,
Novaliches, Quezon City
- 1997 – 1999 : College Instructor
University of Saint Anthony
Iriga City
- 1995 – 1997 : School Secretary/ Finance Officer
Buhi Institute Foundation
Buhi, Camarines Sur

1988 - 1992	Office Clerk Theo. Arthur Chemical Enterprises Karuhatan, Valenzuela
1988	Clerk Municipal Treasurer's Office Buhi, Camarines Sur

D. GOVERNMENT EXAMINATION TAKEN/PASSED

1995	:	Professional Board Examination for Teachers 81.87%
1988	:	Career Service Professional 82.41%

Appendix A1 Number Sense Test

Name: _____ Year & Section: _____

Sex: _____ Age: _____

Practice Questions:

1. Without counting exactly, about how many children are there in your class?
 A. 5 B. 50 C. 500 D. 5000
2. What number goes in the box will make this statement true?
 $30 + \square = 50$
 Answer: _____ A. 10 B. 20 C. 30 D. 50

Instructions:

DO NOT write anything on this test questionnaire.
 There are 50 questions in this test. You will have 45 minutes to answer these questions. Read each question carefully. Then, write the letter of the answer in your answer sheet.

Test Questions:

1. Mark ran 100 meters in 15.52 seconds. Chong took 2 tenths of a second longer. How long did it take Chong to run 100 meters.
 A. 34.52 seconds B. 16.52 seconds C. 15.72 seconds D. 15.54 seconds
2. Ten bottles of orange juice cost a total of Php 7.95 at the first shop. I can get 5 bottles of the same juice for a total of Php 4.15 at the second shop. Which shop is a bottle of orange juice cheaper?
 A. First shop B. Second shop C. Both shops D. None of them
3. How many different decimals are there between 1.52 and 1.53? Which of the following is your answer and then fill in the blanks.
 A. None. Why?

 B. One. What is it?

 C. A few. Give two examples.
 _____ and _____
 D. Many. Give two examples.
 _____ and _____

4. Which of the following fractions represent the largest amount?

A. $\frac{5}{6}$

B. $\frac{5}{7}$

C. $\frac{5}{8}$

D. $\frac{5}{9}$

5. Which two of the numbers below will make a fraction as close as possible to $\frac{1}{2}$?

3, 4, 9, 12

A. $\frac{3}{4}$

B. $\frac{3}{9}$

C. $\frac{4}{9}$

D. $\frac{4}{12}$

6. How many different fractions are there between $\frac{2}{5}$ and $\frac{3}{5}$?

A. None. Why?

B. One. What is it?

C. A few. Give two examples. _____ and _____

D. Many. Give two examples. _____ and _____

7. Which of the following statements below are true about the fraction $\frac{2}{5}$?

A. It is greater than $\frac{1}{2}$

C. It is equivalent to 0.4

B. It is the same as 2.5

D. It is less than $\frac{1}{3}$

8. Which of the following decimal best represents the amount of the box shaded?



- A. 0.018 B. 0.15 C. 0.4 D. 0.801

9. Which of the following fractions will fill in the boxes below to make a fraction between 0 and $\frac{1}{10}$ and whose numerator is **NOT** 1?

Answer: _____

A. $\frac{3}{5}$

B. $\frac{7}{10}$

C. $\frac{2}{25}$

D.

$\frac{9}{100}$

10. Which of the following numbers below will make the fraction $\frac{\boxed{}}{8}$ between 2 and 3 ?

A. 17

B. 20

C. 23

D. All of the above

11. 0.5×840 is the same as

A. $840 \div 2$

B. $840 + 2$

C. 5×8400

D. 5×840

12. About how many days have you lived to this day? Which of the following is your nearest answer?

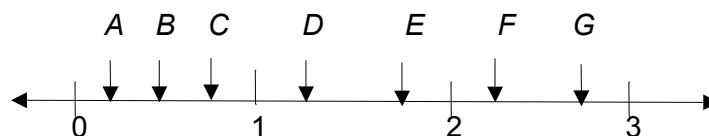
A. 450

B. 4500

C. 45000

D. 450000

13. Which letter in the number line below shows a fraction where the numerator is nearly twice the denominator?



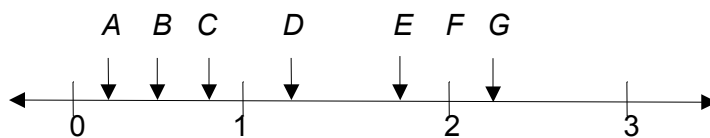
A. A

B. D

C. E

D. G

14. Which letter in the number line below shows a fraction where the numerator is twice the denominator?



- A. B B. C C. F D. G

15. Which of the following fractions below are greater than $\frac{3}{4}$ but less than 1?

- A. $\frac{3}{4}$ B. $\frac{5}{8}$ C. $\frac{4}{5}$
 D. $\frac{7}{10}$

16. Without calculating the exact answer, which best estimates for:

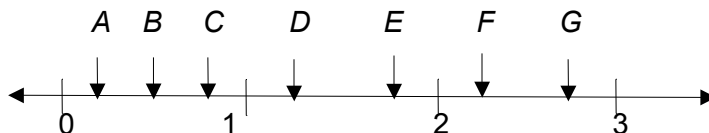
$$29 \times 0.98$$

- A. More than 29 B. Less than 29 C. Equal to 29 D. Impossible to tell without working it out

17. When a 2 – digit number is multiplied by a 2 – digit number, the product is

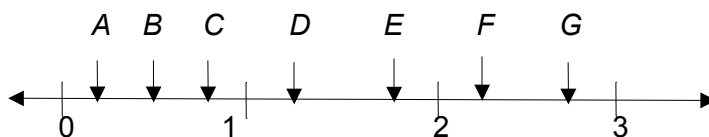
- A. always a 3 – digit number C. either a 3 or 4 – digit number
 B. always a 4 – digit number D. sometimes a 5 – digit number

18. On the number line below, which letter best represents $D \times F$?



- A. A B. C C. E D. G

19. On the number line below, which letter best represents $E + F$?



- A. C B. E C. F D. G

20. Which of the following best estimates for 87×0.09 ?

- A. Very much less than 87 C. A little more than 87
 B. A little less than 87 D. Very much more than 87

21. Which of the following best estimates for $54 \div 0.09$?

- A. A lot less than 54
 B. A little less than 54
 C. A little more than 54
 D. Very much more than 54

22. Without calculating, which of the following total is more than 1?

- A. $\frac{2}{5} + \frac{3}{7}$
 B. $\frac{1}{2} + \frac{4}{9}$
 C. $\frac{3}{8} + \frac{2}{11}$
 D. $\frac{4}{7} + \frac{1}{2}$

23. Which of the following below will make $5 \times 7\frac{1}{2}$ _____ $35 \div \frac{1}{2}$, a true statement?

- A. is greater than B. is equal to C. is less than D. is not equal to

24. Amina had Php 426 and spent 0.9 of the money on her clothes. Without calculating an exact answer, which statement best described how much she spent?

- A. Slightly less than Php 426
 B. Very much less than Php 426
 C. Slightly more than Php 426
 D. Impossible to tell without calculating

25. Which is the correct statement below if $\frac{4}{5} \times \frac{7}{6}$?

- A. Is less than $\frac{7}{6}$
 B. Is equal to $\frac{7}{6}$
 C. Is greater than $\frac{7}{6}$
 D. Is not equal to $\frac{7}{6}$

26. A four digit number is represented by # # # #. If # # # # + 30 > 40, then which of these statements is true?

- A. $30 \times 40 = \# \# \# \#$
 B. $30 \times 40 > \# \# \# \#$
 C. $30 \times \# \# \# \# < 40$
 D. $40 \times \# \# \# \# < 30$

27. Which one of these answers is the best estimate of the following product?

- A. $45 \times 1.05 = 39.65$
 B. $4.5 \times 6.5 = 292.5$
 C. $87 \times 1.076 = 93.61$
 D. $589 \times 0.95 = 559.55$

28. Which of these best estimates for $29 \div 0.8$?

- A. Less than 29
B. Equal to 29

- C. Greater than 29
D. Impossible to tell without calculating

29. Which best estimates for $\frac{2}{5} \times \frac{5}{4}$?

- A. Less than $\frac{2}{3}$

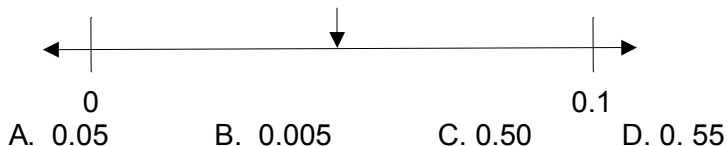
- C. Greater than $\frac{2}{3}$

- B. Equal to $\frac{2}{3}$

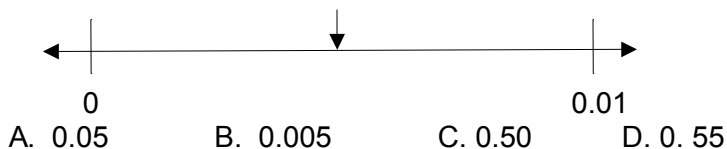
- D. Impossible to tell without

calculating

30. Which of the following is the correct estimate of the decimal number shown by the arrow on the number line?



31. Which of the following is the correct estimate of the decimal number shown by the arrow on the number line?



32. Which of the following expression below represents the larger amount.

I 145×4

II $144 + 146 + 148 + 150$

- A. I only B. II only C. None D. Impossible to tell without calculating

33. Which numbers below will fill in both boxes to make the sentence true?

$$243 \times \square = \square \times 24.3$$

- A. 0 B. 0.1 C. 1 D. 10

34. If 93×134 is equal to 12 462, then 93×135 is equal to

- A. 12 055 B. 12 505 C. 12 550 D. 12 555

35. If 93×134 is equal to 12 462, then $12462 \div 930$ is equal to

- A. 13.4 B. 13.43 C. 14.3 D. 14.34

36. Which numbers below will fill in the box to make the sentence true?

$$\frac{1}{2} \square = \frac{3}{6}$$

- A. $\frac{2}{4}$ B. $\frac{2}{3}$ C. 1 D. 3

37. A farmer has 80 boxes with 40 mangoes in each box. He needs to repack them equally into 40 new boxes. How many mangoes will there be in each new box?

- A. 2 B. 40 C. 80 D. 120

38. There are 1,000 fish in a tank. If I increase the number of fish by 50 %, how many fish will there be in the tank?

- A. 500 B. 1050 C. 1500 D. 2000

39. Clare used a calculator to compute

$$715.347 + 589.2 + 4.553$$

After writing down the answer 13091, she said that she forgot the decimal point. Write down Clare's answer with the decimal point in the correct place.

- A. 1.3091 B. 13.091 C. 130.91 D. 1309.1

40. If these numbers are written in order starting with the smallest, which is on the top line?

$$0.595 ; \quad \frac{2}{4} ; \quad 61\% ; \quad 0.3 ; \quad 30.5\%$$

1. _____
2. _____
3. _____
4. _____

- A. 0.595 B. $\frac{2}{4}$ C. 61% D. 0.3

41. A shopkeeper marks up the price of a shirt from Php 40 to Php 50. What is the

- percent increase?
 A. 10% B. 25% C. 50% D. 90%
42. Kitty eats 600 g of fish in 4 days. How many grams will the cat eat in 6 days?
 (assume that the cat eats the same amount each day)
 A. 400 g B. 600 g C. 800 g D. 900 g
43. A trip to a certain town took 5 hours, travelling at an average speed of 80 kilometers per hour. The return trip took 3 hours. What was the average speed for the whole journey?
 A. 30 kph B. 50 kph C. 80 kph D. 100 kph
44. Last week a diary cost Php 44.50. This week there is a 10% discount on the cost of the diary. What is the cost of the diary this week?
 A. Php 0.45 B. Php4.05 C. Php40.05 D. Php40.50
45. Ken bought 3 sleeping bags at Php 98 each. How could he work out how much he spent?
 A. 3 of Php 100, take away Php 1 C. 3 of Php 100, take away Php 4
 B. 3 of Php 100, take away Php 2 D. 3 of Php 10, take away Php 6
46. All books in a bookshop are being sold at a discount of 15%. The discounted price of a book that normally costs Php 40 is:
 A. Php 25 B. Php 29 C. Php 34 D. Php 36
47. Which of the following best estimates for $[6 \times 347] \div 43$
 A. About 30 B. About 50 C. About 80 D. About 100
48. A meter of a uniform wooden beam weighs about 2.1 kilograms. About how much do 13.8 meters of this wooden beam weigh? The answer in kilograms is closest to:
 A. $16 \frac{1}{2}$ B. 17 C. 26 D. 28
49. Which of the following best estimates for 424×0.76 ?
 A. 280 B. 300 C. 320 D. 34
50. There were 48 tomatoes in the basket. 75% of the tomatoes in a basket were good. How many were good?
 A. 12 B. 32 C. 36 D. 48

This instrument was cited by Parmjit, S. (2009) and was adapted from a number sense test constructed and published by McIntosh, A., Reys, B., Reys, R. E., Bana, J.

Appendix A2
KEY TO CORRECTION - NUMBER SENSE TEST

1. C	26 A
2. A	27 C
3 D	28 C
4 A	29 C
5 B	30 A
6 D	31 B
7 C	32 B
8 C	33 A
9 C	34 D
10 D	35 A
11 A	36 C
12 B	37 C
13 C	38 C
14 C	39 A
15 C	40 D
16 B	41 B
17 C	42 D
18 C	43 D
19 C	44 C
20 A	45 D
21 D	46 C
22 D	47 B
23 C	48 D
24 A	49 C
25 A	50 C

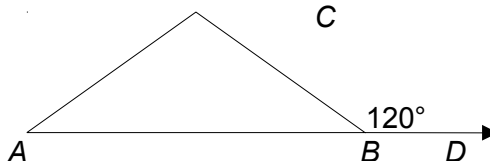
Appendix B1 Problem Solving Skills Test

Instructions:

DO NOT write anything on this questionnaire. In Part I, there are 20 multiple choice questions that will assess your level of geometry concepts and skills. Read each question carefully, then write the letter of the answer on the blank provided for each number in your answer sheet. You will have 45 minutes to answer Part I and Part II questions.

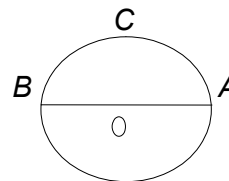
PART I MULTIPLE CHOICE QUESTIONS

1. Perpendicular lines
 - A. intersect to form four right angles
 - B. intersect to form two acute and two obtuse angles
 - C. do not intersect at all
 - D. intersect to form four acute angles
2. The area of a rectangle with length 3 inches and width 12 inches is
 - A. 18 sq. in
 - B. 72 sq. in
 - C. 36 sq. in
 - D. 15 sq. in
3. If two figures are similar but not congruent then they
 - A. have congruent bases and congruent altitudes
 - B. have the same height
 - C. have a different shape but the same size
 - D. have a different size but the same shape
4. The measure of an obtuse angle is
 - A. 90°
 - B. between 45° and 90°
 - C. less than 90°
 - D. between 90° and 180°
5. At right, A , B , and D lie on a straight line. The measure of angle ABC is
 - A. 120°
 - B. 60°
 - C. 80°
 - D. 240°
6. Parallel lines are lines
 - A. in the same plane which never meet
 - B. which never lie in the same plane and never meet
 - C. which always form angles of 90° when they meet
 - D. none of the above



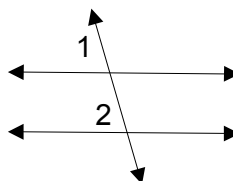
7. If O is the center of the circle, segment OA is called a

A. radius of the circle
 B. diameter of the circle
 C. chord of the circle
 D. segment of the circle



8. Angles 1 and 2 are called

A. exterior angles
 B. alternate interior angles
 C. alternate exterior angles
 D. corresponding angles

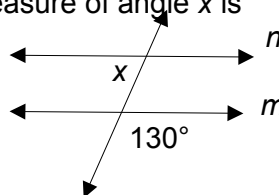


9. The measure of a right angle is

A. less than 90°
 B. between 90° and 180°
 C. 180°
 D. 90°

10. Lines n and m are parallel. The measure of angle x is

A. 130°
 B. 30°
 C. 40°
 D. 50°

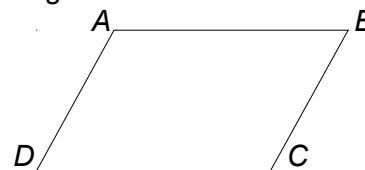


11. An equilateral triangle has

A. all three sides the same length
 B. two angles having the same measure and the third a different measure
 C. all three sides of different lengths
 D. all three angles of different measures

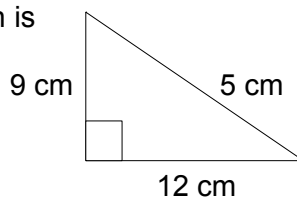
12. Given that $ABCD$ is a parallelogram, which of the following statements is true?

A. $ABCD$ is equiangular
 B. Triangle ABD is congruent to triangle CDB
 C. AC is the same length as BD
 D. All of the above are true



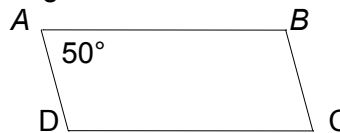
13. The area of the triangle shown is

A. 36 sq. cm
 B. 54 sq. cm
 C. 72 sq. cm
 D. 108 sq. cm
 E. 1620 sq. cm



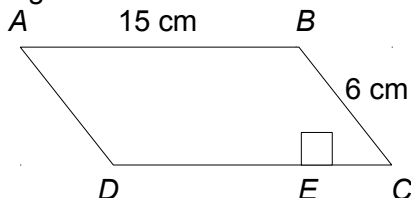
14. $ABCD$ is parallelogram. The measure of angle C is

A. 40°
 B. 130°
 C. 140°
 D. 50°



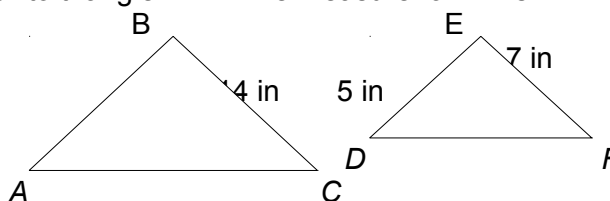
15. The perimeter of this parallelogram $ABCD$ is

A. 25 cm
 B. 42 cm
 C. 21 cm
 D. 60 cm



16. Triangle ABC is similar to triangle DEF . The measure of AB is

A. 10 in
 B. 11 in
 C. 12 in
 D. 13 in

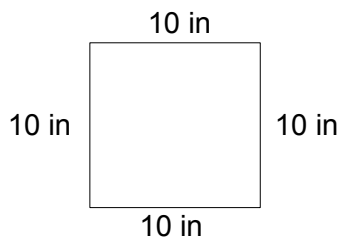


17. The plane figure produced by joining all points exactly 6 inches from a given point is a

A. circle with diameter of 6 in
 B. square with a side of 6 in
 C. sphere with a diameter of 6 in
 D. circle with a radius of 6 in

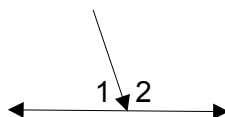
18. The area of the square shown is

A. 40 sq. in
 B. 40 inches
 C. 100 sq. in
 D. 100 inches



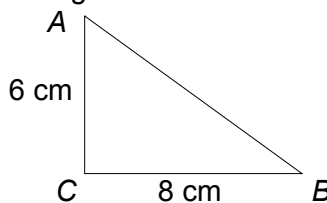
19. Angles 1 and 2 are

A. interior
 B. vertical
 C. supplementary
 D. complementary



20. Angle C is a right angle. The length of side AB is

A. 8 cm
 B. 14 cm
 C. 10 cm
 D. 12 cm



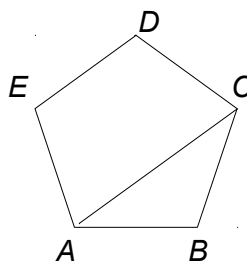
Instructions:

In Part II, there are 20 structured questions that will assess your level of problem solving skills in geometry. Show your work. You are not allowed to use calculator. You will have 45 minutes to answer these questions.

PART II STRUCTURED QUESTIONS

Solve the following:

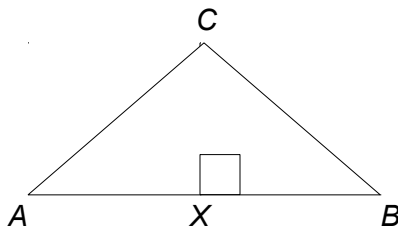
1.



What is the sum of all the interior angles of pentagon $ABCDE$?
Show your work.

Answer: _____

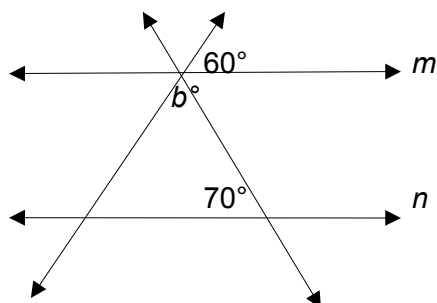
2.



In this triangle :
 $AC = BC$
 AB is twice as long as CX .
 What is the size of angle B ?

Answer: _____

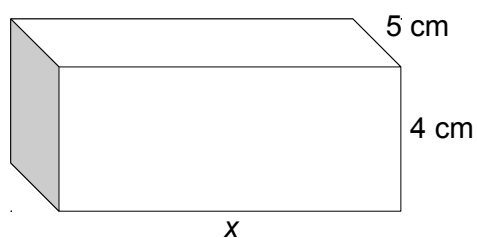
3.



Lines m and n are parallel.
What is the value of b ?

Answer : _____

4.



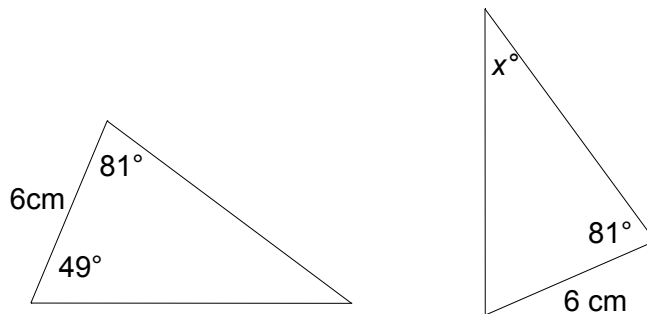
The volume of the rectangular box is 200 cm^3 ?
What is the value of x ?

Answer : _____

5. What is the perimeter of a square whose area is 100 square meters?

Answer: _____

6.

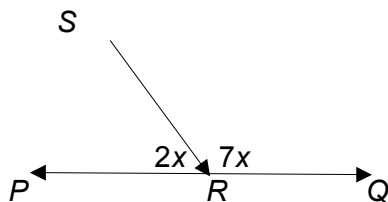


The triangles shown are congruent. The measures of some of the sides and angles are given.

What is the value of x ?

Answer : _____

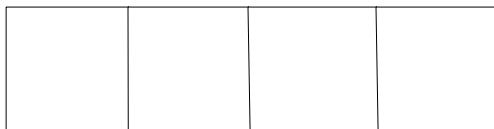
7. In this figure PQ is a straight line.



What is the degree measure of angle PRS ?

Answer : _____

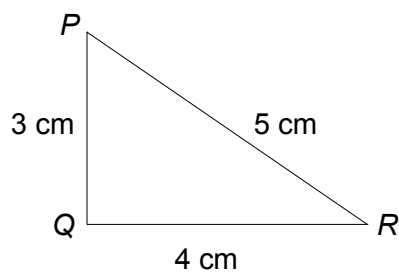
- 8.



In the figure, 17 segments were used to make 4 squares in a row.
 What is the number of squares in a row that can be made in this way using 73 segments?
 Show the calculations that lead to your answer.

Answer : _____

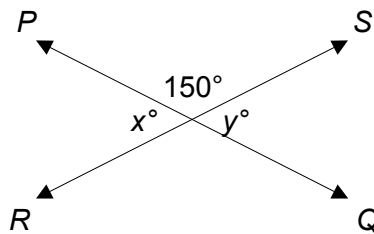
9.



Explain how can you prove that $\triangle PQR$ is a right triangle.

Answer: _____

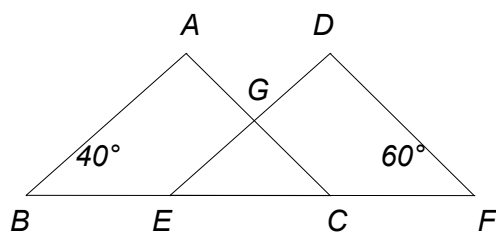
10. In the figure, PQ and RS intersecting straight lines



What is the value of $x + y$?

Answer : _____

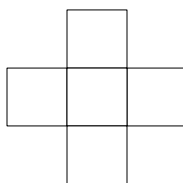
11. In the figure, triangles ABC and DEF are congruent with $BC = EF$.



What is the measure of angle EGC ?

Answer: _____

12. The figure consists of 5 squares of equal areas.
The area of the whole figure is 245 cm^2 .



Find the area of one square.

Answer: _____

13. In a quadrilateral each of 2 angles has a measure of 115° .
If the measure of a third angle is 70° , what is the measure of the remaining angle?

Answer: _____

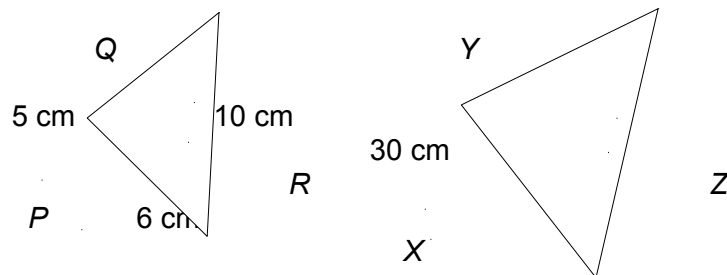
14. The length of a rectangle is 6 centimeters and its perimeter is 16 centimeters.
What is the area of the rectangle in square centimeters?

Answer : _____

15. A line segment measuring 28 meters long is divided into two parts in the ratio 4:3. What is the measure of the longest line segment?

Answer : _____

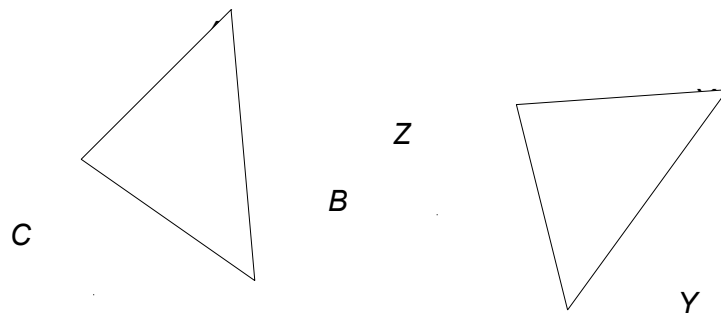
16. $\triangle PQR$ is similar to $\triangle XYZ$



What is the perimeter of $\triangle XYZ$?

Answer: _____

17. Caleb drew two congruent triangles as shown.



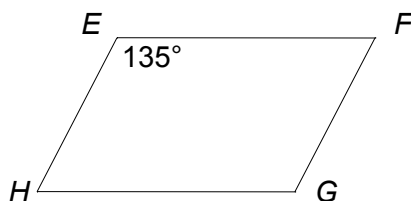
Jan asks Caleb to prove that the triangles are congruent.
Explain how Caleb can prove to Jan that triangle ABC is congruent to triangle XYZ .

Answer : _____

18. Lance is 5 feet tall. His shadow is 8 feet long.
At the same time of day, a tree's shadow is 32 feet long.
What is the height of the tree?

Answer : _____

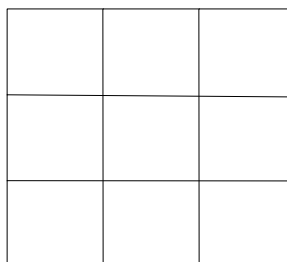
19. A parallelogram is shown



What is the measure of angle F ?

Answer : _____

20. How many squares are there in a 3 – inch by 3 – inch checkerboard?



Answer : _____

Appendix B2**KEY TO CORRECTION – PROBLEM SOLVING SKILLS TEST****PART I**

1. A
2. C
3. D
4. D
5. B
6. A
7. A
8. D
9. D
10. D
11. A
12. B
13. B
14. D
15. B
16. A
17. D
18. D
19. C
20. C

PART II

1. 540°
2. 45°
3. 50°
4. 10 centimeters
5. 40 meters
6. 50°
7. 40°
8. 24 squares with calculations
9. $(5)^2 \text{ cm} = (3)^2 \text{ cm} + (4)^2 \text{ cm}$
10. 60°
11. 80°
12. 49 square centimeters
13. 60°
14. 12 square centimeters
15. 16 meters
16. 126 centimeters
17. Corresponding sides are congruent. Corresponding angles are congruent.
18. 20 feet
19. 45°
20. 14 squares

SCORING GUIDE

Correct Response – 2 points

No Response - Blank

Partially Correct Response – 1 point With no work shown

Incorrect Response – 0 point Crossed out, erased, stray marks, illegible, off task

Appendix C1

Multiple Intelligence Test

INSTRUCTIONS:

This activity will help you find out what your strengths are.

Read each statement. Put a check mark " ✓ " before each statement which you feel accurately describes you. If you **do not** identify with a statement, **leave** the space provided blank. There are no right or wrong answers.

1. _____ I can play a musical instrument.
2. _____ I often have a song or piece of music in my head.
3. _____ I find it easy to make up stories.
4. _____ I have always been physically well coordinated (run, jump, balance, etc.).
5. _____ Music is very important to me.
6. _____ I am a good liar (If I want to be).
7. _____ I play a sport or dance.
8. _____ I am a very social person and like being with other people.
9. _____ I find graphs, charts and diagrams easy to understand.
10. _____ I find it easy to remember quotes or phrases or poems or song lyrics.
11. _____ I can always recognize places that I have been before, even when I was very young.
12. _____ When I am concentrating I tend to doodle.
13. _____ I find mental arithmetic easy (sums in my head).
14. _____ At school one of my favorite subjects is / was English.
15. _____ I like to think through a problem carefully, considering all the consequences.
16. _____ I love adrenaline sports and scary rides.
17. _____ I enjoy individual sports best.
18. _____ I find it easy to remember telephone numbers.
19. _____ I set myself goals and plans for the future.
20. _____ I can tell easily whether someone likes me or dislikes me.
21. _____ To learn something new, I need to just get on and try it.
22. _____ I often see clear images when I close my eyes.
23. _____ I don't use my fingers when I count.
24. _____ At school I love / loved music lessons.
25. _____ I find ball games easy and enjoyable.
26. _____ My favorite subject at school is / was mathematics.
27. _____ I always know how I am feeling.
28. _____ I keep a diary.
29. _____ My favorite subject at school is / was art.
30. _____ I really enjoy reading.
31. _____ It upsets me to see someone cry and not be able to help.
32. _____ I prefer team sports.
33. _____ Singing makes me feel happy.
34. _____ I am happy spending time alone.
35. _____ My friends always come to me for emotional support and advice.

Appendix C2

Multiple Intelligence Scoring Sheet

Place again a check mark on each item you checked. Add the checked marks in each column and write the total on the space provided below. The highest scores indicate your dominant strengths and potential – your natural intelligences.

Linguistic	Logical-Mathematical	Musical	Visual-Spatial	Bodily-Kinesthetic	Interpersonal	Intrapersonal
3	13	1	9	4	8	17
6	15	2	11	7	20	19
10	18	5	12	16	31	27
14	23	24	22	21	32	28
30	26	33	29	25	35	34
Total	Total	Total	Total	Total	Total	Total

This instrument was adapted from V. Chislett MSc and A. Chapman (2005 – 2006) based on Gardner's model.

Appendix D
Letter to the Principal
Republic of the Philippines
PHILIPPINE NORMAL UNIVERSITY
The National Center for Teacher Education

February 11, 2014

DR. MODESTO G. VILLARIN
Principal IV
San Bartolome High School
Quezon City

Dear Dr. Villarín:

The undersigned is a graduate student of Philippine Normal University, Manila and is presently working on his seminar paper entitled, "**Number Sense, Problem Solving Skills and Multiple Intelligences Among High School Students**" in partial fulfillment for the Degree, Master of Arts in Teaching Mathematics under Dr. Rene R. Belecina.

In this regard, may he be permitted to conduct a study to the third year students to determine the relationship between students' number sense and problem solving skills across Multiple Intelligences groups. Likewise, the undersigned respectfully requests your permission for the undersigned to use the math laboratory during the conduct of the study.

Any information elicited from or provided to the researcher will be treated with confidentiality and will be used for research purposes only.

Your favorable consideration and approval will be highly appreciated. Thank you and more power.

Respectfully yours,

RAYNOR N. MENDIZABAL
Researcher

Appendix E
Raw Data in Number Sense Test

N	NC	%	MR	%	EO	%	EE	%	CC
1	1	7.14	4	57.14	0	0	1	12.5	2
2	4	28.57	1	14.29	4	40	2	25	3
3	6	42.86	5	71.43	5	50	6	75	9
4	5	35.71	3	42.86	6	60	3	37.5	6
5	5	35.71	2	28.57	6	60	5	62.5	4
6	1	7.14	4	57.14	2	20	2	25	2
7	4	28.57	0	0.00	2	20	4	50	4
8	7	50.00	3	42.86	6	60	5	62.5	5
9	6	42.86	1	14.29	3	30	6	75	7
10	7	50.00	3	42.86	5	50	5	62.5	5
11	5	35.71	3	42.86	4	40	2	25	2
12	6	42.86	3	42.86	5	50	3	37.5	4
13	8	57.14	4	57.14	6	60	6	75	9
14	3	21.43	5	71.43	4	40	3	37.5	4
15	9	64.29	4	57.14	2	20	5	62.5	8
16	6	42.86	2	28.57	6	60	5	62.5	9
17	5	35.71	2	28.57	5	50	4	50	4
18	5	35.71	1	14.29	6	60	2	25	5
19	3	21.43	2	28.57	2	20	3	37.5	2
20	5	35.71	4	57.14	4	40	3	37.5	4
21	1	7.14	2	28.57	2	20	2	25	5
22	5	35.71	5	71.43	2	20	4	50	6
23	6	42.86	1	14.29	5	50	4	50	2
24	0	0.00	2	28.57	1	10	2	25	0
25	2	14.29	3	42.86	4	40	4	50	6
26	5	35.71	1	14.29	4	40	5	62.5	4
27	4	28.57	1	14.29	3	30	2	25	4
28	3	21.43	2	28.57	3	30	2	25	5
29	4	28.57	1	14.29	7	70	6	75	5
30	11	78.57	6	85.71	9	90	6	75	6
31	5	35.71	2	28.57	5	50	4	50	3
32	6	42.86	1	14.29	4	40	3	37.5	5
33	5	35.71	4	57.14	7	70	4	50	4
34	1	7.14	2	28.57	3	30	2	25	1
35	3	21.43	4	57.14	4	40	3	37.5	3
36	2	14.29	2	28.57	2	20	3	37.5	3
37	6	42.86	0	0.00	3	30	2	25	3
38	3	21.43	3	42.86	6	60	1	12.5	3
39	1	7.14	2	28.57	6	60	3	37.5	3

40	6	42.86	2	28.57	5	50	2	25	4
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%	Total Score
18.18	8
27.27	14
81.82	31
54.55	23
36.36	22
18.18	11
36.36	14
45.45	26
63.64	23
45.45	25
18.18	16
36.36	21
81.82	33
36.36	19
72.73	28
81.82	28
36.36	20
45.45	19
18.18	12
36.36	20
45.45	12
54.55	22
18.18	18
0.00	5
54.55	19
36.36	19
36.36	14
45.45	15
45.45	23
54.55	38
27.27	19
45.45	19
36.36	24
9.09	9
27.27	17
27.27	12
27.27	14
27.27	16
27.27	15

36.36	19
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Raw Data in Number Sense Test

N	NC	%	MR	%	EO	%	EE	%	CC	%
41	3	21.43	1	14.2857	3	30	3	37.5	3	27.2727
42	6	42.86	1	14.2857	2	20	3	37.5	3	27.2727
43	4	28.5714	2	28.5714	5	50	2	25	3	27.2727
44	3	21.4286	1	14.2857	3	30	3	37.5	3	27.2727
45	4	28.5714	3	42.8571	4	40	5	62.5	6	54.5455
46	1	7.14286	3	42.8571	6	60	2	25	7	63.6364
47	2	14.2857	4	57.1429	5	50	3	37.5	1	9.09091
48	3	21.4286	2	28.5714	3	30	2	25	5	45.4545
49	4	28.5714	2	28.5714	2	20	2	25	3	27.2727
50	4	28.5714	3	42.8571	3	30	2	25	4	36.3636
51	1	7.14286	3	42.8571	5	50	4	50	7	63.6364
52	3	21.4286	1	14.2857	4	40	1	12.5	4	36.3636
53	8	57.1429	3	42.8571	4	40	2	25	7	63.6364
54	8	57.1429	5	71.4286	4	40	5	62.5	7	63.6364
55	1	7.14286	3	42.8571	1	10	2	25	3	27.2727
56	4	28.5714	2	28.5714	4	40	2	25	6	54.5455
57	4	28.5714	2	28.5714	1	10	4	50	1	9.09091
58	4	28.5714	2	28.5714	1	10	4	50	8	72.7273
59	0	0	0	0	2	20	3	37.5	3	27.2727
60	3	21.4286	2	28.5714	2	20	1	12.5	4	36.3636
61	2	14.2857	2	28.5714	2	20	1	12.5	0	0
62	4	28.5714	1	14.2857	5	50	6	75	5	45.4545
63	3	21.4286	3	42.8571	1	10	1	12.5	2	18.1818
64	5	35.7143	4	57.1429	4	40	1	12.5	2	18.1818
65	5	35.7143	2	28.5714	3	30	1	12.5	3	27.2727
66	6	42.8571	4	57.1429	5	50	3	37.5	4	36.3636
67	6	42.8571	4	57.1429	6	60	5	62.5	8	72.7273
68	5	35.7143	4	57.1429	1	10	1	12.5	4	36.3636
69	3	21.4286	2	28.5714	2	20	0	0	3	27.2727
70	4	28.5714	2	28.5714	3	30	2	25	3	27.2727
71	5	35.7143	2	28.5714	3	30	2	25	4	36.3636
72	1	7.14286	2	28.5714	2	20	0	0	3	27.2727
73	4	28.5714	2	28.5714	1	10	2	25	5	45.4545
74	4	28.5714	3	42.8571	4	40	4	50	5	45.4545
75	6	42.8571	2	28.5714	2	20	4	50	3	27.2727
76	7	50	4	57.1429	1	10	2	25	2	18.1818
77	3	21.4286	1	14.2857	7	70	4	50	4	36.3636
78	8	57.1429	3	42.8571	3	30	5	62.5	6	54.5455
79	1	7.14286	2	28.5714	4	40	3	37.5	3	27.2727

80	1	7.14286	3	42.8571	5	50	1	12.5	4	36.3636
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Total Score
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Raw Data in Number Sense Test

N	NC	%	MR	%	EO	%	EE	%	CC	%
81	3	21.43	4	57.1429	3	30	2	25	3	27.2727
82	0	0	2	28.5714	2	20	1	12.5	2	18.1818
83	3	21.4286	1	14.2857	4	40	2	25	3	27.2727
84	4	28.5714	3	42.8571	2	20	1	12.5	3	27.2727
85	2	14.2857	2	28.5714	1	10	2	25	2	18.1818
86	2	14.2857	1	14.2857	5	50	3	37.5	3	27.2727
87	2	14.2857	1	14.2857	2	20	5	62.5	3	27.2727
88	3	21.4286	2	28.5714	0	0	0	0	5	45.4545
89	5	35.7143	2	28.5714	5	50	6	75	8	72.7273
90	2	14.2857	2	28.5714	3	30	3	37.5	2	18.1818
91	3	21.4286	4	57.1429	2	20	3	37.5	3	27.2727
92	3	21.4286	3	42.8571	0	0	2	25	6	54.5455
93	2	14.2857	2	28.5714	5	50	0	0	7	63.6364
94	3	21.4286	3	42.8571	5	50	1	12.5	5	45.4545
95	3	21.4286	4	57.1429	4	40	3	37.5	4	36.3636
96	1	7.14286	2	28.5714	1	10	0	0	0	0
97	8	57.1429	0	0	2	20	3	37.5	4	36.3636
98	6	42.8571	3	42.8571	7	70	4	50	6	54.5455
99	5	35.7143	3	42.8571	4	40	3	37.5	3	27.2727
100	4	28.5714	1	14.2857	1	10	2	25	3	27.2727
101	3	21.4286	1	14.2857	2	20	1	12.5	3	27.2727
102	1	7.14286	2	28.5714	4	40	1	12.5	2	18.1818
103	5	35.7143	3	42.8571	5	50	3	37.5	4	36.3636
104	10	71.4286	2	28.5714	3	30	3	37.5	3	27.2727
105	3	21.4286	4	57.1429	4	40	3	37.5	4	36.3636
106	6	42.8571	2	28.5714	9	90	2	25	5	45.4545
107	2	14.2857	1	14.2857	5	50	3	37.5	3	27.2727
108	5	35.7143	1	14.2857	5	50	2	25	3	27.2727
109	3	21.4286	3	42.8571	6	60	2	25	1	9.09091
110	1	7.14286	2	28.5714	4	40	4	50	5	45.4545
111	5	35.7143	3	42.8571	3	30	2	25	1	9.09091
112	4	28.5714	1	14.2857	2	20	4	50	3	27.2727
113	5	35.7143	3	42.8571	8	80	5	62.5	6	54.5455
114	3	21.4286	4	57.1429	7	70	4	50	6	54.5455
115	4	28.5714	2	28.5714	6	60	3	37.5	1	9.09091
116	3	21.4286	2	28.5714	3	30	5	62.5	4	36.3636
117	1	7.14286	2	28.5714	7	70	4	50	3	27.2727
118	3	21.4286	1	14.2857	2	20	2	25	3	27.2727
119	2	14.2857	0	0	4	40	4	50	5	45.4545

120	2	14.2857	1	14.2857	3	30	5	62.5	5	45.4545
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Total Score
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Raw Data in Number Sense Test

N	NC	%	MR	%	EO	%	EE	%	CC	%
121	6	42.86	4	57.1429	2	20	1	12.5	5	45.4545
122	7	50	4	57.1429	0	0	2	25	5	45.4545
123	5	35.7143	4	57.1429	5	50	0	0	5	45.4545
124	3	21.4286	2	28.5714	7	70	5	62.5	5	45.4545
125	1	7.14286	0	0	2	20	4	50	4	36.3636
126	6	42.8571	2	28.5714	1	10	3	37.5	3	27.2727
127	4	28.5714	2	28.5714	1	10	1	12.5	3	27.2727
128	4	28.5714	1	14.2857	5	50	0	0	6	54.5455
129	4	28.5714	3	42.8571	3	30	0	0	5	45.4545
130	4	28.5714	2	28.5714	2	20	5	62.5	5	45.4545
131	3	21.4286	3	42.8571	7	70	6	75	6	54.5455
132	1	7.14286	2	28.5714	4	40	4	50	5	45.4545
133	4	28.5714	3	42.8571	6	60	5	62.5	5	45.4545
134	3	21.4286	1	14.2857	3	30	1	12.5	5	45.4545
135	5	35.7143	1	14.2857	6	60	2	25	5	45.4545
136	4	28.5714	1	14.2857	1	10	2	25	1	9.09091
137	4	28.5714	2	28.5714	2	20	3	37.5	4	36.3636
138	4	28.5714	4	57.1429	3	30	2	25	2	18.1818
139	4	28.5714	2	28.5714	3	30	4	50	4	36.3636
140	5	35.7143	2	28.5714	4	40	2	25	5	45.4545
141	2	14.2857	3	42.8571	2	20	1	12.5	2	18.1818
142	7	50	1	14.2857	4	40	4	50	6	54.5455
143	3	21.4286	3	42.8571	3	30	1	12.5	2	18.1818
144	4	28.5714	1	14.2857	3	30	3	37.5	6	54.5455
145	1	7.14286	2	28.5714	0	0	2	25	3	27.2727
146	3	21.4286	1	14.2857	4	40	1	12.5	5	45.4545
147	4	28.5714	4	57.1429	3	30	4	50	6	54.5455
148	3	21.4286	3	42.8571	3	30	1	12.5	3	27.2727
149	5	35.7143	0	0	4	40	2	25	3	27.2727
150	4	28.5714	3	42.8571	4	40	2	25	3	27.2727
151	7	50	1	14.2857	5	50	3	37.5	3	27.2727
152	1	7.14286	2	28.5714	2	20	1	12.5	3	27.2727
153	3	21.4286	2	28.5714	3	30	2	25	2	18.1818
154	4	28.5714	1	14.2857	7	70	4	50	7	63.6364
155	2	14.2857	1	14.2857	3	30	1	12.5	5	45.4545
156	5	35.7143	3	42.8571	6	60	5	62.5	9	81.8182
157	3	21.4286	1	14.2857	4	40	2	25	1	9.09091
158	6	42.8571	3	42.8571	3	30	3	37.5	2	18.1818
159	3	21.4286	1	14.2857	4	40	2	25	1	9.09091

160	2	14.2857	2	28.5714	1	10	3	37.5	3	27.2727
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Total Score
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Raw Data in Number Sense Test

N	NC	%	MR	%	EO	%	EE	%	CC	%
161	1	7.14	3	42.8571	2	20	3	37.5	3	27.2727
162	4	28.5714	1	14.2857	7	70	4	50	6	54.5455
163	6	42.8571	1	14.2857	2	20	3	37.5	3	27.2727
164	4	28.5714	3	42.8571	6	60	2	25	2	18.1818
165	4	28.5714	4	57.1429	8	80	4	50	2	18.1818
166	6	42.8571	3	42.8571	7	70	4	50	6	54.5455
167	2	14.2857	2	28.5714	3	30	3	37.5	4	36.3636
168	2	14.2857	3	42.8571	7	70	3	37.5	3	27.2727
169	4	28.5714	1	14.2857	4	40	2	25	0	0
170	4	28.5714	1	14.2857	8	80	4	50	6	54.5455
171	3	21.4286	4	57.1429	6	60	3	37.5	4	36.3636
172	2	14.2857	6	85.7143	7	70	4	50	4	36.3636
173	4	28.5714	1	14.2857	2	20	1	12.5	3	27.2727
174	1	7.14286	1	14.2857	5	50	1	12.5	3	27.2727
175	4	28.5714	2	28.5714	7	70	4	50	7	63.6364
176	6	42.8571	3	42.8571	7	70	5	62.5	3	27.2727
177	6	42.8571	4	57.1429	7	70	3	37.5	4	36.3636
178	3	21.4286	3	42.8571	4	40	1	12.5	3	27.2727
179	3	21.4286	2	28.5714	1	10	1	12.5	4	36.3636
180	3	21.4286	2	28.5714	2	20	2	25	3	27.2727
181	5	35.7143	3	42.8571	2	20	2	25	6	54.5455
182	4	28.5714	1	14.2857	3	30	0	0	3	27.2727
183	6	42.8571	3	42.8571	1	10	1	12.5	4	36.3636
184	5	35.7143	3	42.8571	2	20	1	12.5	5	45.4545
185	4	28.5714	0	0	2	20	3	37.5	1	9.09091
186	2	14.2857	2	28.5714	4	40	3	37.5	4	36.3636
187	3	21.4286	2	28.5714	4	40	0	0	6	54.5455
188	5	35.7143	2	28.5714	4	40	3	37.5	5	45.4545
189	5	35.7143	2	28.5714	3	30	1	12.5	1	9.09091
190	5	35.7143	2	28.5714	3	30	3	37.5	0	0
191	5	35.7143	0	0	3	30	2	25	1	9.09091
192	4	28.5714	0	0	4	40	3	37.5	1	9.09091
193	4	28.5714	4	57.1429	4	40	2	25	4	36.3636
194	3	21.4286	2	28.5714	1	10	1	12.5	4	36.3636
195	4	28.5714	1	14.2857	3	30	1	12.5	2	18.1818
196	5	35.7143	3	42.8571	5	50	3	37.5	6	54.5455
197	5	35.7143	3	42.8571	3	30	1	12.5	3	27.2727
198	3	21.4286	3	42.8571	3	30	2	25	4	36.3636
199	3	21.4286	1	14.2857	3	30	3	37.5	0	0

200	4	28.5714	2	28.5714	4	40	1	12.5	2	18.1818
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Total Score
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15
10

Raw Data in Number Sense Test

N	NC	%	MR	%	EO	%	EE	%	CC
201	4	28.57	3	42.8571	4	40	2	25	3
202	4	28.5714	4	57.1429	2	20	1	12.5	2
203	3	21.4286	5	71.4286	4	40	2	25	4
204	3	21.4286	3	42.8571	3	30	1	12.5	4
205	3	21.4286	0	0	3	30	3	37.5	3
206	4	28.5714	3	42.8571	3	30	3	37.5	4
207	2	14.2857	4	57.1429	5	50	3	37.5	1
208	3	21.4286	3	42.8571	2	20	1	12.5	2
209	3	21.4286	3	42.8571	2	20	1	12.5	2
210	4	28.5714	2	28.5714	2	20	2	25	1
211	5	35.7143	5	71.4286	2	20	1	12.5	2
212	3	21.4286	5	71.4286	4	40	2	25	4
213	4	28.5714	2	28.5714	1	10	2	25	2
214	4	28.5714	2	28.5714	5	50	1	12.5	4
215	6	42.8571	1	14.2857	3	30	2	25	2
216	3	21.4286	2	28.5714	5	50	0	0	5
217	4	28.5714	1	14.2857	5	50	1	12.5	5
218	6	42.8571	1	14.2857	2	20	1	12.5	1
219	2	14.2857	3	42.8571	7	70	3	37.5	3
220	4	28.5714	1	14.2857	4	40	2	25	0
221	4	28.5714	1	14.2857	8	80	4	50	6
222	3	21.4286	4	57.1429	6	60	3	37.5	4
223	2	14.2857	6	85.7143	7	70	4	50	4
224	4	28.5714	1	14.2857	2	20	1	12.5	3
225	1	7.14286	1	14.2857	5	50	1	12.5	3
226	4	28.5714	2	28.5714	7	70	4	50	7
227	6	42.8571	3	42.8571	7	70	5	62.5	3
228	6	42.8571	4	57.1429	7	70	3	37.5	4
229	3	21.4286	3	42.8571	4	40	1	12.5	3
230	3	21.4286	2	28.5714	1	10	1	12.5	4
231	3	21.4286	2	28.5714	2	20	2	25	3
232	5	35.7143	3	42.8571	2	20	2	25	6
233	4	28.5714	1	14.2857	3	30	0	0	3
234	6	42.8571	3	42.8571	1	10	1	12.5	4
235	5	35.7143	3	42.8571	2	20	1	12.5	5
236	4	28.5714	0	0	2	20	3	37.5	1
237	2	14.2857	2	28.5714	4	40	3	37.5	4

Legend: NC - Number Concepts EE - Equivalent Expression
 MR - Multiple Representation CC - Counting and Comparison

EO - Effect of Operation

%	Total Score
27.2727	16
18.1818	13
36.3636	18
36.3636	14
27.2727	12
36.3636	17
9.09091	15
18.1818	11
18.1818	11
9.09091	11
18.1818	15
36.3636	18
18.1818	11
36.3636	16
18.1818	14
45.4545	15
45.4545	16
9.09091	11
27.2727	18
0	11
54.5455	23
36.3636	20
36.3636	23
27.2727	11
27.2727	11
63.6364	24
27.2727	24
36.3636	24
27.2727	14
36.3636	11
27.2727	12
54.5455	18
27.2727	11
36.3636	15
45.4545	16
9.09091	10
36.3636	15

ession

omputation

Appendix F
Raw Data in Problem Solving Skills Test

N	GCS	%	PSS	%	Total Score
1	14	70.00	21	52.50	35
2	15	75	19	47.5	34
3	14	70	11	27.5	25
4	7	35	8	20	15
5	13	65	10	25	23
6	14	70	15	37.5	29
7	13	65	12	30	25
8	9	45	1	2.5	10
9	13	65	4	10	17
10	15	75	18	45	33
11	13	65	7	17.5	20
12	18	90	31	77.5	49
13	10	50	13	32.5	23
14	13	65	17	42.5	30
15	13	65	0	0	13
16	0	0	7	17.5	7
17	12	60	16	40	28
18	10	50	5	12.5	15
19	9	45	10	25	19
20	6	30	3	7.5	9
21	14	70	8	20	22
22	8	40	11	27.5	19
23	13	65	10	25	23
24	12	60	12	30	24
25	11	55	18	45	29
26	14	70	13	32.5	27
27	13	65	3	7.5	16
28	11	55	21	52.5	32
29	15	75	10	25	25
30	0	0	6	15	6
31	12	60	16	40	28
32	11	55	21	52.5	32
33	13	65	11	27.5	24
34	9	45	14	35	23
35	10	50	9	22.5	19
36	10	50	15	37.5	25
37	7	35	3	7.5	10
38	9	45	10	25	19
39	11	55	8	20	19

40	8	40	11	27.5	19
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Raw Data in Problem Solving Skills Test

N	GCS	%	PSS	%	Total Score
41	9	45.00	10	25.00	19
42	10	50	12	30	22
43	6	30	6	15	12
44	5	25	0	0	5
45	13	65	15	37.5	28
46	8	40	8	20	16
47	12	60	9	22.5	21
48	9	45	6	15	15
49	6	30	9	22.5	15
50	13	65	15	37.5	28
51	14	70	19	47.5	33
52	15	75	29	72.5	44
53	14	70	24	60	38
54	8	40	4	10	12
55	16	80	17	42.5	33
56	12	60	9	22.5	21
57	11	55	14	35	25
58	16	80	18	45	34
59	3	15	0	0	3
60	7	35	13	32.5	20
61	6	30	0	0	6
62	13	65	6	15	19
63	7	35	11	27.5	18
64	8	40	2	5	10
65	16	80	23	57.5	39
66	12	60	11	27.5	23
67	16	80	15	37.5	31
68	10	50	19	47.5	29
69	7	35	16	40	23
70	15	75	0	0	15
71	6	30	12	30	18
72	8	40	19	47.5	27
73	16	80	20	50	36
74	8	40	5	12.5	13
75	11	55	9	22.5	20
76	10	50	20	50	30
77	13	65	26	65	39
78	15	75	28	70	43
79	10	50	20	50	30

80	11	55	7	17.5	18
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Raw Data in Problem Solving Skills Test

N	GCS	%	PSS	%	Total Score
81	13	65.00	2	5.00	15
82	16	80	17	42.5	33
83	15	75	20	50	35
84	12	60	7	17.5	19
85	9	45	14	35	23
86	12	60	18	45	30
87	10	50	22	55	32
88	13	65	0	0	13
89	9	45	14	35	23
90	14	70	16	40	30
91	8	40	20	50	28
92	13	65	16	40	29
93	12	60	15	37.5	27
94	10	50	20	50	30
95	4	20	8	20	12
96	6	30	0	0	6
97	10	50	6	15	16
98	10	50	6	15	16
99	10	50	9	22.5	19
100	10	50	5	12.5	15
101	8	40	4	10	12
102	10	50	13	32.5	23
103	7	35	3	7.5	10
104	10	50	17	42.5	27
105	6	30	5	12.5	11
106	5	25	3	7.5	8
107	7	35	4	10	11
108	12	60	3	7.5	15
109	10	50	8	20	18
110	10	50	7	17.5	17
111	8	40	6	15	14
112	6	30	3	7.5	9
113	10	50	8	20	18
114	9	45	16	40	25
115	10	50	5	12.5	15
116	9	45	1	2.5	10
117	6	30	11	27.5	17
118	8	40	16	40	24
119	11	55	8	20	19

120	4	20	4	10	8
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Raw Data in Problem Solving Skills Test

N	GCS	%	PSS	%	Total Score
121	6	30.00	3	7.50	9
122	9	45	0	0	9
123	8	40	0	0	8
124	8	40	8	20	16
125	11	55	10	25	21
126	11	55	0	0	11
127	13	65	9	22.5	22
128	7	35	17	42.5	24
129	5	25	5	12.5	10
130	7	35	12	30	19
131	9	45	11	27.5	20
132	14	70	9	22.5	23
133	8	40	8	20	16
134	11	55	2	5	13
135	12	60	16	40	28
136	1	5	16	40	17
137	12	60	0	0	12
138	8	40	5	12.5	13
139	11	55	0	0	11
140	6	30	13	32.5	19
141	7	35	5	12.5	12
142	7	35	11	27.5	18
143	12	60	5	12.5	17
144	12	60	0	0	12
145	4	20	0	0	4
146	12	60	0	0	12
147	6	30	10	25	16
148	6	30	7	17.5	13
149	15	75	0	0	15
150	8	40	8	20	16
151	6	30	4	10	10
152	7	35	0	0	7
153	7	35	0	0	7
154	8	40	4	10	12
155	8	40	3	7.5	11
156	12	60	0	0	12
157	8	40	0	0	8
158	9	45	9	22.5	18
159	9	45	0	0	9

160	10	50	0	0	10
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Raw Data in Problem Solving Skills Test

N	GCS	%	PSS	%	Total Score
161	11	55.00	0	0.00	11
162	6	30	0	0	6
163	11	55	0	0	11
164	10	50	1	2.5	11
165	10	50	0	0	10
166	11	55	0	0	11
167	5	25	2	5	7
168	7	35	2	5	9
169	5	25	1	2.5	6
170	11	55	1	2.5	12
171	7	35	0	0	7
172	8	40	0	0	8
173	6	30	0	0	6
174	10	50	0	0	10
175	6	30	11	27.5	17
176	8	40	0	0	8
177	8	40	0	0	8
178	8	40	0	0	8
179	5	25	7	17.5	12
180	8	40	7	17.5	15
181	8	40	6	15	14
182	15	75	10	25	25
183	7	35	0	0	7
184	13	65	18	45	31
185	7	35	4	10	11
186	9	45	1	2.5	10
187	6	30	2	5	8
188	10	50	1	2.5	11
189	14	70	7	17.5	21
190	16	80	22	55	38
191	8	40	3	7.5	11
192	6	30	5	12.5	11
193	15	75	3	7.5	18
194	2	10	5	12.5	7
195	6	30	4	10	10
196	3	15	4	10	7
197	5	25	8	20	13
198	7	35	0	0	7
199	7	35	2	5	9

200	6	30	0	0	6
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Raw Data in Problem Solving Skills Test

N	GCS	%	PSS	%	Total Score
201	7	35.00	2	5.00	9
202	13	65	3	7.5	16
203	14	70	2	5	16
204	14	70	6	15	20
205	8	40	0	0	8
206	5	25	2	5	7
207	7	35	2	5	9
208	5	25	1	2.5	6
209	11	55	1	2.5	12
210	7	35	0	0	7
211	8	40	0	0	8
212	6	30	0	0	6
213	10	50	0	0	10
214	6	30	11	27.5	17
215	8	40	0	0	8
216	8	40	0	0	8
217	8	40	0	0	8
218	5	25	7	17.5	12
219	8	40	0	0	8
220	8	40	6	15	14
221	15	75	10	25	25
222	12	60	0	0	12
223	12	60	0	0	12
224	4	20	0	0	4
225	12	60	10	25	22
226	6	30	7	17.5	13
227	6	30	0	0	6
228	15	75	8	20	23
229	8	40	4	10	12
230	6	30	0	0	6
231	7	35	0	0	7
232	7	35	4	10	11
233	8	40	3	7.5	11
234	8	40	0	0	8
235	12	60	0	0	12
236	8	40	9	22.5	17
237	9	45	9	22.5	18

Legend:

GCS - Geometry Concepts & Skills

PSS - Problem Solving Skills

Appendix G
Raw Data in Dominant Intelligences
Multiple Intelligences Domain

N	L	LM	M	VS	BK	IE
1	2	5	4	2	4	4
2	5	2	4	3	4	3
3	3	2	4	5	4	3
4	5	2	5	1	4	2
5	2	4	1	2	5	3
6	0	4	2	3	5	3
7	1	4	2	1	4	3
8	4	3	4	2	5	3
9	4	4	4	4	5	3
10	4	5	4	3	4	4
11	1	5	2	3	5	2
12	2	5	3	1	1	4
13	5	3	4	3	2	4
14	3	5	4	2	4	3
15	1	3	4	4	4	3
16	4	4	3	3	1	5
17	3	5	4	1	5	4
18	4	2	4	1	2	4
19	5	2	4	4	1	4
20	3	2	3	4	4	3
21	3	2	4	2	3	2
22	3	1	3	2	4	3
23	3	5	5	2	2	4
24	1	1	1	2	4	3
25	4	2	4	3	2	3
26	3	4	3	2	5	2
27	3	1	4	1	5	1
28	2	5	2	1	2	3
29	5	5	2	2	2	4
30	3	3	4	4	4	4
31	5	1	3	3	3	4
32	0	5	4	1	4	2
33	0	5	3	0	3	4
34	4	4	5	2	5	3
35	1	1	3	1	3	4
36	3	0	4	4	0	3
37	2	2	3	2	2	4
38	5	1	5	0	4	2
39	3	2	2	1	1	3

40	3	3	2	3	3	3
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IA	DI
3	2
3	1
3	4
4	1,3
3	5
3	5
3	2,5
4	5
4	5
4	2
1	2,5
2	2
3	1
2	2
5	7
2	6
4	2,5
1	1,3,6
3	1
4	4,6,7
3	3
2	5
1	2,3
3	5
4	1,3,7
1	5
4	5
2	2
2	1,2
2	3,4,5,6
4	1
4	2
4	2
4	3,5
4	6,7
0	3,4
4	6,7
3	1,3
4	7

3	1,2,4,5,6,7
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Raw Data in Dominant Intelligences
Multiple Intelligence Domain

N	L	LM	M	VS	BK	IE
41	4	1	4	2	4	4
42	4	3	3	5	4	5
43	3	3	0	5	3	1
44	2	1	2	3	2	1
45	3	4	4	3	5	4
46	5	4	4	0	5	4
47	3	0	4	1	5	3
48	1	4	2	2	1	2
49	3	1	4	0	3	2
50	3	4	2	2	4	2
51	3	5	4	4	4	4
52	5	2	4	2	3	4
53	3	4	5	3	4	2
54	3	3	3	0	2	3
55	1	4	4	3	4	3
56	2	1	3	1	5	3
57	2	1	4	2	3	3
58	3	1	1	2	2	2
59	4	1	4	3	3	4
60	1	4	3	3	2	3
61	2	3	5	1	5	5
62	1	5	2	2	5	4
63	2	3	3	3	5	3
64	2	2	3	1	4	2
65	1	4	2	0	3	1
66	2	1	3	1	5	3
67	1	2	2	1	5	3
68	3	4	2	1	5	2
69	1	3	0	4	2	3
70	5	2	1	1	2	4
71	3	1	4	3	5	3
72	4	2	1	1	4	1
73	2	4	5	4	2	3
74	2	1	4	2	4	2
75	2	4	4	3	3	4
76	4	2	3	2	2	1
77	4	3	5	5	4	1
78	5	1	4	2	2	3
79	2	2	5	3	4	4

80	2	5	4	3	4	5
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IA	DI
2	1,3,5,6
4	4,6
2	4
4	7
5	5,7
5	1,5,7
2	5
1	2
0	3
2	2,5
3	2
4	1
2	3
2	1,2,3,6
3	2,3,5
3	5
3	3
2	1
4	1,3,6,7
2	2
3	3,5,6
3	2,5
3	5
3	5
0	2
2	5
2	5
2	5
3	4
1	1
4	5
2	1,5
3	3
3	3,5
4	2,3,6,7
3	1
2	3,4
4	1
4	3

5	2,6,7
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Raw Data in Dominant Intelligences
Multiple Intelligence Domain

N	L	LM	M	VS	BK	IE
81	3	1	4	4	5	2
82	1	5	2	1	3	3
83	3	3	4	3	5	4
84	3	4	5	3	2	1
85	2	1	4	1	4	3
86	4	4	5	4	4	4
87	2	2	4	0	4	4
88	2	1	2	0	1	1
89	0	5	0	0	0	1
90	2	2	1	2	3	0
91	1	0	2	2	2	0
92	3	5	4	2	5	3
93	1	1	2	1	1	2
94	1	1	2	0	5	4
95	1	0	3	0	0	0
96	1	3	5	0	1	1
97	0	1	0	2	3	2
98	2	0	0	0	3	1
99	1	0	0	4	3	2
100	2	2	5	5	5	3
101	1	3	3	1	2	3
102	3	1	3	1	3	3
103	2	0	0	3	4	1
104	2	2	5	2	5	3
105	4	2	5	3	4	3
106	0	1	2	0	4	0
107	3	2	2	1	3	3
108	4	3	4	2	4	2
109	0	3	4	2	2	4
110	3	1	3	1	3	3
111	4	3	5	3	5	5
112	0	1	2	0	3	3
113	3	3	5	1	5	4
114	3	3	4	2	3	4
115	2	2	5	3	4	5
116	2	1	5	2	3	1
117	5	3	4	1	1	2
118	4	1	5	2	4	4
119	4	3	2	1	3	4

120	3	3	5	3	5	4
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IA	DI
4	5
4	2
5	5,7
3	3
4	3,5,7
5	3,7
2	3,5,6
3	7
0	2
4	7
3	7
4	2,5
1	3,6
3	5
0	3
2	3
1	5
1	5
0	4
2	3,4,5
3	2,3,6,7
2	1,3,5,6
2	5
3	3,5
3	3
1	5
2	1,5,6
5	7
4	3,6,7
3	1,3,5,6,7
4	3,5,6
2	5
5	3,5,7
3	3,6
3	3,6
4	3
3	1
3	3
3	1,6

5	3,5,7
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Raw Data in Dominant Intelligences
Multiple Intelligence Domain

N	L	LM	M	VS	BK	IE
121	3	3	4	3	3	3
122	3	4	5	3	4	4
123	4	3	5	4	4	4
124	3	0	1	0	0	4
125	2	1	4	2	4	3
126	3	2	4	4	5	2
127	4	4	3	4	5	3
128	2	2	4	1	3	3
129	3	4	4	3	4	4
130	1	2	3	4	4	4
131	4	1	5	3	4	4
132	1	0	2	2	4	2
133	2	5	2	3	4	4
134	4	0	4	1	5	4
135	1	4	1	3	4	5
136	3	3	5	2	5	3
137	3	1	1	1	3	4
138	1	1	5	2	5	3
139	5	4	4	3	5	3
140	4	2	2	1	3	2
141	2	5	1	5	5	5
142	2	1	4	2	3	2
143	3	0	4	0	5	4
144	4	1	5	4	5	4
145	2	4	3	4	5	3
146	1	2	1	1	4	4
147	4	2	1	3	3	3
148	4	0	5	0	1	4
149	1	1	3	1	3	4
150	4	1	4	1	4	2
151	2	2	5	2	2	2
152	1	0	1	3	1	2
153	3	2	4	2	5	4
154	3	2	5	2	4	2
155	2	4	0	1	2	4
156	5	3	5	4	4	5
157	3	0	4	1	3	4
158	4	3	4	4	2	3
159	5	3	4	4	3	3

160	2	1	4	0	5	2
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IA	DI
2	3
4	3
4	3
4	6,7
4	3,7
3	5
4	5
4	3,7
3	2,3,5,6
4	4,5,6,7
4	3
2	5
4	2
4	5
4	6
4	3,5
2	6
2	5
4	1,5
3	1
3	2,4,5,6
4	3,7
2	5
4	3,5
3	5
2	5,6
3	1
4	3
3	6
2	1,3,5
4	3
4	7
3	5
4	3
2	2
5	1,3,6,7
2	3,6
3	1,3,4
3	1

3	5
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Raw Data in Dominant Intelligences
Multiple Intelligence Domain

N	L	LM	M	VS	BK	IE
161	2	3	5	2	5	4
162	2	4	3	3	5	3
163	2	4	4	1	4	3
164	1	4	1	3	3	4
165	4	1	5	5	3	4
166	4	2	5	5	5	5
167	1	4	3	4	5	4
168	4	2	2	2	2	5
169	3	2	4	1	5	2
170	1	2	4	3	2	2
171	2	2	5	1	3	3
172	4	3	4	3	4	4
173	1	4	4	4	5	4
174	3	2	5	2	2	2
175	2	2	5	2	5	4
176	2	1	3	3	5	2
177	2	3	4	2	3	1
178	4	4	3	3	5	3
179	4	5	4	5	4	3
180	3	3	4	4	5	2
181	3	2	3	2	5	4
182	3	3	4	4	5	3
183	3	3	4	3	5	3
184	5	1	1	1	3	3
185	2	5	3	3	5	1
186	5	0	4	3	5	3
187	2	1	4	2	4	4
188	2	2	5	2	4	4
189	3	1	3	3	3	2
190	1	2	0	0	0	0
191	2	3	5	0	4	2
192	3	2	5	3	4	3
193	2	1	3	4	5	3
194	4	4	3	2	5	4
195	2	1	2	1	3	1
196	3	1	3	1	3	3
197	4	1	3	0	3	3
198	3	2	4	2	0	3
199	4	2	5	3	5	2

200	3	1	3	0	2	3
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IA	DI
4	3,5
5	5,7
2	2,3,5
1	2,6
5	3,4,7
4	3,4,5,6
2	5
4	6
4	5
3	3
4	3
3	1,3,5,6
2	5
0	3
3	3,5
2	5
1	3
4	5
4	2,4
3	5
4	5
3	5
2	5
3	1
3	2,5
4	5
4	3,5,6,7
4	3
3	1,3,4,5,7
0	2
1	3
3	3
2	5
3	5
2	5
3	1,3,5,6,7
3	1
2	3
4	3,5

2	1,3,6
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Raw Data in Dominant Intelligences
Multiple Intelligence Domain

N	L	LM	M	VS	BK	IE
201	5	1	2	0	3	4
202	4	0	2	1	3	3
203	3	3	2	1	4	2
204	3	1	4	2	2	2
205	3	1	3	3	3	3
206	4	3	5	3	3	3
207	5	2	4	1	5	2
208	5	3	4	3	5	5
209	4	5	5	4	3	2
210	3	1	4	2	3	3
211	2	3	2	2	3	4
212	3	2	4	4	5	4
213	0	4	1	4	4	5
214	3	1	4	3	5	4
215	1	1	3	1	2	2
216	3	1	4	1	5	3
217	1	3	3	1	3	3
218	3	2	4	2	5	4
219	2	2	4	2	2	2
220	2	2	3	1	3	2
221	5	2	3	3	3	4
222	3	4	4	4	4	3
223	5	2	2	2	2	4
224	3	2	4	1	5	2
225	1	2	4	3	2	2
226	2	2	5	1	3	3
227	4	3	4	3	4	4
228	1	5	4	4	4	4
229	3	2	5	2	2	2
230	2	2	5	2	5	4
231	2	1	3	3	5	2
232	2	3	4	2	3	1
233	4	4	3	3	4	3
234	4	4	4	4	5	3
235	3	3	4	4	5	2
236	3	2	3	2	5	4
237	3	3	4	4	5	3

Legend: L - Linguistic

LM - Logical - Mathematical

VS - Visual - Spatial

BK - Bodily Kinesthetic

M - Musical

IE - Interpersonal

IA	DI
1	1
4	1,7
5	7
3	3
4	7
3	3
4	1,5
5	1,5,6,7
4	2,3
3	3
4	6,7
2	5
4	6
2	5
1	3
4	5
4	7
2	5
2	3
1	3,5
3	1
3	2,3,4,5
4	1
4	5
3	3
4	3
3	1,3,5,6
2	2
0	3
3	3,5
2	5
1	3
4	1,2,5
4	5
3	5
4	5
3	5

IA - Intrapersonal

Appendix H
Summary of Raw Data

N	Number Sense Score	Problem Solving Skills Score
1	8	35
2	14	34
3	31	25
4	23	15
5	22	23
6	11	29
7	14	25
8	26	10
9	23	17
10	25	33
11	21	20
12	33	49
13	19	23
14	28	30
15	28	13
16	20	7
17	19	28
18	12	15
19	12	19
20	22	9
21	18	22
22	5	19
23	19	23
24	19	24
25	14	29
26	15	27
27	23	16
28	38	32
29	19	25
30	19	6
31	24	28
32	9	32
33	17	24
34	12	23
35	14	19
36	16	25
37	15	10
38	19	19
39	13	19

40	15	19
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MI Group
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Summary of Raw Data

N	Number Sense Score	Problem Solving Skills Score
41	16	19
42	13	22
43	22	12
44	19	5
45	15	28
46	15	16
47	13	21
48	16	15
49	20	15
50	13	28
51	24	33
52	29	44
53	10	38
54	18	12
55	12	33
56	19	21
57	8	25
58	12	34
59	7	3
60	21	20
61	10	6
62	16	19
63	14	18
64	22	10
65	29	39
66	15	23
67	10	31
68	14	29
69	29	39
70	8	15
71	14	18
72	20	27
73	17	36
74	16	13
75	19	20
76	25	30
77	13	39
78	14	43
79	15	30

80	7	18
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MI Group
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2

Summary of Raw Data

N	Number Sense Score	Problem Solving Skills Score
81	13	15
82	13	33
83	13	35
84	9	19
85	14	23
86	13	30
87	16	32
88	10	13
89	26	23
90	14	30
91	12	28
92	15	29
93	14	27
94	16	30
95	17	12
96	18	6
97	4	16
98	18	16
99	17	19
100	26	15
101	11	12
102	10	23
103	10	10
104	20	27
105	21	11
106	18	8
107	24	11
108	14	15
109	16	18
110	15	17
111	16	14
112	14	9
113	14	18
114	24	25
115	16	15
116	17	10
117	17	17
118	11	24
119	15	19

120	16	8
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MI Group
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1

Summary of Raw Data

N	Number Sense Score	Problem Solving Skills Score
121	18	9
122	18	9
123	19	8
124	22	16
125	11	21
126	15	11
127	11	22
128	16	24
129	15	10
130	18	19
131	25	20
132	16	23
133	22	16
134	19	13
135	9	28
136	15	17
137	15	12
138	17	13
139	18	11
140	10	19
141	22	12
142	12	18
143	17	17
144	8	12
145	14	4
146	21	12
147	13	16
148	14	13
149	16	15
150	19	16
151	9	10
152	12	7
153	23	7
154	12	12
155	28	11
156	11	12
157	17	8
158	11	18
159	11	9

160	12	10
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MI Group
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1
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1
2

Summary of Raw Data

N	Number Sense Score	Problem Solving Skills Score
161	22	11
162	15	6
163	17	11
164	22	11
165	26	10
166	14	11
167	18	7
168	11	9
169	23	6
170	20	12
171	23	7
172	11	8
173	11	6
174	25	10
175	24	17
176	24	8
177	14	8
178	11	8
179	12	12
180	18	15
181	11	14
182	15	25
183	16	7
184	10	31
185	15	11
186	15	10
187	19	8
188	12	11
189	13	21
190	11	38
191	12	11
192	18	11
193	11	18
194	11	7
195	22	10
196	15	7
197	15	13
198	10	7
199	16	9

200	13	6
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MI Group
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2
1
2
2

Summary of Raw Data

N	Number Sense Score	Problem Solving Skills Score
201	16	9
202	13	16
203	18	16
204	14	20
205	12	8
206	17	7
207	15	9
208	11	6
209	11	12
210	11	7
211	15	8
212	18	6
213	11	10
214	16	17
215	14	8
216	15	8
217	16	8
218	11	12
219	18	8
220	11	14
221	23	25
222	20	12
223	23	12
224	11	4
225	11	22
226	24	13
227	24	6
228	24	23
229	14	12
230	11	6
231	12	7
232	18	11
233	11	11
234	15	8
235	16	12
236	10	17
237	15	18

MI Group
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Appendix I Statistics Print out

NUMBER SENSE TEST

Parameter	Value	
Mean	16.27	
SD	5.34	
SEM	0.35	
N	237	
90% CI		15.70 to 16.85
95% CI		15.59 to 16.96
99% CI		15.37 to 17.17
Minimum	4	
Median	15	
Maximum	38	

PROBLEM SOLVING SKILLS TEST

Parameter	Value	
Mean	17.15	
SD	9.07	
SEM	0.59	
N	237	
90% CI		16.18 to 18.12
95% CI		15.99 to 18.31
99% CI		15.62 to 18.68
Minimum	3	
Median	15	
Maximum	49	

NUMBER SENSE TEST STRANDS

NUMBER CONCEPTS

Parameter	Value
Mean	3.86
SD	1.81
SEM	0.12

N	237
90% CI	3.67 to 4.06
95% CI	3.63 to 4.10
99% CI	3.56 to 4.17
Minimum	0
Median	4
	11

Maximum

MULTIPLE REPRESENTATIONS

Parameter	Value	
Mean	2.32	
SD	1.25	
SEM	0.08	
N	237	
90% CI		2.19 to 2.45
95% CI		2.16 to 2.48
99% CI		2.11 to 2.53
Minimum	0	
Median	2	
Maximum	6	

EFFECT OF OPERATIONS

Parameter	Value	
Mean	3.72	
SD	1.94	
SEM	0.13	
N	237	
90% CI		3.51 to 3.93
95% CI		3.47 to 3.97
99% CI		3.39 to 4.05
Minimum	0	
Median	4	
Maximum	9	

EQUIVALENT EXPRESSIONS

Parameter	Value	
Mean	2.59	
SD	1.47	
SEM	0.10	
N	237	
90% CI		2.44 to 2.75
95% CI		2.41 to 2.78
99% CI		2.35 to 2.84
Minimum	0	
Median	2	
Maximum	6	

COUNTING AND COMPUTATION

Parameter	Value	
Mean	3.79	
SD	1.84	
SEM	0.12	
N	237	
90% CI		3.59 to 3.99
95% CI		3.55 to 4.02
99% CI		3.48 to 4.10
Minimum	0	
Median	4	
Maximum	9	

PROBLEM SOLVING SKILLS TEST CATEGORIES

GEOMETRY CONCEPTS AND SKILLS

Parameter	Value
Mean	9.54
SD	3.34
SEM	0.22
N	237

90% CI		9.18 to 9.90
95% CI		9.11 to 9.97
99% CI		8.98 to 10.10
Minimum	0	
Median	9	
Maximum	18	

PROBLEM SOLVING SKILLS

Parameter	Value	
Mean	7.59	
SD	7.02	
SEM	0.46	
N	237	
90% CI		6.83 to 8.34
95% CI		6.69 to 8.48
99% CI		6.40 to 8.77
Minimum	0	
Median	6	
Maximum	31	

NUMBER SENSE TEST

Paired *t* test results

P value and statistical significance:

The two-tailed P value equals 0.0004

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 3.42

95% confidence interval of this difference: From 1.58 to 5.25

Intermediate values used in calculations:

$t = 3.7204$

$df = 64$

standard error of difference = 0.918

Review your data:

Group

Group One

Group Two

Mean	18.54	15.42
SD	6.45	4.59
SEM	0.80	0.35
N	65	172

PROBLEM SOLVING SKILLS TEST

Paired *t* test results

P value and statistical significance:

The two-tailed P value equals 0.0238

By conventional criteria, this difference is considered to be statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 3.71

95% confidence interval of this difference: From 0.51 to 6.91

Intermediate values used in calculations:

$t = 2.3162$

$df = 64$

standard error of difference = 1.601

Review your data:

Group	Group One	Group Two
Mean	23.18	14.87
SD	9.84	7.63
SEM	1.22	0.58
N	65	172

X Values

$$\Sigma = 3857$$

$$\text{Mean} = 16.274$$

$$\Sigma(X - M_x)^2 = SS_x = 6723.173$$

Y Values

$$\Sigma = 4055$$

$$\text{Mean} = 17.11$$

$$\Sigma(Y - M_y)^2 = SS_y = 19289.148$$

X and Y Combined

$$N = 237$$

$$\Sigma(X - M_x)(Y - M_y) = 1339.869$$

R Calculation

$$r = \Sigma((X - M_x)(Y - M_y)) / \sqrt{(SS_x)(SS_y)}$$

$$r = 1339.869 / \sqrt{(6723.173)(19289.148)} = 0.1177$$

Meta Numerics (cross-check)

$$r = 0.1177$$

Key

X: X Values

Y: Y Values

M_x : Mean of X Values

M_y : Mean of Y Values

$X - M_x$ & $Y - M_y$: Deviation scores

$(X - M_x)^2$ & $(Y - M_y)^2$: Deviation Squared

$(X - M_x)(Y - M_y)$: Product of Deviation Scores

The value of R is 0.1177. Although technically a positive correlation, the relationship between your variables is weak (*nb.* the nearer the value is to zero, the weaker the relationship).

The value of R^2 , the coefficient of determination, is 0.0139.

P Value from Pearson (R) Calculator

This should be self-explanatory, but just in case it's not: your r score goes in the R Score box, the number of pairs in your sample goes in the N box (you must have at least 3 pairs), then you select your significance level and press the button.

If you need to derive a r score from raw data, [you can find a Pearson \(r\) calculator here](#).

R Score:

N :

Significance Level:

☐ 0.01

☒ 0.05

☐ 0.10

The P-Value is 0.070501. The result is *not* significant at $p < 0.05$.

APPENDIX J

Sample Response to Multiple Intelligence Test

MULTIPLE INTELLIGENCE TEST

Name: Alyssa Vina Mae P. Barblane Year & Section: III - Agonillo

Sex: Female Age: 15

INSTRUCTIONS:

This activity will help you find out what your strengths are.

Read each statement. Put a check mark "✓" before each statement which you feel accurately describes you. If you **do not** identify with a statement, **leave** the space provided blank. There are no right or wrong answers.

1. ☐ I can play a musical instrument.
2. ☒ I often have a song or piece of music in my head.
3. ☒ I find it easy to make up stories.
4. ☐ I have always been physically well coordinated (run, jump, balance, etc.).
5. ☒ Music is very important to me.
6. ☒ I am a good liar (If I want to be).
7. ☐ I play a sport or dance.
8. ☒ I am a very social person and like being with other people.
9. ☒ I find graphs, charts and diagrams easy to understand.
10. ☒ I find it easy to remember quotes or phrases or poems or song lyrics.
11. ☒ I can always recognize places that I have been before, even when I was very young.
12. ☒ When I am concentrating I tend to doodle.
13. ☐ I find mental arithmetic easy (sums in my head).
14. ☒ At school one of my favorite subjects is / was English.
15. ☒ I like to think through a problem carefully, considering all the consequences.
16. ☐ I love adrenaline sports and scary rides.
17. ☐ I enjoy individual sports best.
18. ☒ I find it easy to remember telephone numbers.
19. ☒ I set myself goals and plans for the future.
20. ☒ I can tell easily whether someone likes me or dislikes me.
21. ☒ To learn something new, I need to just get on and try it.
22. ☐ I often see clear images when I close my eyes.
23. ☐ I don't use my fingers when I count.
24. ☒ At school I love / loved music lessons.
25. ☐ I find ball games easy and enjoyable.
26. ☐ My favorite subject at school is / was mathematics.
27. ☒ I always know how I am feeling.
28. ☐ I keep a diary.
29. ☒ My favorite subject at school is / was art.
30. ☒ I really enjoy reading.
31. ☒ It upsets me to see someone cry and not be able to help.
32. ☐ I prefer team sports.
33. ☒ Singing makes me feel happy.
34. ☒ I am happy spending time alone.
35. ☒ My friends always come to me for emotional support and advice.

19

Name: Alyssa Vina Mae P. Bartolone Year & Section: III-Agonillo

Multiple Intelligence Scoring Sheet

Place again a check mark on each item you checked. Add the checked marks in each column and write the total on the space provided below. The highest scores indicate your dominant strengths and potential – your natural intelligences.

Linguistic	Logical – Mathematical	Musical	Visual – Spatial	Bodily – Kinesthetic	Interpersonal	Intrapersonal
3 /	13	1	9 /	4	8 /	17
6 /	15 /	2 /	11 /	7	20 /	19 /
10 /	18 /	5 /	12 /	16	31 /	27 /
14 /	23	24 /	22	21 /	32	28
30 /	26	33 /	29 /	25	35 /	34 /
Total 5	Total 2	Total 4	Total 4	Total 1	Total 4	Total 3

This instrument was adapted from V. Chislett MSc and A. Chapman (2005 – 2006) based on Gardner's model.

MULTIPLE INTELLIGENCE TEST

Name: Jhett Ballon Year & Section: 111-Aguino
 Sex: Male Age: 15

INSTRUCTIONS:

This activity will help you find out what your strengths are.

Read each statement. Put a check mark "✓" before each statement which you feel accurately describes you. If you **do not** identify with a statement, **leave** the space provided blank. There are no right or wrong answers.

1. ☐ I can play a musical instrument.
2. ☒ I often have a song or piece of music in my head.
3. ☐ I find it easy to make up stories.
4. ☐ I have always been physically well coordinated (run, jump, balance, etc.).
5. ☒ Music is very important to me.
6. ☐ I am a good liar (If I want to be).
7. ☐ I play a sport or dance.
8. ☒ I am a very social person and like being with other people.
9. ☒ I find graphs, charts and diagrams easy to understand.
10. ☒ I find it easy to remember quotes or phrases or poems or song lyrics.
11. ☒ I can always recognize places that I have been before, even when I was very young.
12. ☐ When I am concentrating I tend to doodle.
13. ☒ I find mental arithmetic easy (sums in my head).
14. ☐ At school one of my favorite subjects is / was English.
15. ☒ I like to think through a problem carefully, considering all the consequences.
16. ☐ I love adrenaline sports and scary rides.
17. ☐ I enjoy individual sports best.
18. ☒ I find it easy to remember telephone numbers.
19. ☒ I set myself goals and plans for the future.
20. ☒ I can tell easily whether someone likes me or dislikes me.
21. ☒ To learn something new, I need to just get on and try it.
22. ☐ I often see clear images when I close my eyes.
23. ☐ I don't use my fingers when I count.
24. ☐ At school I love / loved music lessons.
25. ☐ I find ball games easy and enjoyable.
26. ☒ My favorite subject at school is / was mathematics.
27. ☐ I always know how I am feeling.
28. ☐ I keep a diary.
29. ☐ My favorite subject at school is / was art.
30. ☐ I really enjoy reading.
31. ☒ It upsets me to see someone cry and not be able to help.
32. ☐ I prefer team sports.
33. ☐ Singing makes me feel happy.
34. ☐ I am happy spending time alone.
35. ☐ My friends always come to me for emotional support and advice.

Name: Jafet Ballon Year & Section: III-Aguino

Multiple Intelligence Scoring Sheet

Place again a check mark on each item you checked. Add the checked marks in each column and write the total on the space provided below. The highest scores indicate your dominant strengths and potential – your natural intelligences.

Linguistic	Logical – Mathematical	Musical	Visual – Spatial	Bodily – Kinesthetic	Interpersonal	Intrapersonal
3	13 ✓	1	9 ✓	4	8 ✓	17
6	15 ✓	2 ✓	11 ✓	7	20 ✓	19 ✓
10 ✓	18 ✓	5 ✓	12	16	31 ✓	27
14	23	24	22	21 ✓	32	28
30	26 ✓	33	29	25	35	34
Total 1	Total 4	Total 2	Total 2	Total 1	Total 3	Total 1

This instrument was adapted from V. Chislett MSc and A. Chapman (2005 – 2006) based on Gardner's model.

MULTIPLE INTELLIGENCE TEST

Name: Ibanez, John Rick Year & Section: 11- Jaena

Sex: Male Age: 16

INSTRUCTIONS:

This activity will help you find out what your strengths are.

Read each statement. Put a check mark "✓" before each statement which you feel accurately describes you. If you **do not** identify with a statement, **leave** the space provided blank. There are no right or wrong answers.

1. ☐ I can play a musical instrument.
2. ☒ I often have a song or piece of music in my head.
3. ☐ I find it easy to make up stories.
4. ☒ I have always been physically well coordinated (run, jump, balance, etc.).
5. ☐ Music is very important to me.
6. ☐ I am a good liar (If I want to be).
7. ☒ I play a sport or dance.
8. ☒ I am a very social person and like being with other people.
9. ☐ I find graphs, charts and diagrams easy to understand.
10. ☐ I find it easy to remember quotes or phrases or poems or song lyrics.
11. ☐ I can always recognize places that I have been before, even when I was very young.
12. ☐ When I am concentrating I tend to doodle.
13. ☐ I find mental arithmetic easy (sums in my head).
14. ☐ At school one of my favorite subjects is / was English.
15. ☐ I like to think through a problem carefully, considering all the consequences.
16. ☒ I love adrenaline sports and scary rides.
17. ☐ I enjoy individual sports best.
18. ☐ I find it easy to remember telephone numbers.
19. ☒ I set myself goals and plans for the future.
20. ☐ I can tell easily whether someone likes me or dislikes me.
21. ☒ To learn something new, I need to just get on and try it.
22. ☐ I often see clear images when I close my eyes.
23. ☐ I don't use my fingers when I count.
24. ☒ At school I love / loved music lessons.
25. ☒ I find ball games easy and enjoyable.
26. ☒ My favorite subject at school is / was mathematics.
27. ☒ I always know how I am feeling.
28. ☐ I keep a diary.
29. ☐ My favorite subject at school is / was art.
30. ☐ I really enjoy reading.
31. ☒ It upsets me to see someone cry and not be able to help.
32. ☐ I prefer team sports.
33. ☐ Singing makes me feel happy.
34. ☒ I am happy spending time alone.
35. ☒ My friends always come to me for emotional support and advice.

Name: Jhanez, John Rick Year & Section: 11 - Joena

Multiple Intelligence Scoring Sheet

Place again a check mark on each item you checked. Add the checked marks in each column and write the total on the space provided below. The highest scores indicate your dominant strengths and potential – your natural intelligences.

Linguistic	Logical – Mathematical	Musical	Visual – Spatial	Bodily – Kinesthetic	Interpersonal	Intrapersonal
3	13	1	9	4 ✓	8 ✓	17
6 ✓	15	2 ✓	11	7 ✓	20 ✓	19 ✓
10	18	5	12	16 ✓	31 ✓	27 ✓
14	23	24 ✓	22	21 ✓	32	28
30	26 ✓	33	29	25 ✓	35 ✓	34 ✓
Total 1	Total 1	Total 2	Total 0	Total 5	Total 4	Total 3

This instrument was adapted from V. Chislett MSc and A. Chapman (2005 – 2006) based on Gardner's model.

APPENDIX K

Sample Response to Number Sense Test

NUMBER SENSE TEST ANSWER SHEET

Name: Carmella FormosoYear & Section: III - Agoncillo Im/Sex: FemaleAge: 14 years old

38
50

Practice Questions:

1. Without counting exactly, about how many children are there in your class?
A. 5 B. 50 C. 500 D. 5000
2. What number goes in the box to make this statement true?
 $30 + \square = 50$
Answer: _____ A. 10 B. 20 C. 30 D. 50

Instructions:

DO NOT write anything except your answer.

There are 50 questions in the test. Write the letter of the correct answer on the blank provided for each number

You will have 45 minutes to answer the questions.

ANSWERS:

- | | | | | |
|-------------|-------------|-------------|-------------|-------------|
| 1 <u>c</u> | 11 <u>a</u> | 21 <u>d</u> | 31 <u>b</u> | 41 <u>a</u> |
| 2 <u>a</u> | 12 <u>b</u> | 22 <u>d</u> | 32 <u>b</u> | 42 <u>c</u> |
| 3 <u>d</u> | 13 <u>c</u> | 23 <u>c</u> | 33 <u>a</u> | 43 <u>d</u> |
| 4 <u>a</u> | 14 <u>c</u> | 24 <u>a</u> | 34 <u>d</u> | 44 <u>d</u> |
| 5 <u>b</u> | 15 <u>a</u> | 25 <u>a</u> | 35 <u>d</u> | 45 <u>c</u> |
| 6 <u>d</u> | 16 <u>b</u> | 26 <u>a</u> | 36 <u>d</u> | 46 <u>c</u> |
| 7 <u>c</u> | 17 <u>c</u> | 27 <u>d</u> | 37 <u>b</u> | 47 <u>d</u> |
| 8 <u>c</u> | 18 <u>c</u> | 28 <u>c</u> | 38 <u>c</u> | 48 <u>d</u> |
| 9 <u>c</u> | 19 <u>c</u> | 29 <u>c</u> | 39 <u>b</u> | 49 <u>e</u> |
| 10 <u>d</u> | 20 <u>a</u> | 30 <u>a</u> | 40 <u>b</u> | 50 <u>c</u> |

Name: Formoso, CarmellaYear & Section: III - Aopncillo

Number Sense Strand	Total Number of Items	Items with Wrong Answers	Total Correct Answers	Percentage of Correct Answers
Number Concepts	(14) 1,3,4,6,8,10,15,18 19,22,25,29,36,39	15, 36, 39 3	1,3,4,6,8,10,18,19 22,25,29 11	78.57%
Multiple Representations	9 (7) 7,8,13,14,30,31,40	40 1	7,9,13,14,30,31 6	85.71%
Effect of Operations	(10) 16,17,20,21,24,27 28,38,48,49	27 1	16,17,20,21,24,28 38,48,49 9	90%
Equivalent Expressions	(8) 11,23,26,32,33,34 37,45	37, 45 2	11,23,26,32,33,34 6	75%
Counting and Computations	(11) 2,5,12,35,41,42,43 44,46,47,50	35,41,42,44,47 5	2,5,12,43,46,50 6	54.55%

38

NUMBER SENSE TEST ANSWER SHEET

Name: MARK JOHN M. CARCIAYear & Section: III - LAURELSex: MALEAge: 1522/50

Practice Questions:

- Without counting exactly, about how many children are there in your class?
A. 5 B. 50 C. 500 D. 5000
- What number goes in the box to make this statement true?
 $30 + \square = 50$
Answer: A. 10 B. 20 C. 30 D. 50

Instructions:

DO NOT write anything except your answer.

There are 50 questions in the test. Write the letter of the correct answer on the blank provided for each number

You will have 45 minutes to answer the questions.

ANSWERS:

- | | | | | |
|-------------|-------------|-------------|-------------|-------------|
| 1 <u>A</u> | 11 <u>A</u> | 21 <u>A</u> | 31 <u>C</u> | 41 <u>A</u> |
| 2 <u>A</u> | 12 <u>A</u> | 22 <u>D</u> | 32 <u>B</u> | 42 <u>D</u> |
| 3 <u>B</u> | 13 <u>B</u> | 23 <u>A</u> | 33 <u>B</u> | 43 <u>D</u> |
| 4 <u>A</u> | 14 <u>A</u> | 24 <u>A</u> | 34 <u>D</u> | 44 <u>B</u> |
| 5 <u>C</u> | 15 <u>C</u> | 25 <u>A</u> | 35 <u>A</u> | 45 <u>B</u> |
| 6 <u>B</u> | 16 <u>A</u> | 26 <u>C</u> | 36 <u>D</u> | 46 <u>C</u> |
| 7 <u>B</u> | 17 <u>C</u> | 27 <u>B</u> | 37 <u>C</u> | 47 <u>B</u> |
| 8 <u>B</u> | 18 <u>C</u> | 28 <u>A</u> | 38 <u>C</u> | 48 <u>C</u> |
| 9 <u>A</u> | 19 <u>D</u> | 29 <u>C</u> | 39 <u>B</u> | 49 <u>C</u> |
| 10 <u>D</u> | 20 <u>C</u> | 30 <u>B</u> | 40 <u>D</u> | 50 <u>B</u> |

Name: MARK JOHN GARCIAYear & Section: III - LAUREL

Number Sense Strand	Total Number of Items	Items with Wrong Answers	Total Correct Answers	Percentage of Correct Answers
Number Concepts	(14) 1,3,4,6,8,10,15,18 19,22,25,29,36,39	1,3,6,8,19,36 39	7	50%
Multiple Representations	(7) 7,8,13,14,30,31,40	7,9,13,14,30,31	1	14.29%
Effect of Operations	(10) 16,17,20,21,24,27 28,36,48,49	16,20,21,27,38 48	4	40%
Equivalent Expressions	(8) 11,23,26,32,33,34 37,45	23,26,33,45	4	50%
Counting and Computations	(11) 2,5,12,35,41,42,43 44,46,47,50	5,12,41,44,50	6	54.55%

 22

NUMBER SENSE TEST ANSWER SHEET

Name: Nielmark A. faciolarYear & Section: III-RectoSex: MaleAge: 1510/50

Practice Questions:

1. Without counting exactly, about how many children are there in your class?
 A. 5 B. 50 C. 500 D. 5000

2. What number goes in the box to make this statement true?

$$30 + \square = 50$$

Answer: _____ A. 10 B. 20 C. 30 D. 50

Instructions:

DO NOT write anything except your answer.

There are 50 questions in the test. Write the letter of the correct answer on the blank provided for each number

You will have 45 minutes to answer the questions.

ANSWERS:

- | | | | | |
|-------------|-------------|-------------|-------------|-------------|
| 1 <u>D</u> | 11 <u>C</u> | 21 <u>B</u> | 31 <u>D</u> | 41 <u>B</u> |
| 2 <u>B</u> | 12 <u>D</u> | 22 <u>C</u> | 32 <u>B</u> | 42 <u>C</u> |
| 3 <u>B</u> | 13 <u>A</u> | 23 <u>C</u> | 33 <u>C</u> | 43 <u>B</u> |
| 4 <u>A</u> | 14 <u>B</u> | 24 <u>C</u> | 34 <u>A</u> | 44 <u>A</u> |
| 5 <u>A</u> | 15 <u>C</u> | 25 <u>A</u> | 35 <u>B</u> | 45 <u>D</u> |
| 6 <u>C</u> | 16 <u>A</u> | 26 <u>C</u> | 36 <u>B</u> | 46 <u>D</u> |
| 7 <u>B</u> | 17 <u>A</u> | 27 <u>D</u> | 37 <u>A</u> | 47 <u>A</u> |
| 8 <u>D</u> | 18 <u>B</u> | 28 <u>C</u> | 38 <u>D</u> | 48 <u>C</u> |
| 9 <u>A</u> | 19 <u>C</u> | 29 <u>A</u> | 39 <u>C</u> | 49 <u>C</u> |
| 10 <u>C</u> | 20 <u>C</u> | 30 <u>B</u> | 40 <u>A</u> | 50 <u>A</u> |

Name: Nielmark A. Faculan Year & Section: III - Recto

Number Sense Strand	Total Number of Items	Items with Wrong Answers	Total Correct Answers	Percentage of Correct Answers
Number Concepts	(14) 1,3,4,6,8,10,15,18 19,22,25,29,36,39	1,3,6,8,10,18 22,29,36,39	4	29.572%
Multiple Representations	(7) 7,8,13,14,30,31,40	7,8,13,14,30,31 40	0	0%
Effect of Operations	(10) 16,17,20,21,24,27 28,38,48,49	16,17,20,21,24 27,38,48	2	20%
Equivalent Expressions	(8) 11,23,26,32,33,34 37,45	11,26,32,34,37	3	37.50%
Counting and Computations	(11) 2,5,12,35,41,42,43 44,46,47,50	2,5,12,35,41,43 44,46,47,50	1	9.09%

10

APPENDIX L

Sample Response to Problem Solving Skills Test

PROBLEM SOLVING SKILLS TEST ANSWER SHEET

Name: John Philip Caraban Year & Section: III-Aguino
 Sex: Male Age: 11

14
20

Instructions:

In Part I, there are 20 multiple choice questions that will assess your level of geometry concepts and skills. Read each question carefully. Then, write the letter of the correct answer on the blank provided for each number. You will have 45 minutes to answer these questions.

ANSWERS:

PART I MULTIPLE CHOICE QUESTIONS

- 1 c
- 2 c
- 3 d
- 4 d
- 5 b
- 6 b
- 7 a
- 8 b
- 9 d
- 10 d

- 11 a
- 12 c
- 13 b
- 14 d
- 15 b
- 16 a
- 17 d
- 18 c
- 19 c
- 20 d

ANSWERS:

PART II

1 $(n-2)180^\circ$

$(5-2)180^\circ$

$(3)180^\circ$

$=540^\circ$

2 $x = 90^\circ$

$b = \frac{1}{2}90^\circ$

$b = 45^\circ$

3 $\frac{76}{20} = 3.8$

4 $V = Lwh$

$700 \text{ cm}^3 = (x)(15)(4)$

$\frac{700 \text{ cm}^3}{20} = \frac{20x}{20}$

$x = 35 \text{ cm}^3$

5

$P = 4s$ $s = \sqrt{100}$

$P = 4(10)$ $s = 10$

$P = 40$

$P = 4s$

$P = 4(10)$

$P = 40$

6 $x = 180 - (81 + 49)$

$x = 180 - (130)$

$x = 50^\circ$

7 $180 = 2x + 7x$

$180 = 9x$

$20 = x$

$PRS = 2x$

$PRS = 2(20)$

$PRS = 40$

8 $13:4 = 73:?$

$4(73) = 13x$

$292 = 13x$

$22.3 = x$

9 because of the $30^\circ - 60^\circ - 90^\circ$

10 $150 + y = 180$

$y = 180 - 150$

$y = 30^\circ$

$150 + x = 180$

$x = 180 - 150$

$x = 30^\circ$

Name: Casabon, John Philip Year & Section: III - Aquino

Problem Solving	Total Number of Items	Items with Correct Response	Items with Partially Correct Response	Items with Incorrect Response	Items with No Response	Percentage of Correct Response
Assess level of geometry concepts and skills	Part I (20) 1,2,3,4,5, 6,7,8,9,10, 11,12,13,14,15, 16,17,18,19,20	14		6		70%
Assess level of problem solving skills	Part II (40) 1,2,3,4,5, 6,7,8,9,10, 11,12,13,14,15, 16,17,18,19,20	11	2	7	0	65%
		22	2			

PROBLEM SOLVING SKILLS TEST ANSWER SHEET

Name: Sanchez, Shaina Mae G. Year & Section: III-Jaena

Sex: Female Age: 14

Instructions:

In Part I, there are 20 multiple choice questions that will assess your level of geometry concepts and skills. Read each question carefully. Then, write the letter of the correct answer on the blank provided for each number. You will have 45 minutes to answer these questions.

ANSWERS:

PART I MULTIPLE CHOICE QUESTIONS

1 a. ✓

2 c. ✓

3 c. ✓

4 d. ✓

5 b. ✓

6 a. ✓

7 a. ✓

8 a. ✓

9 d. ✓

10 d. ✓

11 a. ✓

12 d. ✓

13 b. ✓

14 d. ✓

15 b. ✓

16 a. ✓

17 b. ✓

18 a. ✓

19 d. ✓

20 c. ✓

14
20

ANSWERS:

PART II

$$1) \angle DAC + \angle EBD + \angle ACE + \angle ADB + \angle BEC = 0$$

$$2) AC = BC \quad AB = 2CX$$

$$\angle B = \frac{1}{2} \angle C$$

$$3) 70(2) - 180 = 6$$

$$140 - 180 = 6$$

$$40 = 6$$

$$6 = 40$$

4

$$V = 5 \times 4 \times 8$$

$$V = 200 \times 10 = V = 200 \text{ cm}^3$$

5

$$P = 400 \text{ m}^2$$

$$P = (100 \text{ m}^2) \times 4$$

$$P = 4(100 \text{ m}^2)$$

$$P = 400 \text{ m}^2$$

$$6) 81^\circ + 49^\circ = 140^\circ - 180^\circ = X$$

$$X = 40^\circ$$

$$7) 20 \times 7 = 140$$

$$20 \times 2 = 40$$

$$\angle PRG = 40^\circ$$

$$8) 18 \text{ squares}$$

$$17 \times 4 = 68 \text{ segments} + 5 = 73$$

$$16 \text{ squares} + 2 = 18$$

9) because it is a right triangle and its measure are going up each number.

$$10) 150^\circ(2) - 380 = 0$$

$$300^\circ - 380 = 80 \div 2$$

$$X = 40^\circ$$

$$Y = 40^\circ$$

22

8/40

11
$$\begin{array}{r} 60 \\ + 40 \\ \hline 100 \\ - 150 \\ \hline 80 \end{array}$$
 $m\angle EGC = 80^\circ$ 2pts

16
$$\begin{array}{l} XY + YZ + ZX = P \\ 30 + 60 + 36 = P \\ P = 126 \\ \Delta XYZ = 126 \end{array}$$
 2pts

12 $A = 5^2$
 $A = 25$ X

17
$$\begin{array}{r} 135(2) \quad 270 \\ 360 - 270 = 90 \\ m\angle F = 90 \end{array}$$
 ?

13
$$\begin{array}{r} 115 \\ + 115 \\ \hline 230 \\ + 70 \\ \hline 300 \\ - 360 \\ \hline 60 \end{array}$$
 m of the remaining $\angle$ is 60° 2pts

18
$$\begin{array}{l} 5 + 3 = 8 \text{ ft.} \\ 32 - 3 = 29 \end{array}$$
 height of a tree is 29 1pts

14 $A = 6(16)$
 $A = 96$ X

19
$$\begin{array}{r} 135(2) \quad 270 \\ 360 - 270 = 90 \\ m\angle F = 90 \end{array}$$
 2pts

15
$$\begin{array}{r} 28 \\ 3 \overline{) 28} \quad 9.1 \\ 27 \\ \hline 1 \end{array}$$
 $\frac{19}{28} = \frac{2}{8}$
 $\frac{19}{28} = \frac{2}{8}$
18 f

20 1 - big square
4 - med. square
9 - small square
14 squares 2pts

Name: Sanchez, Shaina Mae G. Year & Section: III-Jaena

Problem Solving	Total Number of Items	Items with Correct Response	Items with Partially Correct Response	Items with Incorrect Response	Items with No Response	Percentage of Correct Response
Assess level of geometry concepts and skills	Part I (20) 1,2,3,4,5, 6,7,8,9,10, 11,12,13,14,15, 16,17,18,19,20	14		6		70%
Assess level of problem solving skills	Part II (40) 1,2,3,4,5, 6,7,8,9,10, 11,12,13,14,15, 16,17,18,19,20	1 2	6 6			35%

Miguel C. Rodriguez II-Honors Math

I

1. A

2. C

3. D

4. D

5. B

6. B

7. A

8. D

9. D

10. D

11. A

12. B

13. B

14. D

15. B

16. A

17. D

18. C

19. C

20. C

II

1. $360 + 180 = 540^\circ$

2. 95° Property of ~~isosceles~~ isosceles Rt. Triangle

3. $180 - 130 = 50^\circ$ $b = 50^\circ$

4. $(x)(x)(5) = 200 \rightarrow 20x = 200$ $x = 10 \text{ cm}$

5. $\sqrt{100} \rightarrow 10(5) = 50 \text{ m.}$

6. $180 - 130 = 50^\circ$ $x = 50^\circ$

7. $2x + 7x = 180 \rightarrow \frac{9x}{9} = \frac{180}{9}$ $x = 20$ $\angle PRS = 2x \rightarrow \angle PRS = 40^\circ$

8. $5^2 = 8^2 + 9^2 \rightarrow 25 = 64 + 81 \rightarrow 25 \neq 145$

9. $180 - 150 = 30^\circ$ $x \text{ and } y = 30^\circ$

10. $180 - 40 + 60 \rightarrow 180 - 100 = 80$ $\angle EGC = 80^\circ$

11. $360 - 115 + 115 + 70 \rightarrow 360 - 300 = 60^\circ$

12. $2(6) + 2(2) = 16$ $6(2) = 12 \text{ cm}^2$

13. $28 \div 7 = 4(4) = 16 \text{ meters}$

14. $5:30, 10:60, 6:36$ $30 + 60 + 36 = 126 \text{ cm}$

15. The same size & shape.

16. $8:32, 5:X$ $\frac{8}{5} = \frac{32}{X}$ $X = 20 \text{ feet}$

17. $180 - 135 = 45^\circ$

18. 14

Name: Saludaga Miguel O. Year & Section: III - Agoncillo

Problem Solving	Total Number of Items	Items with Correct Response	Items with Partially Correct Response	Items with Incorrect Response	Items with No Response	Percentage of Correct Response
Assess level of geometry concepts and skills	Part I (20) 1,2,3,4,5, 6,7,8,9,10, 11,12,13,14,15, 16,17,18,19,20	18	8	2		90%
Assess level of problem solving skills	Part II (40) 1,2,3,4,5, 6,7,8,9,10, 11,12,13,14,15, 16,17,18,19,20	13 26	5 5		2	90%