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Teachers' Mathematical Beliefs and Content Knowledge

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TEACHERS' MATHEMATICAL BELIEFS AND CONTENT KNOWLEDGE

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APPROVAL SHEET

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ABSTRACT

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This study attempted to describe the mathematical beliefs and mathematical content knowledge of elementary mathematics teachers. It also tried to determine if there is a significant relationship between teachers' mathematical beliefs and mathematical content knowledge. Teachers' beliefs included beliefs about the content of the knowledge of mathematics, beliefs about their teaching practices, and beliefs about the effect of their knowledge of the content of mathematics on their teaching practices. Teachers' beliefs about the content of mathematics were described as to numbers and operations, measurements, patterns, and Geometry. Teachers' beliefs about their teaching practices were described as to motivation, time management, lesson planning, and delivery of lesson. Teachers' mathematical content knowledge involved both conceptual and procedural knowledge on whole numbers, rational numbers, measurement, geometry, and graphs. To gather the need data, the following research instruments were used: Teachers' Beliefs About Their Knowledge of the Content of Mathematics Scale, Teachers' Beliefs About Their Teaching

Practices Scale, Teachers' Beliefs About How Mathematical Content Knowledge Affects Teaching Practices Scale, Conceptual Knowledge Test, and Procedural Knowledge Test. The study employed the descriptive research design with fifty elementary mathematics teachers of District II-B in the Division of Antipolo City as the participants of the study. The data were analyzed using the frequency, percentage, mean, standard deviation, and Pearson-Product Moment Correlation. It was found out that teachers have positive beliefs about their knowledge of the content of mathematics. They also have positive beliefs about their teaching practices and how mathematical content knowledge affects their teaching practices. They perceive the importance of the knowledge of the content of Mathematics in their teaching profession. As regards their mathematical content knowledge, the teachers are ***proficient*** in conceptual knowledge but ***beginning*** in procedural knowledge. It was also found out that teachers' beliefs are not related to mathematical content knowledge. Thus, teachers' beliefs are not factors that affect their mathematical content knowledge.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

CHAPTER I

The Problem and Its Background

Introduction

Elementary teachers need a thorough understanding and knowledge of mathematics so that they can teach it accurately, effectively, and coherently as a subject and as a discipline to pupils. However, research studies on teachers' mathematics content knowledge have shown that many possess a limited knowledge of mathematics in key content areas such as numbers (Ball, 1990; Thanheiser, 2009; Tobias, 2013).

Recently, the focus of mathematics education research is on teachers' mathematical content knowledge. There are many factors that are contributory and related to teachers' mathematical content knowledge. Some of these are the mathematical beliefs that they held that influence their content knowledge in mathematics.

Many teachers believe that knowledge of mathematical definitions is an important aspect of mathematical knowledge for teaching. Moreover, beliefs play great role in mathematics learning and teaching. The learning outcomes of students are strongly related to their beliefs and attitudes about mathematics (Furinghetti and Pehkonen, 2000). On the other hand, Thompson (1992) has been investigating teachers' beliefs extensively. She has looked into teachers' conceptions of mathematics and their relationship to instructional practice. The issue of changing teachers' beliefs, comments on methodology, and descriptions of theoretical frameworks, are included in her work (Thompson, 1992).

The study of teachers' instructional beliefs and their influence on instructional practice gained momentum in the last decade. Some research on teachers' thinking reveals that teachers hold well articulated educational beliefs that in turn shape instructional practice (Buzeika, 1996; Frykholm, 1995;McClain, 2002; Stipek, Givvin, Salmon, &MacGyvers, 2001; Thompson, 1992). Researchers studying teachers' knowledge, beliefs, and affect related to mathematics teaching and learning are still trying to tease out the relationships among these constructs and to determine how teachers' knowledge, beliefs, and affect relate to their instruction. Thompson (1992) points out that researchers must consider the content knowledge of mathematics and the relationship between what a teacher thinks about mathematics and how the teacher teaches. The mathematics teacher's mental contents or schemas include knowledge of mathematical beliefs and its teaching and learning, and other factors. Knowledge is important, but it alone is not enough to account for the differences between mathematics teachers.

An individual's beliefs are understood as his/her subjective, experience-based, often implicit knowledge and emotions on some matter or state of art. The teachers' conception of the nature of mathematics is his or her belief system concerning its nature as a whole is hypothesized to be related to their mathematical content knowledge. Teachers' conceptions of the nature of mathematics by no means have to be consciously held views rather than implicitly held philosophies.

Meanwhile, Grossman, Wilson, & Shulman (1989) stated that "No discussion of teacher knowledge would be complete without an accompanying discussion of teacher's belief, for it is difficult sometimes to differentiate between the two". Teachers' beliefs about the subject matter they teach and their beliefs about teaching and learning seem to influence what and how they teach. Furthermore, Thompson (1992) pointed out that the difficulties involved in changing teachers' performance are intimately connected with what they believe and know.

Moreover, the significance of mathematical beliefs and mathematical content knowledge was highlighted by Wilkins and Ma (2003). They said that a person's mathematical disposition is related to her or his beliefs about and attitude towards mathematics may be as important as content knowledge for making informed decisions in terms of willingness to use this knowledge in everyday life.

Mathematics teachers all over the world face demands related to choosing and developing definitions that are appropriate for use among their students. Zazkis and Leikin (2008) suggest that teachers' mathematical content knowledge and mathematical beliefs affect their instructional decisions, the explanations they provide in the classroom, the way they guide their students, and how they conduct mathematical discussions. Thus, future professional development is asserted by the teachers' beliefs and mathematical content knowledge.

Meanwhile, a number of attempts had been made by researchers to build ideas on mathematical content knowledge for teaching. Much remains unknown, however, about the specific knowledge required doing the mathematical task of teaching involving practices and performances that are related to teacher beliefs. It has always been noted anywhere in the world the need for effective instruction in mathematics and to increase the level of challenging academic content in relation to teaching practices and performance.

In recent years mathematics educators have stressed the importance of students' developing deep and interconnected understandings of mathematical concepts and principles and not just an ability to memorize formulas and apply procedures. These educators found that mathematics is best learned in environments where students are encouraged to discover and create knowledge of mathematics through inquiry and problem solving. Despite countless efforts aimed at encouraging teachers to embrace this view of teaching mathematics, studies have shown that most teachers have not fully implemented these ideas. Most professional development programs neglect to take into account the beliefs that teachers hold about the nature of mathematics and have therefore had little impact on changing teaching. This study provides an understanding of the relationship between teachers' beliefs about mathematics and how they teach mathematics and the ways in which that relationship interacts with professional development to bring about change in teaching practices.

It is in this connection that this study was conducted to find out the relationship of teachers’ mathematical beliefs and mathematical content knowledge. Indeed, this study was conceived to find meaning on these aspects. Hence, the emphasis of this paper was to describe teachers’ mathematical content knowledge and mathematical beliefs of elementary Mathematics teachers of District II-B, Division of Antipolo City. In the long run, without a doubt, the teachers of Mathematics are facing challenging tasks that would make a difference in the life of their pupils.

Conceptual Framework

This study is anchored on different concepts about teachers' mathematical beliefs and their relationship to mathematical content knowledge. Educational scientists and researchers have attempted to systematize a framework for teachers' mathematical belief systems into smaller sub–systems. Most authors agree with a system mainly consisting of beliefs about what mathematics is, how mathematics teaching and learning actually occurs, and how mathematics teaching and learning should occur ideally (Ernest, 1989, 1989; Thompson, 1991). Certainly, the range of teachers' mathematical beliefs is vast since such a list would include all teachers' thoughts on personal efficacy, computers, calculators, assessment, group work, perceptions of school culture, particular instructional strategies, textbooks, students' characteristics, and attribution theory, among others.

As Beswick (2005) mentioned, although the concept of beliefs has been a very popular element of research in recent decades, this construct lacks a commonly agreed definition. That is, the literature contains inconsistent definitions of the term "belief." Different researchers used differing definitions. For example, Sigel (1985) described beliefs as "mental constructions of experience". According to Richardson, (1996), beliefs are "psychologically held understandings, premises, or propositions about the world that are felt to be true." Various ways have been used to distinguish beliefs from knowledge. For example, Nespor (1987) stated the four characteristics of beliefs to be existential presumption, alternativity, affective and evaluative loading, and episodic structure; these distinguish beliefs from knowledge. One of the features of beliefs is the existential presumptions, which are personal truths and cannot be changed by persuasion. Therefore, the beliefs one holds may not agree with others', whereas knowledge is a social construct, which must meet the criteria of truthfulness in the over-all community (Green, 1971). And alternatively, the conceptualization of ideal situations separate from present reality is another characteristic of beliefs. In order to reach this ideal situation, knowledge systems where goals and the paths to their achievement are required (Nespor, 1987).

In addition, both evaluative and affective components, such as feelings and subjective evaluations affect one's beliefs. However, knowledge is not dependent on these components. To clarify, a teacher's feelings about a subject does not affect his/her knowledge whereas his/her beliefs about teaching that subject are affected by his/her feelings (Nespor, 1987). Finally, beliefs have episodic structure; that is, past experiences or events can be influential in shaping beliefs. As Calderhead and Robson (1991) stated, experiences as a student (*i.e.*, particular events in the classroom) may affect teachers' images of teaching.

Theoretical conceptualisations of teachers' mathematical beliefs show that the range of these beliefs can be expressed in multiple dimensions (Kuhs & Ball, 1986; Renne, 1992; Ernest, 1991). Ernest (1991), for example, outlined a developmental sequence of five different mathematics-related belief systems that are hypothesized to be found among teachers: authoritarian, utilitarian, mathematics centred, progressive, and socially aware. Ernest's contribution showed that it is possible to relate these attitudinal representations to conceptions on the theory of mathematics, learning mathematics, teaching mathematics, and assessment in mathematics, as well as identifying beliefs on the aims of mathematics education. According to Ernest (1991) the most important of these categories is the teacher's philosophy of mathematics, which might vary from absolutist to social-constructivist values.

Teachers' theories of learning and teaching are said to relate to approaches used in class and are fundamental because they define the teacher's perception of the learner's role as active or passive, dependent or autonomous, or as receiver or creator of knowledge. Ernest (1991) also proposed three main philosophical conceptions of mathematics among teachers. In the instrumentalist view, mathematics is seen as a collection of rules and skills that are to be used for the attainment of a particular goal. Teachers adhering to the Platonist view will maintain that "mathematics is a static but unified body of certain rules" that are to be discovered and are not amenable of personal creation. The problem solving view presents mathematics as a continuous process of inquiry that always remains open to revision.

Kuhs and Ball (1986) characterised three different and dominant conceptions of the ideal teaching and learning of mathematics. The first is the learner-focused view that stresses the learner's construction of mathematical knowledge through social interaction. The second is the content-focused view with an emphasis on conceptual understanding. The third is the content-focused approach with an emphasis on performance which values performance as the key goal whose attainment depends on the mastery of rules and procedures.

Furthermore, Renne (1992) conceptualised four different teachers' conceptions of teaching and learning mathematics. Two groups of teachers are identified in the purpose of schooling category, namely, *school-knowledge oriented* and *child development oriented*. Teachers within the school knowledge group believe that teaching is an act of passing information on to others while learning involves the process of reproducing that information. At the same time, school-knowledge oriented teachers place great emphasis on the syllabus and curricular guidelines to guide their instruction. In turn, child development oriented teachers are more likely to consider children's needs and characteristics as the primary factors in instructional decision making. The second category in the matrix relates teachers' beliefs to the way teachers perceive knowledge itself. School knowledge oriented teachers' design activities that emphasise acquisition of knowledge in terms of "what" is going to be learned. As such, this type of knowledge is concerned more with rules, procedures, and drill. This type of knowledge is very fragmentary because it does not help the learner relate isolated pieces of knowledge to the whole framework. In contrast, child development oriented teachers are more concerned with learning of mathematical concepts within an interrelated knowledge structure that is holistic and meaningful.

These three different conceptualisations of teachers' beliefs about the nature and pedagogy of mathematics (Ernest, 1991; Kuhs & Ball, 1986; Renne, 1992) constitute an analytical framework to discuss teachers' mathematical belief systems. In general, it can be argued that teachers' belief systems are complex networks of smaller sub-systems operating contextually.

Several researchers have defined what a teacher needs to know to teach mathematics. There are for example several theoretical models describing what mathematical content knowledge is (for example Brekke, 1995; Kilpatrick, et al., 2001; NCTM, 1989, 2000; Niss & Højgaard Jensen, 2002). But even if there is an agreement that mathematical content knowledge is a prerequisite to be able to teach mathematics, there is also a growing understanding that this is not enough (Ball, 2002; Ball & Bass, 2003; Ball, Hill, & Bass, 2005; Niss, 2007). As an answer to this there are developed several models of teachers' knowledge needed to teach mathematics, like the 'content knowledge for teaching' (Ball, Thames, & Phelps, 2007, 2008), ‘mathematical teacher competency’ by Niss and Højgaard Jensen (2002), ‘proficient teaching of mathematics’ by Kilpatrick, Swafford and Findell (2001) and ‘knowledge of teaching mathematics’ by The Teacher Education and Development Study in Mathematics (TEDS-M) (Tatto, et al., 2008). The knowledge quartet (KQ) (Rowland & Turner, 2009) adds another perspective with the main focus on the knowledge that is observable in practice, and less focus on foundation that may not be useful to understand knowledge in practice.

Not surprisingly, research has confirmed that teachers need to know the mathematics they are teaching both deeply and thoroughly. More surprisingly, research has also shown that there is no clear relationship between the teachers’ formal mathematical education and their students’ learning of mathematics (Askew, 2008; Ball, Lubienski, & Mewborn, 2001; Perrin-Glorian, Deblois, & Robert, 2008). The reason that such a relationship has not been established may be that measuring teachers’ mathematical knowledge just in terms of their level of formal education (number of courses or ECTS) is not precise enough because there are probably aspects of such knowledge that are more important than others. One suggestion in the search for aspects of teachers’ mathematical knowledge that matter for students’ learning is to use Shulman’s (1986) distinction between subject matter knowledge and pedagogical content knowledge. One recent development resulting from this suggestion is the framework ‘content knowledge for teaching’ (Ball, et al., 2008).

Common content knowledge are defined as ‘the mathematical knowledge and skill used in settings other than teaching’ (Ball, et al., 2007, p. 32). It is questions that commonly are answerable by people who know mathematics, and therefore not knowledge unique to the teachers. Specialized content knowledge is defined as the mathematical knowledge and skill uniquely needed by teachers in the conduct of their work and therefore not commonly needed for purposes other than teaching (Ball, et al., 2007). Also this specialized content knowledge is purely mathematical and does not require knowledge of students or teaching. But it is not the mathematics learned at the university mathematics courses, it is ‘mathematics in its decompressed or unpacked form (Ball, et al., 2007). The knowledge of content and students is defined as knowledge that combines knowing about students and knowing about mathematics. Teachers need to anticipate what students are likely to think and what they will find confusing (Ball, et al., 2007). Knowledge of common student conceptions and misconceptions are a vital part of this domain. Knowledge of content and teaching is defined as ‘knowledge that combines knowing about teaching and knowing about mathematics.’ Included in this domain are for example the selection of examples, the sequencing of the content, the advantages and disadvantages of different representations, which student contributions could be used and how, when the whole class needs clarification, when to take it with single students or small groups, and the decision of what method or algorithm to introduce.

Figure 1 shows the conceptual paradigm of the study. It can be seen from the figure that the study investigated the relationship between teachers’ mathematical beliefs and teachers’ mathematical content knowledge. Teachers’ mathematical beliefs include beliefs about the knowledge of the content of mathematics, beliefs about teaching practices, and beliefs on how knowledge of the content of mathematics affects teaching practices. Teachers’ mathematical content knowledge includes conceptual and procedural knowledge.

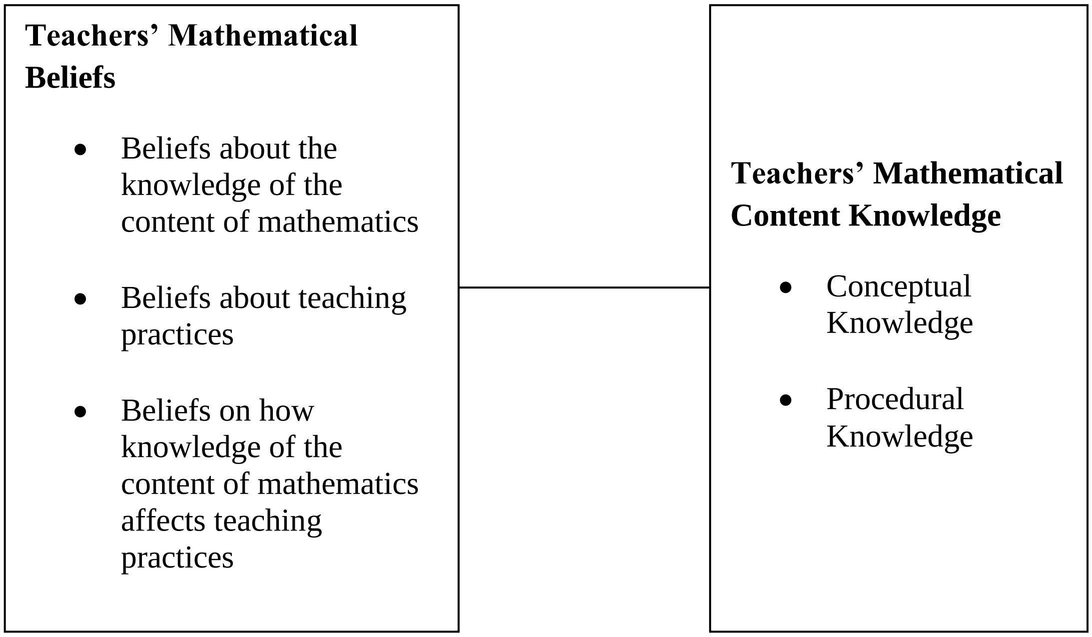

Figure 1. Conceptual Paradigm

Positive beliefs about the knowledge of the content of mathematics means they perceived that their knowledge of mathematics is useful in their classroom teaching while negative beliefs about their knowledge of the content of mathematics means it is not useful.

Positive beliefs about teaching practices means that they perceived that their teaching practices is meaningful while negative beliefs about teaching practices means it is not meaningful.

Positive beliefs on how knowledge of the content of mathematics affects teaching practices means that they perceived that how knowledge of the content of mathematics affects teaching practices is essential while negative beliefs on how knowledge of the content of mathematics affects teaching practices means not essential.

Statement of the Problem

The purpose of this study was to describe teachers' beliefs, conceptual knowledge, and procedural knowledge. It also attempted to determine the relationship between teachers' beliefs and conceptual and procedural knowledge of mathematics.

Specifically, it sought answers to the following questions:

1. What are the teachers' beliefs about their knowledge of the content of Mathematics in terms of the following?
    a. Numbers and Operations
    b. Measurements
    c. Patterns
    d. Geometry
2. What are the teachers' beliefs about their teaching practices in terms of the following?
    a. Motivation
    b. Time management
    c. Lesson planning
    d. Delivery of lesson
3. What are the teachers' beliefs about the effect of their knowledge of the content of Mathematics on their teaching practices in terms of the following?
    a. Motivation
    b. Time management
    c. Lesson planning

d. Delivery of lesson

4. What is the level of mathematical content knowledge of teachers in terms of the following?
    a. Conceptual knowledge
    b. Procedural knowledge
5. Is there a significant relationship between teachers' beliefs and their conceptual and procedural knowledge of mathematics?

Hypothesis

This study tested the following hypotheses:

1. There is a significant relationship between teachers' mathematical beliefs and their conceptual knowledge.
2. There is a significant relationship between teachers' mathematical beliefs and their procedural knowledge.

All hypotheses were tested at 0.05 level of significance.

Significance of the Study

The value of teaching rests so much on the outcomes or the result of the academic performance of the children under the tutelage of a teacher. Such performance is greatly affected by their teachers' mathematical beliefs and mathematical content knowledge. Therefore, this study will be of great help to the following.

The result of this study may serve as guide to **curriculum planners** in developing curriculum materials that can help teachers adopt their mathematical beliefs and their knowledge of the content of Mathematics that can be integrated with their teaching practices.

Likewise, the result of this study could serve as valuable inputs to **school administrators** in the planning faculty development programs which are most needed in enhancing teachers' mathematical content knowledge, mathematical beliefs, and teaching practices.

The result of this study can also be a good source of knowledge and information to **Math teachers** having known and realized their mathematical beliefs and mathematical content knowledge.

Moreover, this study will be of great importance to the **pupils** since they are the ultimate beneficiaries of the educational system. Under a school system with a happy and motivated teachers, they are rewarded of quality education eventually find the rightful place in the community, possibly become assets to their families as well as their community and become competitive to the world at large.

In addition, the findings of this study maybe useful to **future researchers** might be interested in investigating teachers' mathematical beliefs and mathematical content knowledge. This may serve as a reference or baseline information in conducting related studies on teacher's beliefs and content knowledge.

Scope and Delimitation of the Study

This study was limited to describing teachers' mathematical beliefs and mathematical content knowledge. Teachers' beliefs included beliefs about the content of the knowledge of mathematics, beliefs about their teaching practices, and beliefs about the effect of their knowledge of the content of mathematics on their teaching practices. Teachers' beliefs about the content of mathematics were described as to numbers and operations, measurements, patterns, and Geometry. Teachers' beliefs about their teaching practices were described as to motivation, time management, lesson planning, and delivery of lesson. Teachers' mathematical content knowledge involved both conceptual and procedural knowledge on whole numbers, rational numbers, measurement, geometry, and graphs.

Teachers' mathematical beliefs were measured using three beliefs scales which were developed by the researcher and content validated by some experts in mathematics and education. Likewise, mathematical content knowledge was measured using the Conceptual Knowledge Test and Procedural Knowledge Test, which were adopted from Dino (2010). The study involved 50 elementary Math teachers of District II-B, Division of Antipolo City during the school year 2014 - 2015. The study also investigated the relationship between teachers' mathematical beliefs and mathematical content knowledge.

Definition of Terms

For better understanding of the study, the following terms were defined operationally and conceptually.

- **Teachers' Mathematical Beliefs.** These refer to those belief systems held by teachers on the teaching and learning of mathematics. Most authors agree with a system mainly consisting of beliefs about what mathematics is, how mathematics teaching and learning actually occurs, and how mathematics teaching and learning should occur ideally (Ernest, 1989a, 1989b; Thompson, 1991). In this study, these refer to the beliefs about the knowledge of the content of mathematics, beliefs about teaching practices, and beliefs about how knowledge of the content of mathematics affects teaching practices. These were measured using the beliefs scale developed by the researcher and content validated by the experts.
- **Teachers' Mathematical Content Knowledge**- This refers to the knowledge of theories, principles and structures in mathematics. In this study, this refers to the conceptual and procedural knowledge on whole numbers, rational numbers, measurement, geometry, and graphs. This is measured using the conceptual knowledge test and the procedural knowledge test.

Chapter II

REVIEW OF RELATED LITERATURE

This chapter presents the review of related literature and studies that helped the researcher enrich the contents of this study.

Teachers' Mathematical Beliefs

Mathematics teachers all over the world are facing demands related to choosing and developing definitions that are appropriate for use among their students. Zazkis and Leikin (2008) suggest that teachers' knowledge of mathematical definitions and their concept images affect their instructional decisions, the explanations they provide in the classroom, the way they guide their students, and how they conduct mathematical discussions.

Furinghetti and Pehkonen (2002) have recently tried to clarify the problems of the concept 'belief' with the help of specialists' evaluations of mathematical belief research, and they conclude with suggestions. When dealing with beliefs and related terms, it is advisable to consider two types of knowledge (objective knowledge and subjective knowledge), to consider beliefs as belonging to subjective knowledge, to include affective factors in the belief systems, and distinguish affective and cognitive beliefs, if needed to consider degrees of stability, and to acknowledge that beliefs are open to change, to take care of the context (e.g. population, subject, etc.) and the research goal within which beliefs are considered."

Philipp (2007) reiterates that beliefs can be held with varying degrees of conviction, whereas knowledge is generally not thought of in this way. For example, whereas one might say that he or she believed something strongly, one is less likely to speak of knowing a fact strongly. Second, beliefs are not consensual, whereas knowledge is. One is generally aware that others may believe differently and that their stances cannot be disproved, whereas with respect to knowledge, one finds “general agreement about procedures for evaluating and judging its validity”

Chapman (2002) noted that it has become an accepted view that it is the [mathematics] teacher's subjective school related knowledge that determines for the most part what happens in the classroom.

A third method for producing changes in belief structures is through pre-service teachers' experiences with mathematical discovery, which has been shown to have a profound, and immediate, transformative effect on the beliefs regarding the nature of mathematics, as well as their beliefs regarding the teaching and learning of mathematics (Liljedahl, 2005).

According to Raymond (1997) early and continued reflection about mathematics beliefs and practices, beginning in teacher preparation, may be the key to improving the quality of mathematics instruction and minimizing inconsistencies between beliefs and practice. Teachers should not work in isolation either but as members of learning communities.

Ball and Bass (2000) have taken a similar approach to mathematical knowledge for teaching elementary school mathematics. They describe mathematical knowledge for teaching as a "kind of understanding that is not something a mathematician would have, but neither would be part of a high school social studies' teacher's knowledge".

Van Zoest, Jones, and Thornton (1994) also interviewed and observed six elementary pre-service mathematics teachers participating as students in an intervention program to enhance their teachers' mathematical beliefs. The authors found that participants acquired beliefs consistent with socio-constructivist views of learning and teaching mathematics, although they were not able to translate these views into practice in the early stages of instructional episodes. The reason for this inconsistency was found in teachers' lack of pedagogical skill to guide students through the whole problem solving process, time needed to go through a task, teachers' and students' tension on how to go about a problem solving situation, and teachers' concerns about students' ability.

On the other hand, Cooney (1985) studied a beginning mathematics teacher who was committed in belief and in practice to problem solving instruction. The author described the conflict between the teacher's struggle to teach problem solving and students who preferred a more content-based instruction, a friction that sometimes led to classroom management problems.

As Raymond (1993) investigated beliefs and practices of six beginning elementary mathematics teachers and found diverse degrees of consistency. Two teachers displayed a high degree of correspondence between belief and practice, two teachers showed a moderate level, while the other two showed a low level. Reasons for the inconsistencies were found to be lack of resources, time limitations, discipline, and pressure to conform to standardized testing. The author concluded that there is a dialectical relationship between beliefs and practice. According to the researcher, teachers' mathematical beliefs influenced their practice more than their instructional practices influence their mathematical beliefs. The researcher also found that previous school experiences, teachers' current practice, and, importantly, teacher education courses also influence teachers' mathematical beliefs. Teachers also identified their own mathematical beliefs, students' abilities, the particular topic to be taught, the school culture, as well as the mathematics curriculum as factors that influenced their instructional practice.

Effandi and Norulpaziana's (2010) study aims to investigate the beliefs about the nature of Mathematics, Mathematics teaching and learning among teacher trainees. The sample is consisted of 100 teacher trainees from two higher institution of learning in Selangor, Malaysia. Research tool used is a Mathematical belief questionnaire which consists of three dimensions: beliefs about the nature of Mathematics, beliefs about teaching and beliefs about learning of Mathematics. Descriptive statistic was used to describe and summarize the data. In addition, t-test was used to test the hypothesis. The results indicate that the beliefs of Mathematics trainee teachers are positive towards the constructivism approach. Teacher trainees believe that mathematical problems can be solved in many ways. Teacher trainees also believe that teaching Mathematics should involve the opportunity to use Mathematics in daily situations and in learning Mathematics students need to understand the concepts, principles and strategies of Mathematics. Lastly, the findings also found that there were significant differences regarding the beliefs about the nature of Mathematics and beliefs about learning of Mathematics based on gender.

In conceptualizing and framing questions about mathematical knowledge for teaching at the elementary level, Ball and colleagues (Ball et al., 2000b) examine mathematics teaching to generate hypotheses about how teachers access and deploy mathematical knowledge in their teaching. They contend that a special kind of mathematical work is entailed in teaching, and that teachers are more likely to engage in this kind of mathematical work than others who work in mathematically intensive careers.

Philipp (2007), on the other hand, maintained that beliefs are closely related to knowledge, but a distinction should be made between the terms. This distinction between knowledge and beliefs is a false dichotomy, however. In general, knowledge is seen as an "essentially a social construct" (Op 'T Eynde, De Corte, and Verschaffel, 2002). That is, the division between knowledge and belief is the evaluations of these notions against some socially shared criteria. If the truth criterion is satisfied then the conception is deemed to be knowledge.

Indeed the conceptualisation of knowledge used by Beswick, Callingham and Watson (2011) included beliefs and confidence in addition to Shulman’s knowledge types and Ball et al.’s elaborations thereof. Their data suggested that this was reasonable at least for the middle school teachers involved in their study. In this study we were interested in exploring, (1) whether the various aspects of such an holistic view of teacher knowledge, operationalized by a particular instrument, together measure a single underlying construct, (2) how the development of pre-service teachers’ abilities in relation to the various aspects of the this construct relate to one another, and (3) the relative difficulty that endorsement of a set of belief items presented for pre-service teachers.

In an attempt to relate teacher content knowledge to student performance in the NSES, Taylor (2011) finds that, when combined with time on task, teacher knowledge leads to substantial gains in student learning. However, this only occurs at a very high level of knowledge, indicating a non-linear relationship between teacher knowledge and learner performance. The strongest finding by Taylor (2011) is the significant positive relationship between learner outcomes and curriculum coverage.

Studies on Beliefs about Mathematics Teaching

A teacher's system of beliefs about teaching involves their beliefs about students, learning, the nature of the science [mathematics], epistemology, and the role of teachers (Wallace & Kang, 2004). Two types of research have dominated the literature about mathematics teachers' beliefs. Some studies have aimed to investigate descriptively mathematics teachers' beliefs about mathematics teaching, learning and the nature of mathematics; other studies have explored the relationship between mathematics teachers' beliefs and their teaching practices.

Descriptive Studies about Teachers' Beliefs

Studies directed at determining teachers' beliefs about mathematics teaching have demonstrated that many pre-service teachers believed that mathematics is a closed set of procedures and that mathematics teaching meant transferring the correct information to students (Ball, 1991; Brown, Cooney & Jones, 1990; Thompson, 1992). Gates (2006) pointed out by referring to Romberg and Carpenter (1986) and Cuban (1984) that this characterization of mathematics teaching was widespread and had persisted as a dominant model during the past 100 years.

However, Thompson (1985) found that a mathematics teacher may possess constructivist beliefs. Mapolelo (1998) similarly found that the pre-service teachers in his study believed that learning mathematics meant being able to solve a mathematics problem. Barkastas-Tasos and Malone (2005) stated that secondary level mathematics teachers held two main beliefs: a contemporary-constructivist orientation and a transmission-information processing orientation. Seaman, Szydlik, Szydlik and Beam (2005) stated that the majority of pre-service elementary level mathematics teachers described mathematics as a collection of rules and formulas, but simultaneously believed that mathematics was a creative, flexible endeavor. Cady and Rearden (2007) reported that most pre-service mathematics teachers described the student’s role as passive, but believed that mathematics teachers should provide real-life mathematical problems. Beswick (2007) reported nine constructivist beliefs of secondary mathematics teachers; the teachers in her sample advocated the establishment of classroom environments that were consistent with the principles of constructivism.

Andrews and Hatch (2000) compared Hungarian and English teachers' conceptions of mathematics and its teaching and found the most obvious difference between the two groups to be that Hungarian teachers tended to reject the idea of creating a mathematically enriched classroom environment, whereas their English colleagues would accept it. Gellert (1999) reported that the prospective elementary teachers in his sample regarded mathematics classes mainly in terms of the degree the pupils enjoyed them and thus regarded the teacher’s role as an entertainer.

Studies about the Relationship between Teachers' Beliefs and Practice

In terms of the relationship between teachers' beliefs and their practice, some studies indicated consistency (Even & Tirosh, 1995; Stipek *et al.*, 2001; Thompson, 1985; Speer, 2005). Thompson (1985) explained this consistency by noting that a mathematics teacher with constructivist beliefs was observed to encourage her students to construct knowledge by making their ideas explicit and explaining their reasoning in her instruction; this is a constructivist approach. Similarly, Even and Tirosh (1995) brought out that instruction by a teacher who believed mathematics to be a set of unexplainable rules called for memorization of those rules. Moreover, Stipek *et al* (2001) indicated that teachers with traditional beliefs employed traditional practices. For example, they did not give their students much autonomy to become involved in the learning process. Similarly, Speer (2005) pointed to a relationship between teachers' beliefs and their practice, especially regarding the role of the teacher.

On the other hand, some research studies found inconsistency between teacher beliefs and practice (Cooney, 1985; Raymond, 1997; Thompson, 1992; Westerman, 1990; Shield, 1999; Barkastas-Tasos & Malone, 2005). For example, Raymond (1997) found that beginning mathematics teachers although believed to teach according to principles of constructivism; in practice they used mostly traditional methods in the classroom. Similarly, the research of Barkastas-Tasos and Malone (2005) showed that mathematics teachers held less traditional beliefs compared to their instruction, but the reality of the classroom environment prevented them from putting their constructivist beliefs into practice. The classroom situation can influence the transfer of teachers' beliefs into practice (Leinhardt, 1989; Brown & Borko, 1992; Westerman, 1990; Barkastas-Tasos & Malone, 2005; Beswick, 2005).

Underlying Reasons of not Finding Relation between Teachers' Beliefs and Practice

Beswick (2006) explained such inconsistencies by the notion of clustering. From Green (1971) she stated, "[A] person may hold beliefs that contradict one another without being aware of the contradiction" because "beliefs within a system can be held in groups that are isolated from other beliefs.". On the other hand, Speer (2008) proposed that data Australian Journal of Teacher Education collection and analysis methods might underlie the different findings on relationships between belief and practice. She claimed that if the aim of a study is to find out the relationships between beliefs and instructional practices, then survey and interview research is not productive: "Those methods may be fine for documenting beliefs held by teachers, but those beliefs, at that level of detail, may carry little explanatory power for teachers' instructional decisions". Leatham (2006) also argued that such consistencies are due to the underlying framework for conceptualizing teachers' beliefs: "Instead of viewing teachers' beliefs as inconsistent, teachers' abilities to articulate their beliefs as well as researchers' interpretations of those beliefs are seen as problematic."

Factors Influencing Beliefs and Importance of this Study

As cited above, personal experiences, episodes or events in the past, are influential in shaping beliefs (Calderhead & Robson, 1991; Nespor, 1987; Richardson, 1996; Grootenboer, 2008). Thus, beliefs have a contextual nature; they may depend on the contextual factors of the beholder. Furthermore, Hofer and Pintrich (1997) pointed out that teachers' views about mathematics and mathematical knowledge were related closely to what they thought about mathematics teaching and learning. It is clear that determining teachers' beliefs in different countries is important, because teachers in different countries may have different experiences as a learner.

Teachers' Mathematical Beliefs and Instructional Practice

Studies on the relationship between pedagogical beliefs and instructional behaviour have reported different degrees of consistency (Frykholm, 1995;Thompson, 1992). While the nature of this relationship seems to be dialectical in nature (Wood et al., 1991) it is not clear whether beliefs influence practice or practice influences beliefs (McGalliard, 1983). It is in fact a complex relationship (Thompson, 1992) where many mediating factors determine the direction and magnitude of the relationship. This section reports a number of studies that have explored the relationship between teachers' mathematical beliefs and instructional practice. Benbow (1995) conducted an intervention program to deliberately modify the beliefs and instructional practices of 25 preservice mathematics elementary teachers. Findings showed that there was no change in teachers' mathematical beliefs at the end of the program. However, the researcher stated that instructional behaviour in terms of selection of curriculum content and learning activities, teacher's role, and teachers' beliefs on self-efficacy were modified as a result of the program. Lack of pedagogical knowledge and subject-based content were found in some cases to be an obstacle to transfer progressive oriented beliefs into practice.

Brown and Rose (1995) conducted an interview study with 10 elementary mathematics teachers in order to determine their theoretical orientations. Teachers' responses showed a varied range of theories of teaching and learning mathematics. Teachers also said that these orientations influenced their instructional behaviour. The analysis of data revealed that teachers do not implement fully their ideal conceptions of mathematics education because of perceived pressure from parents and school administrators to implement traditional teaching. Other identified mediating factors were the need for more preparation time to satisfy instructional and curricular demands, and the challenges of mixed ability classes. Erickson (1993), in a study with two experienced middle school mathematics teachers, concluded that teachers' ideal beliefs have a strong influence on their instructional practice. However, obstacles to fully implement their ideals included lack of preparation time and lack of collaboration among peers; size of room; availability of technology, materials, and money; non-supportive administration and parents; need for lengthened class periods; and personal opportunity for growth. Foss and Kleinsasser (1996) studied the behaviour and instructional practice of 20 elementary mathematics preservice teachers. At the end of a one semester methods course participants had not changed their beliefs about teaching and learning mathematics, which were found to be traditional-oriented and heavily influenced by previous traditional learning experiences in diverse educational settings. Participants' instructional behaviour replicated or modelled activities learned in the methods course, but not to the extent that reflected an adoption of innovative approaches to teaching and learning mathematics in an articulated and consistent way. In addition, Cooney (1985) studied a beginning mathematics teacher who was committed in belief and in practice to problem solving instruction. The author described the conflict between the teacher's struggle to teach problem solving and students who preferred a more content-based instruction, a friction that sometimes led to classroom management problems.

Perry et al. (1999) studied the beliefs of Australian head secondary mathematics teachers and classroom secondary mathematics teachers as independent samples. Head teachers said that curriculum demands were an obstacle to implementing innovative teaching. In the respondents' words: We try to make the work relevant but we are constrained by the syllabus. Sometimes, I feel, pressure of the syllabus tends to force us to cut corners with the kids…If I sound cheesed off, it's just that I may be a disillusioned mathematics teacher. (p. 14)

Raymond (1993) investigated beliefs and practices of six beginning elementary mathematics teachers and found diverse degrees of consistency. Two teachers displayed a high degree of correspondence between belief and practice, two teachers showed a moderate level, while the other two showed a low level. Reasons for the inconsistencies were found to be lack of resources, time limitations, discipline, and pressure to conform to standardized testing. The author concluded that there is a dialectical relationship between beliefs and practice. According to the researcher, teachers' mathematical beliefs influenced their practice more than their instructional practices influence their mathematical beliefs. The researcher also found that previous school experiences, teachers' current practice, and, importantly, teacher education courses also influence teachers' mathematical beliefs. Teachers also identified their own mathematical beliefs, students' abilities, the particular topic to be taught, the school culture, as well as the mathematics curriculum as factors that influenced their instructional practice.

Taylor (1990) attempted to assist a high school teacher to modify his beliefs through a process of conceptual change. However, there were conflicting beliefs, such as the teacher's belief that he had to teach for constant assessment and for covering the syllabus given that he did not want to jeopardize students' learning with alternative strategies. Consequently, change in instructional behaviour was restricted. Van Zoest, Jones, and Thornton (1994) interviewed and observed six elementary preservice mathematics teachers participating as students in an intervention program to enhance their teachers' mathematical beliefs. The authors found that participants acquired beliefs consistent with socioconstructivist views of learning and teaching mathematics, although they were not able to translate these views into practice in the early stages of instructional episodes. The reason for this inconsistency was found in teachers' lack of pedagogical skill to guide students through the whole problem solving process, time needed to go through a task, teachers' and students' tension on how to go about a problem solving situation, and teachers' concerns about students' ability to solve the problem.

Other studies not showing consistency include Grant (1984) studying secondary mathematics teachers, Kessler (1985) investigating four senior high school mathematics teachers, Brosnan, Edwards, and Erickson (1996) researching four middle school mathematics preservice teachers, and Desforges and Cockburn (1987) studying seven experienced mathematics primary school teachers. Thompson (1985) studied two relatively experienced mathematics teachers in their teaching of problem solving and found a high level of consistency between their beliefs and instructional practice.

Phillip, Flores, Sowder, and Schapelle (1994) reached the same conclusion while studying four “extraordinary” mathematics teachers. Other studies reporting a strong relationship between teachers’ beliefs and practices have been conducted by McGalliard (1983) investigating senior high school mathematics teachers, and Steinberg, Haymore, and Marks (1985) studying novice teachers. Shirk (1973) working with preservice elementary teachers and Stonewater and Oprea (1988) working with inservice teachers also reported similar consistencies.

In general, inconsistencies between teachers’ beliefs and practices are due to constraining forces out of a teachers’ control, such as parental and administrative pressure to follow traditional oriented methods of instruction. Other factors include the traditional oriented mathematical learning style of the students as well as a lack of time and materials. These factors seem to act as major barriers for some teachers in implementing their progressive beliefs, constraints that current approaches in mathematics education do not take into account (Nolder, 1990).

Teachers’ Disciplinary Mathematics Content Knowledge is Related to Their Classroom Instructional Practice

Many studies can be identified that examined the influence of teachers’ disciplinary mathematics content knowledge on their instructional planning and classroom practice. Several of these studies included multiple sub-studies. Nine of the studies focused on elementary school teachers, one on both elementary and middle grades teachers,[2] five on middle grades teachers, and six on high school teachers. One study involved both middle grades and high school teachers. Because more studies were conducted in the elementary grades, the findings are more strongly supported at this level, but a growing number of studies in recent years have examined middle and secondary grades teachers. Many of the studies included observations, audio taping, and videotaping, often of multiple lessons. Interviews of the teachers were also used in a number of the studies to provide additional data and to substantiate the relationships between knowledge and practice the researchers discerned. All but two studies reported a direct link between teacher content knowledge and teaching practice. For example, in a comparison of two mathematics teachers, one study[6] found that the more knowledgeable teacher presented problems in contexts that were familiar to the children in the classroom and linked them to activities they had previously completed. Another study related measures of ten elementary and middle grades teachers' mathematics knowledge for teaching to several aspects of their practice. The researchers reported that teachers with stronger content knowledge were more likely to respond to students' mathematical ideas appropriately, and to make fewer mathematical or language errors during instruction. The majority of studies found that the converse of this relationship also appears to be true; that is, a *lack* of content knowledge seems to limit a teacher's instruction.[7] For example, one study found that when teachers with weak content knowledge departed from their instructional materials, they tended to obscure or distort the mathematics concepts the students were expected to learn because they chose to augment instruction with inappropriate mathematical representations. Of the two studies that did not find a direct link between teacher content knowledge and instructional practice, one found that greater content knowledge strengthened the relationship between positive beliefs about standards-based teaching practices and reported use of these practices, and the other found that teachers' conceptual understanding was not linked to conceptually-oriented teaching strategies. Several limitations were identified in the methodologies of the studies. Although all of the studies had measures of teacher content knowledge, only four included a quantitative measure that could be used readily in replications or extensions of the studies. In many cases, the measurement of teacher content knowledge was not fully described. Several studies used the same form of measurement to examine both teaching content knowledge and teaching practice, possibly leading to a confounding of independent and dependent variables. In two of these studies, each of which focused on only one teacher, the measure used to assess content knowledge might be idiosyncratic to the teacher involved in the study, making it difficult to consider generalizability of the results or replication of the study.

For two of the quantitative studies,[14] the measure of classroom practice was a self-report survey. This approach raises the concern that the measure may be capturing beliefs about teaching, rather than actual teaching practice. Also, the instruments used for measuring classroom practices in many of the studies either had low reliability or were not described in sufficient detail to communicate what was being measured. There were also limitations to the conclusions of many of the studies. For example, most did not account for factors other than teacher content knowledge that may have influenced classroom instruction, although most of the studies recognized other possible influences. As noted above, one study[15] empirically demonstrated an interaction between content knowledge and beliefs about standards-based teaching practices as factors related to teachers' instruction. Because a primary goal of most of these studies was intensive analysis to describe both the teachers' knowledge and practice in order to detail the connections between them, most of the studies of the relationship between teachers' disciplinary content knowledge and their teaching practice were conducted with fewer than five teachers. Combined with the narrow contexts of the studies, these small sample sizes potentially weaken the generalizability of the findings. However, in several cases the extensive and deep data collection techniques suggest that the results may be broadly applicable. For example, a coordinated set of case studies of fifth grade teachers[17] sought subjects who represented a variety of contexts and found that in each case there was evidence that could illustrate the important relationship between teacher content knowledge and instruction. The argument for generalizability of this finding is that similar examples illustrating this relationship were found for each of the different teachers and contexts studied.

Synthesis

The review of literature provided a background that many studies have conducted on teachers' beliefs and teachers' mathematical content knowledge. However, very few studies have related these two variables. Thus, the present study attempted to correlate teachers' mathematical beliefs and mathematical content knowledge.

Chapter III

METHODOLOGY

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

Research Design

The study used the descriptive design utilizing the survey-correlation method. Calmorin (2004) explains that a descriptive research describes the existing phenomenon in a given situation. It includes present facts or current conditions concerning the nature or persons, a number of subjects or class of events, classification or measurement. Descriptive research is characterized as a fact-finding with adequate interpretations. It is used to obtain information concerning the current status of the phenomena to describe "what exists" with respect to variables or conditions in a situation. The descriptive design involves a range of methods from the survey which describes the status of a phenomenon, the correlation study which investigates the relationship between variables, to developmental studies which seek to determine changes over time.

This method was appropriate to use because the present study attempted to describe the mathematical beliefs and mathematical content knowledge of elementary mathematics teachers. It also attempted to describe the relationship between teachers' mathematical beliefs and their mathematical content knowledge.

Participants of the Study

The participants of the study were elementary Mathematics teachers in the Division of Antipolo City. Fifty (50) Mathematics teachers were selected through random sampling from the different elementary schools of the division.

Table 3.1 shows the profile of the teachers in terms of age, sex, educational attainment, years in service and position.

Table 3.1 Demographic Profile of Teachers

Variable	Number of Teachers	Percent (%)
Age		
40 years old and above	11	22
30 – 39 years old	25	50
20 – 29 years old	14	28
Total	**50**	**100**
Gender		
Female	42	84
Male	8	16
Total	**50**	**100**
Educational Attainment		
Master's Degree	11	22
Bachelor's Degree	39	78
Total	**50**	**100**
Years in Service		
11 year and above	12	24
5 – 10 years	20	40
1 – 4 years	18	36
Total	**50**	**100**
Rank		
Teacher 1	41	82
Teacher 2	5	10
Teacher 3	2	4
Master Teacher	2	4
Total	**50**	**100**
Teaching Performance		
Satisfactory	10	20
Very Satisfactory	40	80
Total	**50**	**100**

Research Instrument

The following are the research instruments that were used to gather the data which are needed in this study.

- **Questionnaire for the Demographic Profile of the Teachers** (Appendix A). This instrument was used to determine the demographic profile of the teachers in terms of age, gender, educational attainment, position, years in teaching profession, and teaching performance.

- **Teachers' Beliefs About the Content of Mathematics Scale** (Appendix B). This instrument was used to measure teachers' beliefs about the content of mathematics as to numbers and operations, measurement, patterns and geometry. The instrument consists of four subscales, namely beliefs about the content of mathematics with regard to numbers and operations, beliefs about the content of mathematics with regard to measurement, beliefs about the content of mathematics with regard to patterns and beliefs about the content of mathematics with regard to geometry. Each subscale has five items which are answerable by a 5-point Likert-scale type. The instrument was developed by the researcher using various sources and instrument. It was content validated by five experts of mathematics. It was also tried out to 30 teachers who were not part of the actual participants of the study.

  The teacher gives his/her beliefs by indicating his/her agreement to the items. Agreement to the items in the scale means positive beliefs while disagreement means negative beliefs. The following scale was used.

Scale	Interpretation
5	Strongly agree
4	Agree
3	Moderately agree
2	Disagree
1	Strongly disagree

The mean rating for each item was interpreted using the following scale.

Scale	Interpretation
4.50 – 5.00	Highly positive
3.50 – 4.49	Positive
2.50 – 3.49	Moderately positive
1.50 – 2.49	Negative
1.00 – 1.49	Strongly negative

- **Teachers' Belief About Teaching Practices Scale** (Appendix C). This instrument was used to determine teachers' beliefs about teaching practices as to motivation, time management, lesson planning, and delivery of lesson. The instrument consists of four subscales. Each subscale has five items which are answerable by a 5-point Likert-scale type. The instrument was developed by the researcher using various sources and instrument. It was content validated by five experts of mathematics. It was also tried out to 30 teachers who were not part of the actual participants of the study.

The teacher gives his/her beliefs by indicating his/her agreement to the items. The following scale was used.

Scale	Interpretation
5	Always practiced
4	Frequently practiced
3	Sometimes practiced
2	Rarely practiced
1	Never practiced

The mean rating for each item was interpreted using the following scale.

Scale	Interpretation
4.50 – 5.00	Highly positive
3.50 – 4.49	Positive
2.50 – 3.49	Moderately positive
1.50 – 2.49	Negative
1.00 – 1.49	Strongly negative

- **Teachers' Beliefs About How Knowledge of the Content of Mathematics Affect Their Teaching Practices Scale** (Appendix D). This instrument was used to determine teachers' beliefs about how knowledge of the content of mathematics affect their teaching practices as to motivation, time management, lesson planning, and delivery of lesson. The instrument consists of four subscales. Each subscale has five items which are answerable by a 5-point Likert-scale type. The instrument was developed by the researcher by using various sources and instruments. It was content validated by five experts of mathematics. It was tried out to 30 teachers who were not part of the actual participants of the study.

The teacher gives his/her beliefs by indicating his/her agreement to the items. The following scale was used.

Scale	Interpretation
5	Always affects
4	Frequently affects
3	Sometimes affects
2	Occasionally affects
1	Hardly ever affects

The mean rating for each item was interpreted using the following scale.

Scale	Interpretation
4.50 – 5.00	Highly positive
3.50 – 4.49	Positive
2.50 – 3.49	Moderately positive
1.50 – 2.49	Negative
1.00 – 1.49	Strongly negative

- **Conceptual Knowledge Test** (Appendix E). This instrument was used to measure teachers' conceptual knowledge of mathematical content in the areas of whole numbers, rational numbers, measurement, geometry, and graphs. The test was adapted from Dino (2010). The test consists of 60 multiple-choice items. It has five subtests distributed as follows.

Subtest	Number of Items
Whole numbers	15
Rational numbers	15
Geometry	15
Measurement	10
Graphs	5

The mean scores of the teachers on this test are interpreted as follows.

Mean Score	Verbal Interpretation
48 – 60	Advanced
36 – 49	Proficient
24 – 35	Approaching proficiency
12 – 23	Developing
0 – 11	Beginning

- **Procedural Knowledge Test (**Appendix F). This instrument was used to measure teachers' procedural knowledge of mathematical content in the areas of whole numbers, rational numbers, measurement, geometry, and graphs. The test was adapted from Dino (2010). The test consists of 60 multiple-choice items. It has five subtests distributed as follows.

Subtest	**Number of Items**
Whole numbers	15
Rational numbers	15
Geometry	15
Measurement	10
Graphs	5

The mean scores of the teachers on this test are interpreted as follows.

Mean Score	**Verbal Interpretation**
48 – 60	Advanced
36 – 49	Proficient
24 – 35	Approaching proficiency
12 – 23	Developing
0 – 11	Beginning

Data Gathering Procedure

To gather the data in this study, the following stages were followed.

Phase I. Preparation Phase. In this phase, the instruments that are needed were prepared, developed, and validated. Permit to conduct the study was also sought from the Division of City Schools. A letter of request was sent to the City Schools Division Superintendent of

Antipolo and District Supervisor to administer the questionnaires to the target participants. A similar letter of request was also personally delivered to the principals of the schools included in the study.

Phase II. Administration of the Instrument. After securing an approval to administer the gathering of data instrument, the researcher carried out the administration of the questionnaire checklist among the participants. Efforts were exerted to ensure that all questions were completely answered.

Data Analysis Procedure

To analyze the data gathered from this study, the following statistical tools were used.

- **Frequency and Percentage**. These were used to describe the demographic profile of the teachers.
- **Mean and Standard Deviation**. These were used to describe teachers' beliefs about their content knowledge of mathematics, beliefs about their teaching practices, and beliefs about how their knowledge of the content of mathematics affects their teaching practices. Likewise, to determine the teachers' mathematical content knowledge in terms of conceptual and procedural knowledge, the mean and standard deviation were also used.
- **Pearson Product-Moment Correlation**. This was used to determine if there is a significant relationship between teachers' mathematical beliefs and mathematical content knowledge.

CHAPTER IV

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

The data gathered from different sources are presented, analyzed, and interpreted in this chapter. The sequence of the presentation followed the order research questions presented in the first chapter.

Problem 1. What are the teachers' beliefs about their knowledge of the content of Mathematics on

e. **Numbers and Operations;**
f. **Measurement;**
g. **Patterns; and**
h. **Geometry?**

Table 4.1 shows the teachers' beliefs about their knowledge of the content of mathematics about numbers and operations, measurement, patterns, and geometry. It can be seen from the table that the teachers agree to almost all items in the scale. For numbers and operations, item 5 got the highest mean rating. They believe that identifying relationships between operations, such as division as the inverse of multiplication, to solve problems is essential in teaching Mathematics. They least believe that computational skills are useless, if they can't apply them to solve numbers and operations.

For measurement, they most believe that they can make their students realize the connections between different representations of a mathematical concept. They least believe that learning to measure is mostly memorizing the steps to follow.

Table 4.1 Teachers' Beliefs About Their Knowledge of the Content of Mathematics

With regard to Numbers and Operations, I believe that…	Mean	Standard Deviation	Verbal Interpretation
1. computational skills are useless, if I can't apply them to solve numbers and operations.	4.16	0.82	Agree
2. there are various meanings of addition and subtraction of whole numbers and the relationship between the two operations.	4.30	0.71	Agree
3. there are situations that entail multiplication and division, such as equal groupings of objects and sharing equally.	4.26	0.63	Agree
4. using the inverse relationships of addition and subtraction, multiplication and division, and squaring and finding square roots to simplify computations and solve problems is important.	4.36	0.69	Agree
5. identifying relationships between operations, such as division as the inverse of multiplication, to solve problems is essential in teaching Mathematics,	4.38	0.70	Agree
With regard to Measurement, I believe that …			
1. learning to measure is mostly memorizing the steps to follow.	3.62	1.00	Agree
2. concepts can be performed using various instruments.	4.26	0.72	Agree
3. I can make my students realize the connections between different representations of a mathematical concept.	4.28	0.74	Agree
4. objects or events have a variety of attributes that can be measured.	4.10	0.78	Agree
5. measurement sense involves an understanding of appropriate measurement units in various situations.	4.40	0.78	Agree
With regard to Patterns, I believe that ...			
1. there are patterns that just can't be discussed by following a predetermined sequence of steps.	4.20	0.73	Agree
2. memorizing steps is not that useful in discovering patterns.	4.02	0.62	Agree
3. any patterns can be discovered if I know the right steps to follow.	4.48	0.68	Agree
4. the mathematics curriculum should help the students to concretize the patterns they meet every day .	4.50	0.58	Strongly agree
5. pattern is a part of my daily routine.	4.40	0.67	Agree
With regard to Geometry, I believe that…			
1. studying geometry provides many foundational skills, and helps to develop the thinking skills in logic, reasoning, and problem solving.	4.42	0.76	Agree
2. I can explore spatial figures.	4.26	0.75	Agree
3. Geometry has its application in art, architecture, engineering, robotics, land surveys, astronomy, sculptures, space, nature, sports, machines, cars and much more.	4.56	0.67	Strongly agree
4. when taking geometry, I may be able to appreciate the different designs in buildings and bridge, etc.	4.44	0.76	Agree
5. Geometry concretizes most natural concepts.	4.34	0.75	Agree

For patterns, they strongly believe that the mathematics curriculum should help the students to concretize the patterns they meet every day. They least believe that memorizing steps is not that useful in discovering patterns. For geometry, they strongly believe that Geometry has its application in art, architecture, engineering, robotics, land surveys, astronomy, sculptures, space, nature, sports, machines, cars and much more. They least believe that they can explore spatial figures.

Table 4.2 shows the summary of teachers' beliefs about their knowledge of the content of mathematics. It can be viewed from the table that teachers have positive beliefs about their knowledge of the content of mathematics.

Table 4.2. Summary of Teachers' Beliefs About Their Knowledge of the Content of Mathematics

Areas	Mean	Standard Deviation	Verbal Interpretation
Numbers and Operations	4.29	0.58	Positive
Measurement	4.13	0.62	Positive
Patterns	4.32	0.51	Positive
Geometry	4.40	0.66	Positive
Overall	**4.29**	**0.53**	**Positive**

Problem 2. What are the teachers' beliefs about their teaching practices in terms of

e. **Motivation;**
f. **Time management;**
g. **Lesson planning; and**
h. **Delivery of lesson?**

Table 4.3 shows the teachers' beliefs about their teaching practices. Practices that are frequently practiced like motivation, time management, lesson planning and delivery of the lesson are considered positive beliefs and those never practiced are considered negative beliefs. It can be viewed from the table that almost all items in the scale are frequently practiced by the teachers. With regard to motivation, they strongly believe that they always call the attention of inattentive in students' knowledge and give equal attention on the less interested students. They least believe that they can frequently provide an activity that leads students to discovering a pattern and then owning an idea. As regards time management, they strongly believe that they frequently **assign homework to extend practice time but they least believe that they** can determine how long and how often a particular lesson is taught and that they can deal with behaviour problems tactfully.

Table 4.3. Teachers' Beliefs About Their Teaching Practices

With regard to Motivation, I believe that . . .	Mean	Standard Deviation	Verbal Interpretation
1. I give equal attention on the less interested students.	4.52	0.58	Always practiced
2. I call the attention of inattentive in students' knowledge.	4.54	0.58	Always practiced
3. I provide an activity that leads students to discovering a pattern and then owning an idea.	4.20	0.73	Frequently practiced
4. I introduce a practical application of genuine interest to the class at the beginning of a lesson.	4.28	0.81	Frequently practiced
5. I use recreational motivation consisting of puzzles, games, paradoxes, or facilities.	4.22	0.68	Frequently practiced
With regards to Time Management, I believe . . .			
1. I can determine how long and how often a particular lesson is taught.	4.20	0.70	Frequently practiced
2. I deal with behaviour problems tactfully.	4.20	0.70	Frequently practiced
3. I establish routines that maximize class activities.	4.24	0.69	Frequently practiced
4. I plan for smooth transitions between lessons.	4.26	0.72	Frequently practiced
5. I assign homework to extend practice time.	4.48	0.54	Frequently practiced
With regard to Lesson Planning, I believe y that . . .			
1. I plan my lessons in accordance with the PELC.	4.60	0.53	Always practiced
2. I communicate objectives to students at the beginning of class so that purpose of the lesson is clear.	4.30	0.61	Frequently practiced
3. I reflect on students' goals and assess their needs.	4.20	0.78	Frequently practiced
4. I plan and adjust for what will be taught in the next meetings.	4.32	0.62	Frequently practiced
5. I base my lessons on a framework to be clear and purposive.	4.26	0.75	Frequently practiced
With regard to Delivery of Lesson, I believe that . . .			
1. I provide opportunities for learners to actively monitor their own progress.	4.24	0.62	Frequently practiced
2. I allow my students to share their ideas during discussion.	4.44	0.54	Frequently practiced
3. I ask my students to summarize the lesson presented.	4.12	0.63	Frequently practiced
4. I ask my students to cite a real-life application of the lesson.	4.22	0.62	Frequently practiced
5. I employ a strategy that provides learning feedback to both students and teacher.	4.16	0.71	Frequently practiced

Moreover, as regards lesson planning, they strongly believe that they always plan their lessons in accordance with the PELC but they least believe that they reflect on students' goals and assess their needs. As regards delivery of the lesson, the teachers strongly believe that they frequently allow their students to share their ideas during discussion but they least believe that they frequently ask their students to summarize the lesson presented.

Table 4.4 summarizes the teachers' beliefs about their teaching practices. It can be seen from the table that teachers have positive beliefs about their teaching practices in terms of motivation, time management, lesson planning, and delivery of the lesson.

Table 4.4. Summary of Teachers' Beliefs About Their Teaching Practices

Areas	Mean	Standard Deviation	Verbal Interpretation
Motivation	4.35	0.58	Positive
Time management	4.27	0.61	Positive
Lesson Planning	4.34	0.56	Positive
Delivery of the Lesson	4.22	0.57	Positive
Overall	**4.25**	**0.54**	**Positive**

Teachers' beliefs have been recognised as crucial determinants of what teachers do in their classrooms and hence a major area of research concerning teachers' beliefs has focussed on changing teachers' beliefs and practices (Wilson & Cooney, 2002) which is, of course, the objective of professional learning programs.

Problem 3. What are the teachers' beliefs about the effect of their knowledge on their teaching practices as to

e. **Motivation;**
f. **Time management;**
g. **Lesson planning; and**
h. **Delivery of lesson?**

Table 4.5 shows the teachers' beliefs about how their knowledge of the content of Mathematics affects their teaching practices. It is evident from the table that as regards motivation, they strongly believe that their knowledge of the content of mathematics frequently affects their preparing of learning environment conducive to learning but they least believe that it frequently affects their using real-life situations to begin a lesson. As regards time management, they strongly believe that their knowledge of the content of mathematics frequently affects their planning for smooth transitions between lessons but they least believe that it frequently affects their deciding on how long and how often to teach various lessons and addressing behaviour-related problems.

The researcher anyhow thinks that for a more meaningful and more positive result, there must be a balance between both beliefs and using this into real life situations. Furthermore, a more desirable result in teaching learning situation gives fulfilment on the part of the teacher and an inspiration on the part of the learners.

Table 4.5. Teachers' Beliefs About How Their Knowledge of the Content of Mathematics Affects Their Teaching Practices

With regard to Motivation, my knowledge affects my...	Mean	Standard Deviation	Verbal Interpretation
1. addressing the individual needs of all types of learners.	4.16	0.68	Frequently affects
2. calling attention to a void in students' knowledge.	4.24	0.69	Frequently affects
3. preparing of learning environment conducive to learning.	4.24	0.69	Frequently affects
4. using real-life situations to begin a lesson.	4.12	0.72	Frequently affects
5. using puzzles, games, stories to elicit participation of students in the teaching-learning activities.	4.18	0.77	Frequently affects
With regard to Time Management, my knowledge affects my..			
1. deciding on how long and how often to teach various lessons.	4.06	0.71	Frequently affects
2. addressing behaviour-related problems.	4.06	0.77	Frequently affects
3. reducing, if not eliminating, of wasted time.	4.16	0.77	Frequently affects
4. planning for smooth transitions between lessons.	4.26	0.75	Frequently affects
5. assigning homework to recapture the salient points of the lesson of the day.	**4.20**	**0.76**	Frequently affects
With regard to Lesson Planning, my knowledge affects my . . .			
1. determining what will be taught (both content and skills).	4.30	0.68	Frequently affects
2. communicating objectives to students at the beginning of class so purpose of the lesson is clear.	4.24	0.74	Frequently affects
3. reflecting students' goals and assess needs.	4.08	0.85	Frequently affects
4. deciding what to teach in following lessons, and how to provide feedback to learners.	4.26	0.69	Frequently affects
5. utilizing a framework as a guide for planning.	4.22	0.76	Frequently affects
With regard to Delivery of Lesson, my knowledge affects my..			
1. providing opportunities for learners to actively monitor their own			

	progress.	4.20	0.78	Frequently affects
2.	encouraging active participation among the learners during the lesson.	4.38	0.78	Frequently affects
3.	encouraging learners to apply what they learned to real-life situations.	4.28	0.81	Frequently affects
4.	managing "teacher talk" time to a maximum of 15% so learners are active participants throughout the remaining 75% of the learning process.	4.16	0.79	Frequently affects
5.	providing a variety of materials and methods to engage learners actively.	4.16	0.82	Frequently affects

As regards delivery of the lesson, the teachers strongly believe that their knowledge of the content of mathematics frequently affects their encouraging active participation among the learners during the lesson but they least believe that it frequently affects their managing "teacher talk" time to a maximum of 15% so learners are active participants throughout the remaining 75% of the learning process and providing a variety of materials and methods to engage learners actively.

Table 4.6 shows the summary of teachers' beliefs about how their knowledge of the content of mathematics affects their teaching practices. It is evident from the table that the teachers have positive beliefs about how their knowledge of the content of mathematics affect their teaching practices in terms of motivation, time management, lesson planning, and delivery of the lesson.

Table 4.6. Summary of Teachers' Beliefs About How Their Knowledge of the Content of Mathematics Affects Their Teaching Practices

Areas	Mean	Standard Deviation	Verbal Interpretation
Motivation	4.19	0.65	Positive
Time management	4.14	0.70	Positive
Lesson Planning	4.22	0.70	Positive
Delivery of the Lesson	4.24	0.75	Positive
Overall	**4.20**	**0.66**	**Positive**

In an attempt to clarify the meaning of belief, Speer (2005) expresses the need to distinguish between belief and knowledge and explains that knowledge is based on objective fact, while beliefs are based on evaluation and judgment. Supplementary to this is Scott (2005) who argues that most of a teacher's professional knowledge can be regarded as belief, claiming that knowledge is considered a belief that has been affirmed as true on the basis of objective proof or consensus of opinion.

Problem 4. What is the level of teachers' conceptual and procedural knowledge of mathematics in terms of the following?

- **a. Whole Numbers**
- **b. Rational Numbers**
- **c. Geometry**
- **d. Measurement**
- **e. Graphs**

Table 4.7 shows the teachers' level of mathematical content knowledge in terms of conceptual and procedural knowledge. It can be seen from the table that as regards conceptual knowledge, the teachers are ***proficient*** on whole numbers, rational numbers, and measurement. However, the level of their conceptual knowledge in Geometry and graphs is only ***basic***. This implies that these topics have not been mastered thoroughly by the teachers and these topics are found difficult by them.

On the other hand, the level of teaches' procedural knowledge in all areas is ***beginning*** only. This means that teachers' procedural knowledge of mathematics is low. This is a surprising result considering that the content of the Procedural Knowledge Test are the topics being taught in the elementary school mathematics.

Table 4.7 Teachers' Level of Mathematical Content Knowledge

Content	Conceptual			Procedural		
	Mean	Standard Deviation	Verbal Interpretation	Mean	Standard Deviation	Verbal Interpretation
Whole Numbers	10.64	2.95	Proficient	6.98	3.85	Beginning
Rational Numbers	8.60	3.97	Proficient	7.48	4.82	Beginning
Geometry	6.18	3.96	Basic	4.80	3.41	Beginning
Measurement	5.44	2.72	Proficient	3.92	2.49	Beginning
Graphs	1.10	0.84	Basic	2.04	1.96	Beginning
Overall	**31.96**	**12.34**	**Proficient**	**25.22**	**13.78**	**Beginning**

Problem 5. Is there a significant relationship between teachers' conceptual and procedural knowledge and their

a. **beliefs about their knowledge of the content of mathematics;**
b. **beliefs about their teaching practices; and**
c. **beliefs about how knowledge affect teaching practices?**

Table 4.8 shows the correlation between teachers' conceptual and procedural knowledge and their beliefs about their knowledge of the content of mathematics, beliefs about their teaching practices, and beliefs about how knowledge affects teaching practices. It can be seen from the table that there is no relationship between teachers' conceptual and procedural knowledge and their beliefs. This implies that teachers' beliefs are not significantly related to teachers' conceptual and procedural knowledge.

Stuart and Thurlow (2000) found out that teachers' beliefs do not correlate positively to their mathematical content knowledge. While teachers have positive beliefs about mathematics, this is not a guarantee that they have high level of mathematical content knowledge. Likewise, teachers with negative beliefs about mathematics do not mean that they have low level of mathematical content knowledge.

Table 4. Correlation Between Teachers' Beliefs and Conceptual and Procedural Knowledge

Variable	Conceptual Knowledge		Procedural Knowledge	
	Correlation coefficient	**p-value**	**Correlation coefficient**	**p-value**
• Beliefs About Their Knowledge of the Content of Mathematics	0.222	0.121	0.158	0.274
• Beliefs About Their Teaching Practices	0.027	0.855	0.018	0.899
• Beliefs About How Mathematical Content Knowledge Affects Teaching Practices	0.098	0.498	0.033	0.818

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

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

Summary

This study attempted to describe the mathematical beliefs and mathematical content knowledge of elementary mathematics teachers. It also tried to determine if there is a significant relationship between teachers' mathematical beliefs and mathematical content knowledge.

Teachers' beliefs included beliefs about the content of the knowledge of mathematics, beliefs about their teaching practices, and beliefs about the effect of their knowledge of the content of mathematics on their teaching practices. Teachers' beliefs about the content of mathematics were described as to numbers and operations, measurements, patterns, and Geometry. Teachers' beliefs about their teaching practices were described as to motivation, time management, lesson planning, and delivery of lesson. Teachers' mathematical content knowledge involved both conceptual and procedural knowledge on whole numbers, rational numbers, measurement, geometry, and graphs.

To gather the need data, the following research instruments were used: Teachers' Beliefs About Their Knowledge of the Content of Mathematics Scale, Teachers' Beliefs About Their Teaching Practices Scale, Teachers' Beliefs About How Mathematical Content

Knowledge Affects Teaching Practices Scale, Conceptual Knowledge Test, and Procedural Knowledge Test. The study employed the descriptive research design with fifty elementary mathematics teachers of District II-B in the Division of Antipolo City as the participants of the study. The data were analyzed using the frequency, percentage, mean, standard deviation, and Pearson-Product Moment Correlation.

Findings

The following are the findings of the study.

1. Teachers have positive beliefs about knowledge of the content of mathematics.
2. Teachers have positive beliefs about their teaching practices.
3. Teachers have positive beliefs about how knowledge of the content of mathematics affects their teaching practices.
4. The level mathematical content knowledge (conceptual knowledge) of teachers is ***proficient***.
5. The level mathematical content knowledge (procedural knowledge) of teachers is ***beginning.***
6. There is no significant relationship between teachers' mathematical beliefs and mathematical content knowledge.

Conclusions

Based on the findings of this study, the following conclusions are made. While

1. Elementary mathematics teachers have generally positive mathematical beliefs. Their procedural knowledge of mathematics are low. This means that a positive mathematical beliefs does not imply high procedural knowledge in mathematics.
2. Elementary mathematics teachers are strong in conceptual knowledge of mathematics but weak in the procedural knowledge of mathematics.
3. Teachers' beliefs are not significant factors that affect their conceptual and procedural knowledge in mathematics. This implies that even if teachers have positive mathematical beliefs, this is not a guarantee that they will also be proficient in mathematical knowledge.

Recommendations

Based on the findings and conclusions of the study, the following are hereby recommended.

1. A similar study should be conducted to verify the finding that teachers' beliefs are not significantly related to mathematical content knowledge using a different sample and different instruments that would measure mathematical beliefs and mathematical content knowledge.
2. The scales developed in this study that measures teachers' mathematical beliefs should be revalidated using more sophisticated procedures like factor analysis.

3. More instruments that measures teachers' mathematical beliefs should be developed to explore other dimensions of this construct.

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APPENDIX A

Questionnaire for Teachers' Demographic Profile

General Directions: Please accomplish this questionnaire very carefully and honestly. Rest assured that the information will be treated with utmost confidentiality and anonymity.

Name(Optional):____

I. Profile of Respondents:

1. Age: ( ) 40 years old and above
   ( ) 30 years old to 39 years old
   ( ) 20 years old to 29 years old

2. Sex: ( ) Male ( ) Female

3. Educational Attainment:
   ( ) Doctorate Degree
   ( ) Master's Degree
   ( ) Bachelor's Degree

4. Years in Service
   ( ) 11 years and above
   ( ) 5 years – 10 years
   ( ) 1 year to 4 years

5. Position
   ( ) Master Teacher
   ( ) Teacher III
   ( ) Teacher II
   ( ) Teacher I

7. Teaching Performance CB-PAST(for the past three consecutive years) _______
   _______ ______

APPENDIX B

Teachers' Beliefs About the Content of Mathematics Scale

Directions: Please check the number that you think corresponds to your belief on the Content of mathematics below.

5- Strongly Agree **4**- Agree **3**- Moderately Agree **2**- Disagree **1**-Strongly Disagree

With regard to **Numbers and Operations, I believe that…**	5	4	3	2	1
1. computational skills are useless, if I can't apply them to solve numbers and operations.					
2. there are various meanings of addition and subtraction of whole numbers and the relationship between the two operations.					
3. there are situations that entail multiplication and division, such as equal groupings of objects and sharing equally.					
4. using the inverse relationships of addition and subtraction, multiplication and division, and squaring and finding square roots to simplify computations and solve problems is important.					
5. identifying relationships between operations, such as division as the inverse of multiplication, to solve problems is essential in teaching Mathematics,					
With regard to **Measurement, I believe that …**					
1. learning to measure is mostly memorizing the steps to follow.					
2. concepts can be performed using various instruments.					
3. I can make my students realize the connections between different representations of a mathematical concept.					
4. objects or events have a variety of attributes that can be measured.					
5. measurement sense involves an understanding of appropriate measurement units in various situations.					

With regard to **Patterns, I believe that ...**					
1. there are patterns that just can't be discussed by following a predetermined sequence of steps.					
2. memorizing steps is not that useful in discovering patterns.					
3. any patterns can be discovered if I know the right steps to follow.					
4. the mathematics curriculum should help the students to concretize the patterns they meet every day .					
5. pattern is a part of my daily routine.					
With regard to **Geometry, I believe that…**					
1. studying geometry provides many foundational skills, and helps to develop the thinking skills in logic, reasoning, and problem solving.					
2. I can explore spatial figures.					
3. Geometry has its application in art, architecture, engineering, robotics, land surveys, astronomy, sculptures, space, nature, sports, machines, cars and much more.					
4. when taking geometry, I may be able to appreciate the different designs in buildings and bridge, etc.					
5. Geometry concretize most natural concepts.					

APPENDIX C

Teachers' Belief About Their Teaching Practices Scale

Directions: Put a check on your level of teaching practices in mathematics.

5- Always practiced
4- Frequently practiced
3- Sometimes practiced
2- Rarely practiced
1- Never practiced

With regard to **Motivation**,	5	4	3	2	1
1. I give equal attention on the less interested students.					
2. I call the attention of inattentive in students' knowledge.					
3. I provide an activity that leads students to discovering a pattern and then owning an idea.					
4. I introduce a practical application of genuine interest to the class at the beginning of a lesson.					
5. I use recreational motivation consisting of puzzles, games, paradoxes or facilities.					
With regards to **Time Management**,					
1. I can determine how long and how often a particular lesson is taught.					
2. I deal with behaviour problems tactfully.					
3. I establish routines that maximize class activities.					
4. I plan for smooth transitions between lessons.					
5. **I assign homework to extend practice time.**					
With regard to **Lesson Planning**,					
1. I plan my lessons in accordance with the PELC.					
2. I communicate objectives to students at the beginning of class so purpose of the lesson is clear.					

3. I reflect students' goals and assess needs.					
4. I plan and adjust for what will be taught in next meetings.					
5. I base my lessons on a framework to be clear and purposive.					
With regard to **Delivery of Lesson**,					
1. I provide opportunities for learners to actively monitor their own progress.					
2. I allow my students to share their ideas during discussion.					
3. I ask my students to summarize the lesson presented.					
4. I ask my students to cite a real-life application of the lesson.					
5. I employ a strategy that provides learning feedback to both students and teacher.					

APPENDIX D

Teachers' Beliefs About How Knowledge of the Content of Mathematics Affect Their Teaching Practices Scale

Directions: Put a check on how knowledge affects your level teaching practices.

5-Always affects
4- Frequently affects
3- Sometimes affects
2- Occasionally affects
1- Hardly ever affects

With regard to **Motivation,** **My knowledge affects my...**	5	4	3	2	1
1. addressing the individual needs of all types of learners.					
2. calling attention to a void in students' knowledge.					
3. preparing of learning environment conducive to learning.					
4. using real-life situations to begin a lesson.					
5. using puzzles, games, stories to elicit participation of students in the teaching-learning activities.					
With regard to **Time Management,** **My knowledge affects my..**					
1. deciding on how long and how often to teach various lessons.					
2. addressing behaviour-related problems.					
3. reducing, if not eliminating, of wasted time.					
4. planning for smooth transitions between lessons.					
5. assigning homework to recapture the salient points of the lesson of the day.					
With regard to **Lesson Planning,** **My knowledge affects my . . .**					

1. determining what will be taught (both content and skills).					
2. communicating objectives to students at the beginning of class so purpose of the lesson is clear.					
3. reflecting students' goals and assess needs.					
4. deciding what to teach in following lessons, and how to provide feedback to learners.					
5. utilizing a framework as a guide for planning.					
With regard **to Delivery of Lesson,** **My knowledge affects my..**					
1. providing opportunities for learners to actively monitor their own progress.					
2. encouraging active participation among the learners during the lesson.					
3. encouraging learners to apply what they learned to real-life situations.					
4. managing "teacher talk" time to a maximum of 15% so learners are active participants throughout the remaining 75% of the learning process.					
5. providing a variety of materials and methods to engage learners actively.					

APPENDIX E

Conceptual Knowledge Test

Multiple Choice Tests

Directions: Each of the items is followed by four suggested answers. Choose the answer you think is correct then encircle the letter of the correct answer.

I. WHOLE NUMBERS

1. What is the function of the zero (0) digit in Hindu-Arabic Numeration System?
   A. Place holder
   B. Place value
   C. Highest digit
   D. Lowest digit

2. In 17,526,010 what is the place value of the digit 5?
   A. thousands
   B. hundred thousands
   C. hundreds
   D. Millions

3. Which is NOT true about the number 734 568 418?
   A. The number has 9 significant digits
   B. Each period has nine digits
   C. Each group has hundreds, tens and ones
   D. The number has three periods

4. Which of the following operations are both commutative and associative?
   A. Addition and subtraction
   B. Subtraction and multiplication
   C. Multiplication and division
   D. Addition and multiplication

5. Which property of whole numbers states that the product of the three numbers is unchanged no matter how we group the numbers?
   A. Associative Property of Addition
   B. Commutative Property of Addition
   C. Associative Property of Multiplication
   D. Commutative Property of Multiplication

6. Which of the following operations are neither associative nor commutative?
   I. Addition

II. Division
III. Subtraction
IV. Multiplication
A. I and II
B. II and IV
C. II and III
D. III and IV

7. Which of the following statements is NOT true?
A. Rounding 119 to the nearest tens gives 120
B. Rounding 150 090 to the nearest hundred thousands gives 160 000
C. Rounding 1234 to the neares thousands gives 1000
D. Rounding 23 452 to the nearest ten thousands gives 20 000

8. Which is the rounding digit when 87 931 426 is rounded to the nearest millions?
A. 8
B. 7
C. 9
D. 3

9. Which is NOT true if 28 756 is rounded to the nearest thousands?
A. Add one (1) to eight (8) then put zero to the remaining place before eight (8)
B. When we round 28 756 to the nearest thousands, it is 29 000 because it is closer to it.
C. When we round 28 756 to the nearest thousands, it is 28 000 because it is closer to it.
D. The rounding digit is 8 which is the thousands place

10. When raising to power, multiplication, and addition are performed in the same expression, which one will you follow to find the value of the expression?
I. Addition
II. Raising power
III. Multiplication
A. I-II-III
B. II-1-I
C. II-I-III
D. III-II-I

11. What is the inverse operation of multiplication?
A. Addition
B. Subtraction
C. Either A or B
D. Division

12. Which of the following is NOT true about integers?
    A. All negative integers are less than zero (0)
    B. All negative integers are greater than zero (0)
    C. Of all negative integer (-1) is the biggest
    D. Of all positive integer (+1) is the smallest

13. Which of the following describes a prime number?
    A. 2k + 2
    B. 2k + 1
    C. 2k
    D. 2k - 2

14. Which of the following describes a prime number?
    A. Any number greater than 2 which is a multiple of 2
    B. Any number greater than three which is a multiple of 3
    C. Any number which is a multiple of 5
    D. Any number greater than one whose only factors are 1 and itself

15. Which best describes the" prime factorization" of a number?
    A. Expressing numbers as the sum of its prime factors
    B. Expressing numbers as product of its prime factors
    C. Finding which prime numbers you need to multiply together to get the original number
    D. Finding composite numbers you need to multiply together to get the original number

II. RATIONAL NUMBERS

1. Which of the following is/are NOT true?
   I. $\frac{1}{4}$ is greater than $\frac{1}{6}$
   II. $\frac{1}{6}$ is greater than $\frac{3}{4}$
   III. $\frac{1}{4}$ is greater than $\frac{1}{2}$
   A. I only
   B. I and II
   C. II and III
   D. I and III

2. Which fractions are arranged in descending order?

   A. $\frac{1}{2}, \frac{1}{3}, \frac{2}{8}, \frac{1}{5}, \frac{3}{18}$

   B. $\frac{3}{18}, \frac{2}{8}, \frac{1}{5}, \frac{1}{3}, \frac{1}{2}$

C. $\frac{1}{2}, \frac{2}{8}, \frac{3}{18}, \frac{1}{5}, \frac{1}{3}$

D. $\frac{3}{8}, \frac{2}{8}, \frac{1}{5}, \frac{1}{3}, \frac{1}{2}$

3. Which is NOT a rational number?
   A. $\frac{1}{2}$
   B. $\sqrt{2}$
   C. -3
   D. 0

4. Which of the following problems can be solved by using the process of addition alone?
   A. Nene walks ¾ km to Jolly's house , then ½ km to the store and finally 5/6 km to her house. How many kilometres did she walk altogether?
   B. Mr Cruz ate ¼ of a whole cake, what part of the whole cake was left?
   C. A group of youth volunteers cleaned a vacant lot in our community. After cleaning, the group gathered 10 ½ kg of plastic, 5 ¼ of copper, and the rest were other recyclable materials. If their total collection was 30 5/6 kg, how much of the other recyclable materials did they gather?

      A. A only
      B. B only
      C. Both A and B
      D. Both a and C

5. Which is TRUE about dividing fractions?
   A. Multiply the dividend by the divisor
   B. Multiply the divisor by the dividend
   C. Multiply the divisor by the reciprocal of the dividend
   D. Multiply the dividend by the reciprocal of the divisor

6. In which operations will you retain denominator of similar fractions?
   A. Addition & Multiplication
   B. Subtraction & Multiplication
   C. Multiplication & Division
   D. Subtraction & Division

7. Which is TRUE about the position of the decimal point in the product of two decimal numbers?
   A. It is the sum of decimal places in the factors
   B. It is the difference of decimal places in the factors
   C. It is the product of decimal places in the factors

D. It is the quotient of decimal places in the factors.

8. What is the correct ascending order of decimal numbers?
   A. 6.30000, 0.06300, 0.00633, 0.00630, 63 630
   B. 0.00633, 0.00630, 63 630, 6.30000, .06300
   C. 0.00630, 0.00633, 0.06300, 6.30000, 63 630
   D. 63 630, 6.30000, 0.06300, 0.00633, 0.00630

9. What kind of decimal is obtained if the result of continuously dividing the numerator by the denominator of a fraction gives the same remainder?
   A. Terminating decimals
   B. Mixed repeating decimals
   C. Non-terminating decimals
   D. Non-terminating / Non-repeating decimals

10. Which of the following equations is NOT equivalent to B=BR?
    A. B= $\frac{P}{R}$
    B. B = $\frac{R}{B}$
    C. R = $\frac{P}{B}$
    D. RB

11. How are decimal numbers changed to percent?
    A. Drop the percent symbol and move the decimal point two places to the right
    B. Replace the percent symbol by the denominator 100 and then change the fraction to simplest form
    C. Get the equivalent fraction whose denominators is 100 and then write the fraction as a percent
    D. Multiply, the decimal by 100 which can simply de done by moving the decimal point two places to the right and write the percent symbol.

12. How are percent changed to fraction?
    A. Drop the percent symbol and move the decimal point two places to the right.
    B. Replace the percent symbol by the denominator 100 and then change the fraction to simplest form
    C. Get the equivalent fraction whose denominator is 100 and then write the fraction as a percent.
    D. Simply move the decimal point two places to the right.

13. Which best describes a proportion?
    A. A comparison between two quantities
    B. An equation stating that two ratios are equivalent
    C. An equation stating that two ratios are unequal

D. A comparison of four quantities

14. Which best describes a ratio?
    A. comparison of two quantities
    B. a comparison of two to the same unit by quantities that belong to the same unit by division
    C. the relationship of two variables
    D. the comparison of two quantities with different units

15. How do ratios and rates differ?
    A. Ratios and rates compare two quantities
    B. Ratios compare two quantities while rates compare more than two quantities
    C. Ratios compare things belonging to the same unit, while rates compare different units
    D. They do not differ from each other.

III. GEOMETRY

1. Which is TRUE about vertical angles?
    A. They are congruent
    B. Each angle is a complement of each other
    C. They are adjacent angles.
    D. Their sum is 180^0

2. What kinds of angles are formed if they have a common vertex and a common side with no common interior point?
    A. Linear pair
    B. Vertical angles
    C. Adjacent angle
    D. Complementary angles

3. What is the other angle if one angle of a linear pair is obtuse?
    A. Right angle
    B. Reflex angle
    C. Acute angle
    D. Obtuse angle

4. Which of the following statements is NOT true?
    A. All squares are rectangle
    B. Every parallelogram is a rhombus
    C. Some rhombuses are rectangles
    D. Not every rectangle is a rhombus

5. Which are TRUE statements?

I. All squares are similar
II. All rectangles are similar
III. All squares are congruent
IV. All rectangles are congruent

A. I only
B. II & III
C. III & IV
D. I, II & III

6. Which is NOT true about parallelograms?
   A. Consecutive angles are complementary
   B. Opposite sides are parallel
   C. Diagonal sides are parallel
   D. A diagonal divides a parallelogram into two congruent triangles

7. Which is NOT correctly paired in finding the area of the following polygons?
   A. Square – s^2
   B. Triangle - $\frac{(b1+b2)h}{2}$
   C. Rectangle – l x w
   D. Parallelogram-bh

8. What is measured by area of the figure?
   A. Distance around the figure
   B. Breadth of the figure
   C. The size of the region enclosed by the figure
   D. The sum of the edges of the figure

9. Which statement is correct?
   A. The area of a triangle is equal to one-half the product of the length of a base and its height
   B. The area of a square is one-half the products of lengths of the diagonals
   C. The area of a rhombus equals one-half the product of the lengths of its diagonals
   D. The area of a trapezoid equals the product of the length of a base and its height.

10. What will you do to determine the length of barbed wire needed to fence a rectangular open space?
   A. Find its perimeter
   B. Find its area
   C. Find its circumference
   D. Find its volume

11. What is perimeter?

A. Half of the total measure of the sides of a polygon
B. The product of the opposite sides of a polygon
C. The product of the length, width and height
D. The total measure of the sides of the polygon

12. Which parts of circle are needed to find its circumference?
    A. Chord and diameter
    B. Diameter and centre
    C. Chord and arc
    D. Diameter or radius

13. Which of the following is the ratio of circumference of a circle to the diameter?
    A. Radius
    B. Pi (π)
    C. Arc
    D. chord

14. Which is NOT correctly paired in finding the volume of a solid?
    A. Cube – s^3
    B. Pyramid – $\frac{1}{3}$Bh
    C. Sphere – $\frac{1}{3}\pi$ r^2
    D. Rectangular prism - lwh

15. Which is NOT true about volume?
    A. Volume is the three-dimensional figure occupied by an object
    B. Volume is the two-dimensional figure that is occupied by the object
    C. Volume has a dimensions of length cubed
    D. Volume can be measured by getting the area of the base and multiplying the area by the height

IV. MEASUREMENTS

1. What are the basic units of measure in the metric system?
   A. meter, gram, litre
   B. hectare, meter, gram
   C. kilometre, meter, litre
   D. litre, gram, centi

2. Which of the following is NOT a linear measure?
   A. miles
   B. furlong
   C. barrel
   D. feet

3. In measurement, which has only one dimension?
   A. Volume
   B. Area
   C. Surface area
   D. Length

4. Which unit is not used to measure the length?
   A. Decimetre
   B. milliliter
   C. Millimeter
   D. kilogram

5. What unit would best measure the weight (mass) of an egg?
   A. Metric tons
   B. Grams
   C. Milligrams
   D. kilograms

6. Which unit is not used to measure the weight of an object?
   A. grams
   B. pounds
   C. meters
   D. kilograms

7. Which of the following is the smallest unit of time?
   A. minutes
   B. microsecond
   C. seconds
   D. nanosecond

8. Which time equivalent is correct?
   A. 1 year = 365 days
   B. 12 months = 365 days
   C. 1 century = 10 years
   D. 1 decade = 10 years

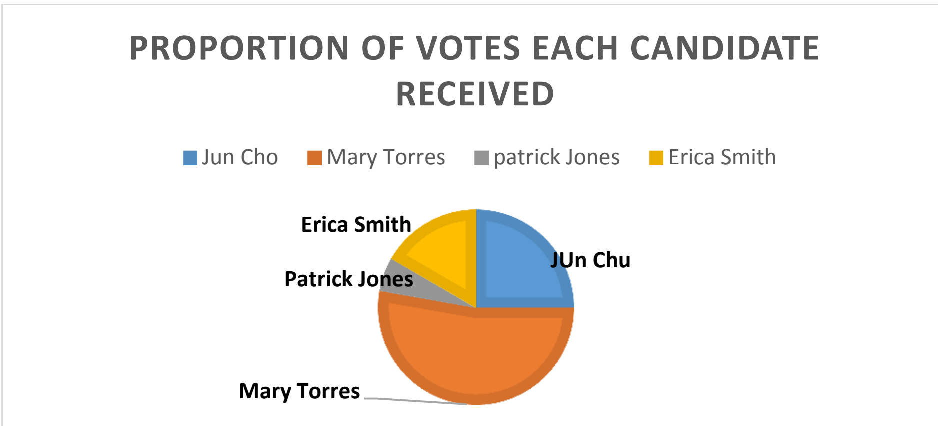
9. Which of these would you most likely use to measure the volume of a glass of orange juice?
   A. litre
   B. ounces
   C. gallons
   D. pint

10. Which of the following is the biggest unit of liquid measure?
    A. cup

B. quart
C. pint
D. ounce

V. GRAPHS

1. A town had an election for mayor. There were for candidates: Jun Cho, May Torres, Patrick Jones and Elisa Smith. The circle graph below shows the votes each candidate received.



The circle graph most likely represents which of the following tables?

A. Number of Votes each Candidate Received

Name	Number of Votes
Jun Cho	1 215
Mary Torres	4 039
Patrick Jones	1 187
Erica Smith	1 204

B. Number of Votes each Candidate Received

Name	Number of Votes
Jun Cho	1 911
Mary Torres	4 035
Patrick Jones	425
Erica Smith	1 274

C. Number of Votes each Candidate Received

Name	Number of Votes
Jun Cho	1 269
Mary Torres	2 995
Patrick Jones	434

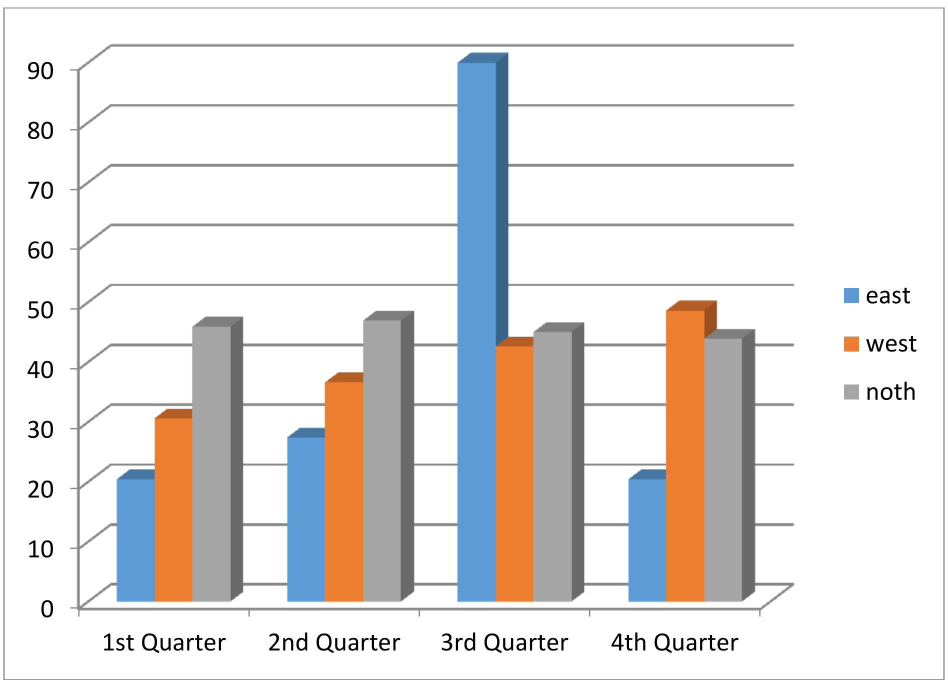
Erica Smith	1 947

D. Number of Votes each Candidate Received

Name	Number of Votes
Jun Cho	2 013
Mary Torres	3 822
Patrick Jones	430
Erica Smith	1 380

2. Look at the bar graph below. Which of the following is consistently increasing at the range value of six from the 1st to 4th quarter?

   A. East
   B. West
   C. North
   D. None of them



APPENDIX F

Procedural Knowledge Test

Directions: Each of the items is followed by four suggested answers. Choose the answer you think is the correct then encircle the letter of the correct answer.

I. WHOLE NUMBERS

1. What is the smallest number that can be performed using each of these digits once 0,1,2,3,4,6,7,8,9?

   A. 123 456 789
   B. 1 023 456 789
   C. 1 203 456 789
   D. 1 234 567 890

2. What is the smallest digit that can be placed in the blank to make 4 _ 345 . 46 346?
   A. 4
   B. 0
   C. 1
   D. 7

3. What is N in the expression , (56 x 12) + (39 x 12) = N x 12?
   A. 95
   B. 68
   C. 24
   D. 51

4. What is N in the expression, $\{ - (-6)^3 \div [- (-2)^2]\} \div \{ 2 - 4 (2)]\}$?
   A. 13.5
   B. 9
   C. -13.5
   D. -9

5. What is 117 less than twice 973? Round your answer to the nearest hundred
   A. 1 300
   B. 1 900
   C. 1 800
   D. 1 850

6. What is the approximate product of 886 x 548?

A. 500 000
B. 523 800
C. 450 000
D. 360 000

7. Rea is reading a 150 page story book. She already read 70 pages. Whenever she has time she reads an average of 20 pages a day. How many days will it take her to finish reading the rest of the book?
    A. 2
    B. 6
    C. 7
    D. 4

8. A group of fisherman rented a boat for 600 pesos. Two members were unable to go so the rent had to be paid by remaining fishermen, with each paying 25 pesos. How many fishermen were originally in the group?
    A. 22
    B. 24
    C. 26
    D. 28

9. A new jeepney fare scheme is roposed so that P5.00 is charged for the first 10 km plus P0.50 for every 1.5 km of fraction thereof. How much should Rosalinda spend for her round trip fare if she plans to visit a park some km away with this new scheme?
    A. P12.00
    B. P 12.50
    C. P12.00
    D. P25.00

10. A vendor bought 80 pineaples at P22.50 each and sold them at P30.00. If 5 were rotten before he was able to sell them, how much did he gain from the pineapples?
    A. P400
    B. P450
    C. P500
    D. P550

11. When I open my Math book, two pages face me. If the sum of the two numbers is 445, what is the bigger page of the page numbers?
    A. 223
    B. 225
    C. 227
    D. 229

12. Shiela has P95.00. Rhea has P45.0 less than twice the money of Sheila. How much do they have altogether?
    A. P140
    B. P145
    C. P235
    D. P240

13. Aling Mena gathered 24 papayas, 36 mangoes and 220 watermelons from her farm, She reserved one of each kind of fruit for her family and sold the rest. How many fruits did she sell?
    A. 78
    B. 77
    C. 76
    D. 75

14. By what factor should the edge of a cube be multiplied so as to enlarge its volume to eight times that of the original?
    A. 2 times
    B. 3 times
    C. 4 times
    D. 8 times

15. What is the product of the smallest prime number greater than 90 and the biggest composite number less than 90?
    A. 8 008
    B. 8 099
    C. 8 184
    D. 8 536

II. RATIONAL NUMBERS

1. A tree grows $\frac{1}{5}$ ft., $\frac{1}{4}$ ft., $\frac{1}{6}$ ft., in three consecutive years. If the tree was 5 ft in tall before, how high is the tree now?
    A. $5\frac{27}{60}$ ft
    B. $5\ \frac{37}{60}$ ft
    C. 6 ft
    D. $6\frac{1}{4}$ ft

2. A pail is half-filled with water. After pouring 7 liters of water, the pail becomes $\frac{3}{4}$ full. How much water is in the pail now?
    A. 14 litres
    B. 21 litres
    C. 28 litres
    D. 32 litres

3. Mother saved $3\frac{3}{4}$ kg of papaya and $1\frac{1}{2}$ kg of lanzones from the fruits she sold to bring home to her family. How many kilograms of fruits did she bring to her family?
    A. $5\frac{1}{3}$
    B. $5\frac{3}{4}$
    C. $5\frac{1}{2}$
    D. $5\frac{1}{4}$

4. A car travelled $2\frac{1}{3}$ hours at 45 km/hr and for 2 hours at 55 km/hr. How many kilometres did it cover in all?
    A. 209 km
    B. 215 km
    C. 248 km
    D. 304 km

5. What is $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{5}{4}$ of 238?
    A. $\frac{770}{6}$
    B. $\frac{595}{6}$
    C. $\frac{123}{6}$
    D. $\frac{50}{9}$

6. Cindy's height is $\frac{5}{6}$ of Yolanda's height. If their total height is 319 cm. what is Yolanda's height?
    A. 174 cm
    B. 145 cm
    C. 265 cm
    D. 54 cm

7. A vendor bought 150 watermelons at P54.50 each. He sold 135 at P65.75 each . The rest were spoiled. How much did he gain?
    A. P701.25
    B. P711.75
    C. P613. 45
    D. P819.25

8. What is$3\frac{1}{8}$ in decimal form?
    A. 0.375
    B. 3.175

C. 3.125
D. 3.375

9. The Boy Scout planted Narra trees along a 0.90 km river bank. For every 0.05 km distance, a Narra seedling is planted. How many seedlings were planted along the river bank?
   A. 13
   B. 15
   C. 19
   D. 21

10. A salesclerk miscalculated the price of a T-shirt. Instead of subtracting the 10% discount, the clerk added it to the original price. If the price calculated by the clerk is P330, what should have been the discounted price of the T-shirt?
    A. P265
    B. P267
    C. P270
    D. P297

11. A washing machine is priced at P6000 if paid in cash. An additional 15% of the cash price is imposed if the payments will be made by installment. F 40% of the total monthly dues are required as down payment, how much should be paid equally in 6 months for the balance?
    A. P750
    B. P720
    C. P690
    D. P480

12. Sheryl spent 20% of her salary on paying bills and 32% of her salary on food. Is she spent she spent $624 and saved the rest, how much money did she save?
    A. $576
    B. $676
    C. $679
    D. $ 825

13. A certain factory employs 60 workers. If 4 out of every five workers are married, how many married workers are employed by the factory?
    A. 16
    B. 20
    C. 24
    D. 48

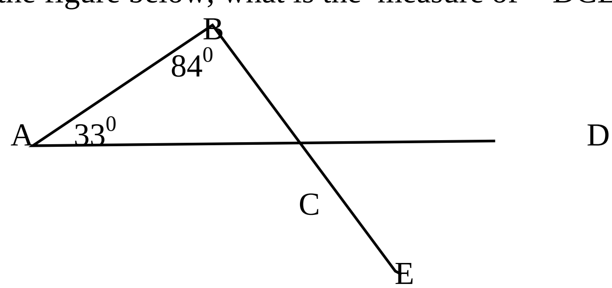
14. Oil is poured into a large empty tank at the rate of 500 gallons per minute. At the same time, oil is leaking out at a rate of 300 gallons per minute if it takes 1 hour to fill, how many gallons of the oil can the tank hold?

A. 5 000
B. 6 000
C. 9 000
D. 12 000

15. The ratio of the number of men to the number of women to the number of children, how many people were at the concert?
A. 450
B. 600
C. 9 000
D. 650

III. GEOMETRY

1. Two angles of a pentagon are right angles while the other three angles have a ratio 2:3:4.What is the measure of the smallest angle?
A. 120^0
B. 90^0
C. 80^0
D. 60^0
2. In the figure below, what is the measure of < DCE?



A. 84^0
B. 96^0
C. 63^0
D. 57^0
3. Two supplementary angles are in the ratio of 11:7. What is the measure of each angle?
A. 110^0& 70^0
B. 145^0& 35^0
C. 120^0& 60^0
D. 100^0& 80^0

4. A rectangular park is 93 m long and 86 m wide. It has a path 1.5 wide around it. What is the area of the path?
A. 546 sq. m.
B. 550 sq. m

C. 7 998 sq.m
D. 8 544 sq. m

5. Two bases of trapezoidal field are 186 m and 160 m and the distance between them is 90 m. how many hectares is the field?
   A. 2.663 hectares
   B. 1.557 hectares
   C. 5.115 hectares
   D. 1.663 hectares

6. The width of a rectangle is length extended by 10%, while its length is shortened by 10%. What is the area of the resulting rectangle, compared to that of the original rectangle?
   A. C. Not changed
   B. 1 % greater
   C. 1% smaller
   D. 10% greater

7. The perimeter of our vegetable garden is 24 m. Its length is twice its width. What is its length?
   A. 12 m
   B. 10 m
   C. 8 m
   D. 6 m

8. What is the perimeter of a rectangle of 3b and breath 10cm, if b = 12 cm?
   A. 82 cm
   B. 92 cm
   C. 12.6 cm
   D. 360 cm

9. A rectangular garden has a perimeter of 63.8m. if it is 22.4m long, what is the measure of its width?
   A. 9.5 m
   B. 19 m
   C. 31.9 m
   D. 48 m

10. Manny jogged around a circular track twice. If the radius of the track is 75 m, how many meters did he jog?
    A. 235.9 m
    B. 471 m
    C. 706.5 m
    D. 942 m

11. A circular lagoon has a diameter of 42 m. if the jogger runs around it 5 ties, how many meters did he jog?

A. 559.9 m
B. 659.4 m
C. 695.4 m
D. 759.4 m

12. The circumference of a car's tire is approximately 18 inches, using the information above, what is the approximate length of the tire's radius?
    A. 3 inches
    B. 6 inches
    C. 9 inches
    D. 18 inches
13. An aquarium that measures 20 cm long, 15 cm wide and 0.03 cm high is half-filled with water. How much water does the aquarium contain when half filled?
    A. 9000 cm ^{3}
    B. 4 500 cm^3
    C. 90 cm^3
    D. 45 cm^3
14. The surface area of a cube is 216 cm2. What is its volume in cubic centimetre?
    A. 142
    B. 183
    C. 191
    D. 216
15. Mang Angelo's business is to deliver water in a subdivision. His water tank measures 2 meter long, 1.5 meters wide and 1.2 meters high. Every morning, he delivers a tank full of water to each of his 3 costumers. How many cubic meters of water does he deliver every morning?
    A. 4.7 m^3
    B. 14.1 m^3
    C. 9.4 m^3
    D. 10.8 m^3

IV. MEASUREMENT

1. The length of fishing line measures 5470 cm. How many kilometres is that length?
    A. 0.0547
    B. 5. 47
    C. 0.547
    D. 54.7

2. The bookshelf in the school library is 72 inches tall. The distance between the ceiling of the library and the bookshelf is 29 inches. What is the closest distance from the ceiling of the library and the bottom of the bookshelf?

A. 43 inches
B. 72 inches
C. 101 inches
D. 20.7 inches

3. In a basketball player, the femur (thigh bone) may have a length of 0.525 m. How many inches long is that femur?
   A. 52.5 inches
   B. 20.7 inches
   C. 0.207 inches
   D. 20.7 inches
4. If a can dogfood contains 22.0 oz (oounces) of dog food, how many grams would that be?
   A. 0.0485 g
   B. 20.6 g
   C. 330 g
   D. 624 g

For numbers 5 and 6, use the conversion units below.

1 ounce (oz) = 28.35 grams (g) 1 kilogram (kg) = 2.205 pounds (lb)

5. A car weigh 3 180 lb., what is its weight in ounce(oz)?
   A. 50 880 oz
   B. 90 153 oz
   C. 8 350 oz
   D. 7 011 oz

6. How many kilograms are there in 5 872 oz?
   A. 166.47 oz
   B. 468.84 oz
   C. 147.66 oz
   D. 66.46 oz

7. The students in Biology were doing their experiments. They stayed in the school for 6 hours and 47 minutes on Saturday, the following day, they stayed 5 hours and 34 minutes . How many hours have the students spent in doing their experiment in the school?
   A. 11 hours and 81 minutes
   B. 21 hours and 21 minutes
   C. 12 hours and 21 minutes
   D. 21 hours and 12 minutes

8. How many hours are there in 4 800 seconds?
   A. $3\frac{1}{4}$ hours

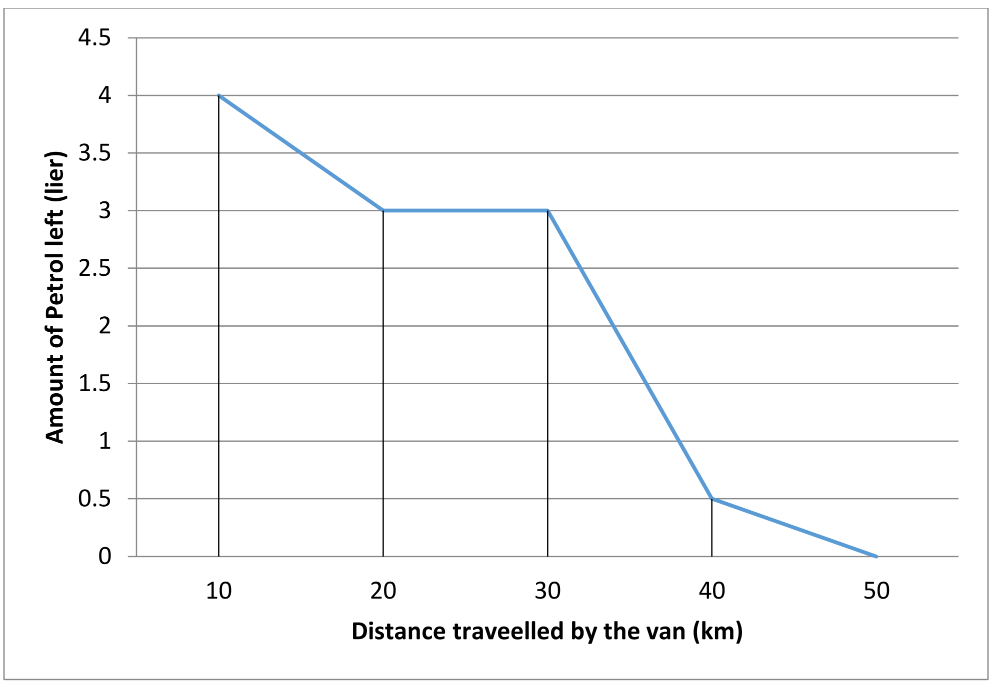
B. $2\frac{1}{2}$ hours
C. $1\frac{1}{3}$ hours
D. $4\frac{1}{4}$ hours

9. How many liters are there in 30.28 gallons ?(1 gallon = 3.785 liters)
    A. 5
    B. 6
    C. 7
    D. 8

10. What is the density (g/ml) of a sample of olive oil if 250 ml has a mass of 0.23kg?
    A. 0.00092 g/ml
    B. 0.9 g/ml
    C. 0.92 g/ml
    D. 57.5 g/ml

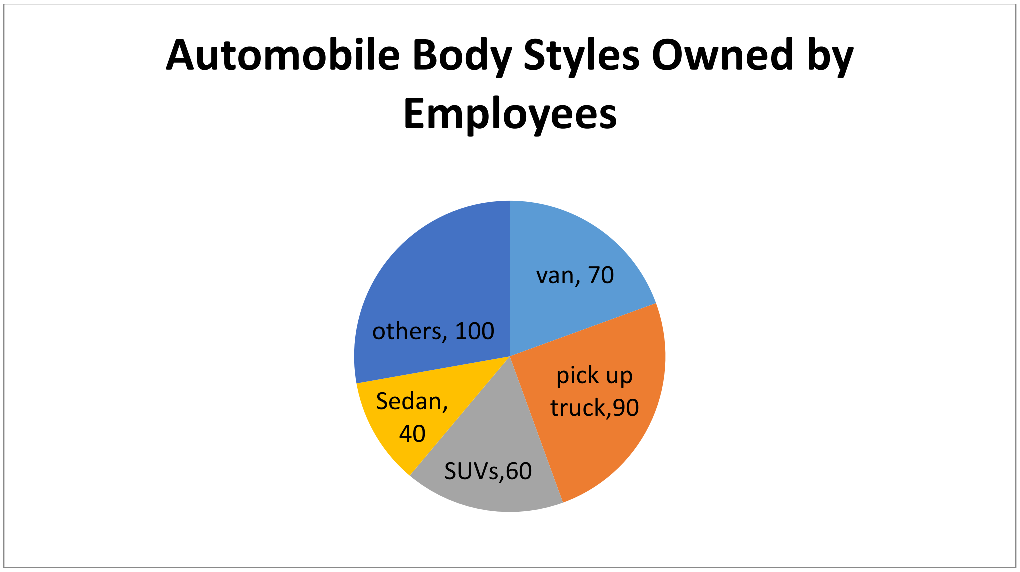
V. GRAPHS

This graph below shows the distance travelled by a van and the amount of petrol oil needed. Study the line graph below and answer question number 1.



1. How much petrol was consumed after the van had travelled 20 km?
    A. 2 L
    B. 3 L
    C. 4 L
    D. 5 L

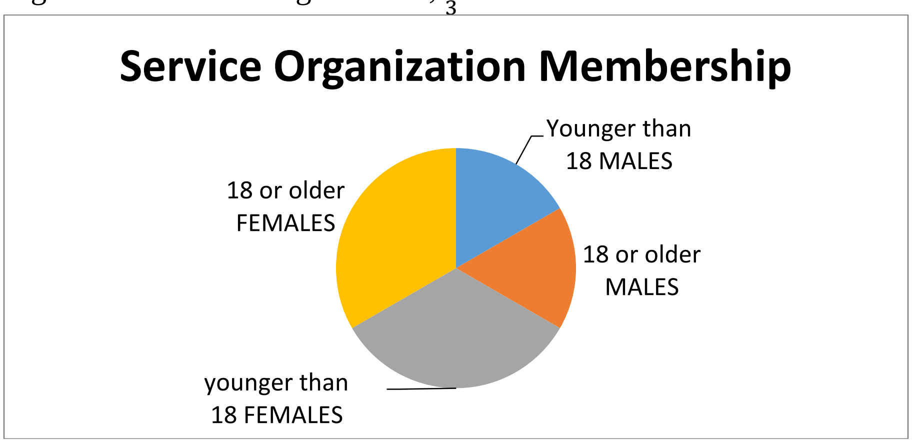
2. The circle graph below represents the body styles of automobiles owned by 1800 employees of certain company.



What is the total number of employees of the company who owns Sedans?

A. 360
B. 450
C. 200
D. 500

3. The circle graph shown below represents the membership of a service organization. In this organization, $\frac{2}{3}$ of the members are female.



Approximately, what fractional part of the total membership, consists of males who are 18 or older?

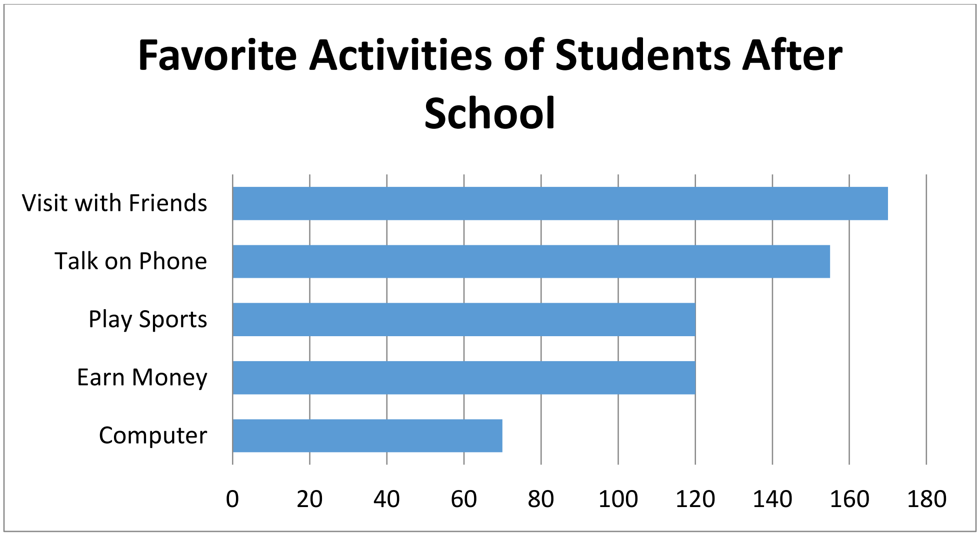
A. $\frac{2}{3}$

B. $\frac{1}{8}$

C. $\frac{1}{6}$

D. $\frac{1}{4}$

For numbers 4 and 5, please refer to the graph below.



4. Which two activities are favoured by an equal number of students?
   A. Playing sports and earning money
   B. Using the computer and earning money
   C. Talking on the phone and playing sports
   D. None of the above

5. Which activity is favoured by most students?
   A. Computer
   B. Earn money
   C. Play sports
   D. Visit friends

APPENDIX G

Letter of Request

DEPARTMENT OF EDUCATION
DIVISION OF ANTIPOLO CITY
RECEIVED
APR 10 2014
By: Time:
OFFICE OF THE SDS

DepED DEPARTMENT OF EDUCATION

Republic of the Philippines
Department of Education
Region IV – A CALABARZON
Division of Antipolo City
KNIGHTS OF COLUMBUS ELEMENTARY SCHOOL

April 8, 2014

DR. MERTHEL M. EVARDOME
Officer-In-Charge
Office of the Schools Division Superintendent
Antipolo City

Madam:

Greetings of peace in the name of public service!

I am presently enrolled at Philippine Normal University for my final units of Research and Thesis Writing. My study is entitled, "Knowledge, Mathematical Beliefs, Teaching Practices and Teaching Performance of Elementary Math Teachers of District II-B, Division of Antipolo."

In connection with this, may I request your permission to allow me conduct a test study using a questionnaire to be given to the Grades IV to VI Math teachers of District II – B, Division of Antipolo. I promise to furnish the schools a copy of the result of my study.

Hoping for your favorable response on this matter.

Thank you and God bless!

Very respectfully,

Evangeline M. Bobita
EVANGELINE M. BOBITA
Researcher

Noted:

DR. RENE R. BELECINA
Research Adviser

APPENDIX G

Letter of Request

Republic of the Philippines
Department of Education
Region IV – A CALABARZON
Division of Antipolo City
KNIGHTS OF COLUMBUS ELEMENTARY SCHOOL

DEPARTMENT OF EDUCATION DIVISION OF ANTIPOLO CITY 2003
RECEIVED APR 03 2014
By: ________ Time: ________

April 3, 2014

DR. MERTHEL M. EVARDOME
Officer-In-Charge
Office of the Schools Division Superintendent
Antipolo City

Madam:

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Thank you and God bless!

Very respectfully,

Evangeline M. Bobita
EVANGELINE M. BOBITA
Researcher

Noted:
Dean of Thesis/Research Professor

1[st] ENDORSEMENT

KNIGHTS OF COLUMBUS ELEMENTARY SCHOOL
Antipolo City – April 3, 2014

Respectfully forwarded to **DR. MERTHEL M. EVARDOME**, Officer –in-Charge, Office of the SDS Antipolo City through the school head, inviting attention to the basic communication of **Evangeline M. Bobita** and recommending favorable action.

MARY GRACE F. SANTIAGO
Head Teacher III

APPENDIX H

Letter of Endorsement

Republic of the Philippines
Department of Education
Region IV-A CALABARZON
Division of Antipolo City

1st Indorsement
April 15, 2014
Antipolo City

Respectfully returned to **Ms. Mary Grace Santiago,** HT-III of Knights of Columbus Elementary School, the herein request of Mrs. Evangeline M. Bobita, Teacher-Researcher with an information that this Office **interposes no objection** on the said request.

MERTHEL M. EVARDOME, Ed. D.
Officer-In-Charge
Office of the Schools Division
Superintendent

I – 74, S. 2014
@emr.2014

Batang Antipulenyo, Dangal ng Bayan Ko

CURRICULUM VITAE

Name	**:**	**EVANGELINE M. BOBITA**
Date of Birth	**:**	February 3, 1982
Place of Birth	**:**	Bangued, Abra
Father	**:**	Rufino B. Bobita
Mother	**:**	Patricia M. Bobita
Adviser	**:**	Rene R. Belecina, Ph.D.

Educational Background

Elementary	**:**	Manabo Pilot Elementary School Manabo, Abra March 1995
Secondary	**:**	Holy Spirit Academy Bangued, Abra March 1999
Tertiary	**:**	**Bachelor of Secondary Education** Major: Mathematics College of the Holy Spirit Tarlac City March 2003

Further Studies	:	**Undergraduate Certificate in English** Philippine Normal university Taft Ave., Manila 24 Units Summer 2010
Graduate Studies:		**Master of Arts in Teaching** Specialization: Mathematics Philippine Normal University Taft Ave., Manila
Employment	:	**Faculty Member** Holy Spirit School Quezon City June 2003-March 2012
		Teacher I Knights of Columbus Elementary School Depertment of Education Division of Antipolo City June 2012-present