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PEDAGOGICAL CONTENT KNOWLEDGE OF MATHEMATICS TEACHERS IN CONGRESSIONAL DISTRICT IV OF NUEVA ECIJA

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Abstract

The study investigated the self-perceived knowledge in content, pedagogy and pedagogical content of Mathematics teachers toward teaching Mathematics. The study used 141 Mathematics teachers from 21 public high schools in the Congressional District IV of Nueva Ecija during school year 2016-2017. The descriptive research and correlation method of research were used by with the questionnaire as the main tool in the data gathering. Specifically, the study answered questions on the profile of the mathematics teacher-respondents, their pedagogical content knowledge in Mathematics and the significant relationship and difference between the given variables. Most of the respondents were between 33-42 years old and females; married; have only their bachelor's degree and not pursue graduate studies; with between 6 – 10 years in service and are all licensed professional teachers; experienced to handle one year level only and teach Mathematics subject. They believed that that have the sufficient pedagogical content knowledge which they apply in teaching. This study suggested that regardless of the profile of a teacher, one can be as effective and efficient with the help of pedagogical content knowledge.

Keywords:
content knowledge (CK); pedagogy; pedagogical content knowledge (PCK); pedagogical knowledge (PK)

1. INTRODUCTION

A number of factors may influence the teaching and learning of Mathematics but teachers play an important role in the teaching process. The common belief of people in the society is a mathematics teacher who knows Mathematics very well is the best person to teach Mathematics. What about knowing to teach Mathematics? What about the teacher's strategies towards teaching the subject?

It is said that teaching is an art and, in this art, the key person in the teaching-learning scenario is the teacher for he/she is the manager, director and facilitator of learning. This is true regardless of his/her educational level because his/her primary objective of teaching is to promote and facilitate learning. For learning to take place, teachers have to teach and make the students learn. The teaching act is an interplay of a constellation of personality traits in teaching competencies, knowledge of the subject taught, the theories the teacher hold about learning as well as his/her assumption of the learners' individual differences which spring them for teachers to have different teaching styles (Stronge, 2007).

As per Department of Education Order No. 31, s. 2012 or the Policy Guidelines on the Implementation of Grades 1 to 10 of the K to 12 Basic Education Curriculum, the overall design of Grades 1 to 10 curriculum on the enhancement of Basic Education Curriculum follows the spiral approach across subjects by building on the same concepts developed in increasing complexity and sophistication starting from grade school. Teachers are expected to use the spiral progression approach in teaching competencies. Thus, teacher quality is an important factor in determining gains in student achievement, even after accounting for prior student learning and family background characteristics.

Many students come to Mathematics classrooms with history of failure, a concept of themselves as poor mathematicians, and a general dislike for the discipline and study of Mathematics. Further, a society that treats Mathematics in the most furtive and superfluous ways enables these students to justify the employment of mechanisms to avoid becoming engaged in and successfully experiencing Mathematics (Grendis and Strassfield, 2002 as cited by Gundran, 2003).

More than ever, it is falling on schools and teachers to improve the employability skills of their students. In response to this demand of an increasingly competitive technical world, Mathematics requirements need to be strengthened in schools.

The basic question on Mathematics instruction remains simple. What are the expected characteristics of a good teacher? To answer this, it may be said that content knowledge and pedagogical knowledge are of paramount importance to teaching. Before anyone can be called an expert teacher, he/she must possess proficiency on the subject matter. No one can impart something he does not have. However, mere knowledge of the content, and general pedagogy are certainly not the only ones expected of teachers.

Pedagogical content knowledge (PCK) is a framework that views knowledge of content in

conjunction with knowledge of the pedagogy (how to teach), giving insights into educational matters relative to the learning and teaching of a topic. Teachers with good PCK are ones who can transform their knowledge of the subject and make it accessible to their learners. PCK also includes an understanding of difficulties that may arise in learning special topics (Ragonis & Hazzan, 2008).

Pedagogical content knowledge (PCK) includes knowledge of content and students and knowledge of content and teaching. The knowledge of content and students is the combined knowledge of mathematical content and students' learning process. The knowledge of content and teaching is the combined knowledge of teaching and mathematics content (Ball et al., 2008). Furthermore, the development of teachers' PCK can be evaluated by Grossman's four criteria: (1) the teacher has a comprehensive understanding of the purpose of teaching a certain subject matter, (2) the teacher has knowledge of instructional strategies and knows how to present particular topics, (3) the teacher has knowledge of students' understanding and misconceptions of the subject matter, (4) The teacher has knowledge of curriculum and curricular materials regarding subject matter.

review of related literature

Content Knowledge

Mathematics content knowledge refers to the breadth and depth of Mathematics knowledge possessed by individuals. A number of research studies have raised serious concerns about the depth of content knowledge in mathematics teachers (Hill & Ball, 2004). In general, the literature pertaining to Mathematics content knowledge teachers overwhelmingly supports the need for conceptual understanding of the subject matter, and specialized Mathematics knowledge for teaching in order to implement solid teaching strategies.

Teacher content knowledge is very essential. One of the aspects of a highly-qualified teacher from the No Child Left Behind Policy is to be knowledgeable in content of the subject taught. According to Hill, Rowan, and Ball (2005), many professional development activities are aimed at improving content knowledge because evidence has shown that teacher knowledge in the subject area can strongly influence student learning. Kane, Rockoff, and Staiger (2008) did a study on students and teachers in New York City. They matched reading and Math scores of first-year teachers to their students. The teachers were then classified as certified, uncertified, or alternatively certified through Teaching Fellows and Teach for America. Teaching Fellows and Teach for America are different means of teacher certification besides undergraduate degree and Praxis tests. The researchers were comparing the academic credentials of the first-year teachers. The researchers used a regression formula that calculated effectiveness, student achievement, and student background factors. They found "little difference in the average academic achievement impacts of certified, uncertified and alternatively certified teachers" (Kane, Rockoff, & Staiger, 2008). The study showed that content knowledge or the lack thereof has little to do with student achievement.

On the other hand, Hill and Ball (2009) found that degrees attained and courses taken have contributed to student achievement. Oddly enough, degrees and courses help more at the secondary level than the elementary level after review of many studies according to Hill and Ball (2005).

Content knowledge in Mathematics is an important construct that can either support or hinder progress in mathematics reform. Ponte and Chapman (2008) stated that "while having strong knowledge of Mathematics does not guarantee that one will be an effective mathematics teacher, teachers who do not have such knowledge are likely to be limited in their ability to help students develop relational and conceptual understanding. Ball et al. (2008) suggest that the absence of reform Mathematics is resultant from teachers' lack of content knowledge within this subject area. "Teachers who do not themselves know a subject well are not likely to have the knowledge they need to help students learn this content" (Ball et al., 2008). Thames and Ball (2010) strongly suggest it is necessary for teachers to possess conceptual Mathematics knowledge in order to effectively explain algorithms, and describe and make connections between concepts.

Knowledge in Mathematics (CK) is theorized to have three subdomains: common content knowledge (CCK), specialized content knowledge (SCK) and horizon content knowledge (SCK) (Ball et al., 2008). Ball, Thames, and Phelps (2008) defined the common content knowledge as the general mathematical knowledge that is needed across all mathematics-related professions or occupations, and they described the specialized content knowledge as the specific mathematical knowledge that is needed for teaching Mathematics. In addition, they explained the horizon content knowledge as the broad range of mathematical content understanding that enables teachers to make connection between Mathematics topics in a curriculum.

According to the Department of Education (2004), to be highly qualified, teachers must have: 1) a bachelor's degree, 2) full state certification or licensure, and 3) proof that they know each subject they teach". Hill, Rowan, and Ball (2005) found that there is no surprise that the quality of Mathematics education coincides with how much content knowledge the teacher has. Mathematical content knowledge can be gathered from Math courses taken throughout grades K-12 and college, but knowing math is not the same as being able to teach Math. According to Hill, Rowan, and Ball (2005), "Mathematical knowledge for teaching goes beyond that captured in measures of mathematics courses taken or basic mathematical skills".

Talbert-Johnson (2006) has made another strong statement about content knowledge: "The mandate specifically identifies the content knowledge and skills of candidates; however, the report fails to mention such intangibles as care for students, efficacy, enthusiasm, and a caring, affirming disposition for all K-12 students". By this statement, Talbert-Johnson meant that content knowledge is not the only measure for justifying that a teacher is highly-qualified. Major and Palmer (2006) asserted, "Teachers learn through studying, by doing and reflecting, by collaborating with other teachers, by looking closely at students and their work, and by sharing what they see". This is where pedagogy comes into play.

Pedagogical Knowledge

Pedagogical knowledge (PK) completes the picture of effective teaching practices. It is defined as the knowledge of methods and strategies of teaching and learning, including the ability to design, implement, and evaluate instructions that respond to students' needs. According to Rodgers & Raider-Roth (2006), "A teacher is knowledgeable of his or her subject matter without

necessarily being able to decompress it in a way that makes it accessible to their students". Having pedagogical knowledge is the way to "decompress" the subject matter knowledge. It was said that the definition of pedagogical knowledge is any theory or belief about teaching and the process of learning that a teacher possesses that influences that teacher's teaching. This process includes the ability to plan and prepare materials; time and classroom management skills; implementation, problem solving, and teaching strategies; questioning techniques; and assessment (Hudson, 2007). Risko et al (2008) did a massive literature review and critique on studies about teacher pedagogical knowledge in relation to reading. They coded the data and came to the conclusion that pedagogical knowledge is essential for teaching and that it can be changed throughout university education coursework and fieldwork. Pedagogical knowledge can be gathered from places other than the university classroom and fieldwork through the university. Hudson's (2007) study in Australia examined the mentor relationships of final year pre-service math and science primary teachers from nine different universities. Hudson's (2007) study showed that cooperating classroom teachers/mentors in the student teaching experiences greatly influenced pedagogical knowledge (Hudson, 2007). The study showed that pedagogical knowledge is greatly influenced by coursework, fieldwork, and mentors throughout undergraduate study.

Experience is another way to gather pedagogical knowledge. A qualitative study was done by Gatbonton (2008) to compare the pedagogical knowledge of novice (teachers with less than two years' experience) teachers and experienced teachers' pedagogical knowledge. Four novice teachers were chosen to teach eight English as a Second Language (ESL) lessons to adult learners. The recollections of each teacher were about each of the lessons were recorded and transcribed. The recollections were then compared to experienced ESL teachers' recollections from a previous study that was performed a similar way by the same researcher. Gatbonton (2008) found that the pedagogical knowledge was similar between the two groups, but the experienced teachers' group seemed to have more detailed pedagogical knowledge, especially in regard to student attitudes and behaviors. This study shows that college courses and fieldwork are helpful in developing a teacher's pedagogical knowledge, but several years' experience will help build upon that knowledge to make it more specialized and useful.

Pedagogical Content Knowledge

Many researchers (Hill et al., 2008; McCray & Chen, 2012) have found that teachers' understanding of the mathematics content knowledge and their expertise in teaching methods "pedagogy" are largely responsible for how effective they are as teachers. More recent research (Lyublinskaya & Tournaki, 2012; Polly, 2011) suggests that teachers' ability to integrate technology into their teaching is also critical to their Mathematics teaching effectiveness.

Teachers must possess pedagogical content knowledge of their content area in order to facilitate students' learning (Ball, 2000). PCK can be influenced positively and negatively by teachers' own K-12 and college experiences and attitudes towards the subject, especially those who teach primary grades and do not necessarily have a degree in a core area. The following study done by Ahtee and Johnson (2006) is an example of the attitudes influencing PCK. A questionnaire was given to eighty-nine Finnish and ninety-eight English pre-service elementary teachers in 2006 after they participated in a teaching demonstration about a physics topic (Ahtee & Johnson, 2006). The participants were not physics majors. After the demonstration, the prospective teachers were given a questionnaire about the topic. The questionnaire showed that poor attitudes held about physics these persons about physics affected their PCK negatively because they did not understand the topic which means they could not accurately guess student responses and difficulties (Ahtee & Johnston, 2006). In a study, Ozden (2008) emphasized that content knowledge had positive influences on pedagogical content knowledge and effective teaching. The study called for more PCK to be emphasized and discussed in teacher education programs. Fortunately, poor preparedness in the content area can be corrected.

PCK involves much more than just content and pedagogical knowledge. PCK involves the knowledge of content and students, as well as the knowledge of content and teaching. This combine knowing how students think and knowing about Mathematics content (Ball, Thames, & Phelps, 2008). Hill, Ball, and Schilling (2004) say this category would include predicting errors and questions. Ball et al. (2008) gives some more examples of this domain: choosing motivating and interesting examples for students, anticipating what students will think about a given task and how they will handle it, and predicting what students are thinking and what they think is confusing about a certain topic.

Hill, Ball, and Schilling (2008) did a study about KCS specifically. They wrote questions that fell into one of four categories: common study errors, students' understanding of content, students' developmental sequences, and common student computations strategies. The researchers gave several versions of the test to teachers and interviewed the teachers. The study showed that KCS was definitely a part of MKT. According to Hill et al. (2008), "Although it remains to be seen whether and how such knowledge is related to improving student learning in mathematics, our results bolster claims that teachers have skills, insights, and wisdom beyond that of other mathematically well-educated adults". Knowledge of content and teaching (KCT) is the fourth domain Teachers must possess pedagogical content knowledge of their content area in order to facilitate students' learning (Ball, 2000). PCK can be influenced positively and negatively by teachers' own K-12 and college experiences and attitudes towards the subject, especially those who teach primary grades and do not necessarily have a degree in a core area.

In contrast, a deep understanding of content in a subject area can greatly influence one's PCK as the following study suggested. Ozden (2008) conducted a study in Turkey. The participants were twenty-eight science pre-service teachers. The participants wrote a lesson plan for a two-hour lesson on a particular science topic for fifth-grade students. The participants then took a content-knowledge test about the topic on which they wrote the lesson plan. Finally, the student teachers were interviewed about writing the lesson plan. The results of the study emphasized that content knowledge had positive influences on pedagogical content knowledge and effective teaching (Ozden, 2008). The study called for more PCK to be emphasized and discussed in teacher education programs. A study done by Derry, Wilsman,

and Hackbarth (2007) suggested that mathematical PCK could be increased. Twenty teachers participated in a summer workshop. Observations, journals, interviews, video tapes, and field-notes were used in data collections. In the same study, twelve teachers took a graduate-level course about connecting to Mathematics. The workshop and course involved conflicting case studies. Two assessments were given to all participants: one about content and PCK and another about analyzing student work. The results showed that the workshop and course helped increase teacher PCK by causing them to reflect on why students got answers correct or incorrect instead of just grading for right or wrong answers (Derry, Wilsman, & Hackbarth, 2007). Schulman (1986) introduced the concept of PCK that illustrate the unique integration of content knowledge of teachers in general pedagogical knowledge. PCK states, subject matter knowledge and general pedagogical strategies are not mutually exclusive. Both represent the construct of teacher knowledge, because both are accessed simultaneously when teachers interpret and present the subject in a way that is accessible learners. In PCK categorization covered, topics most commonly taught in the 'subject area', forms the most benefit from the representation of ideas, analogies 'powerful', illustrations, examples, explanations, and demonstrations. It's the way of representing and formulating the subject matter which makes it understandable to others. PCK also includes an understanding of what makes learning easy or difficult of a particular concept: conceptions and preconceptions of students of various ages and backgrounds who bring them to learn. Schulman (1986) developed a new framework for teacher education and the trend which replaces the dichotomous view of teacher education is based on the separation of content knowledge and general pedagogical knowledge. Therefore, teacher education programs should also consider the PCK by combining pedagogical content knowledge and general knowledge in stages to prepare a more effective teacher.

objectives of the study

- To study the profile of respondents under study
- To study the respondents' content knowledge, pedagogical knowledge and pedagogical content knowledge

To study the relationship between the respondents' profile and their content knowledge, pedagogical knowledge and pedagogical content knowledge

2. METHODOLOGY

A sample consisting of 141 teachers who are handling Mathematics subject in the Junior High School of the big schools in the fourth Congressional District of Nueva Ecija for the school year 2016-2017.

Data collection sources

Primary data

A questionnaire is administered to the 141 respondents and primary data is extracted by this method.

Secondary data

Secondary data is collected through articles, websites etc.

Limitations of the study:

- Sample size is limited
- Locale of the study is limited
- Time is a major constraint

Table: 1
Age of the respondents

23-27	28-32	33-37	38-42	43-47	48-52	53-57	58-62	63-67
11	17	24	24	20	19	19	6	1

From the above table, it is evident that out of 141 respondents one or 0.71% is between 63-67 years old, six or 4.26% are between 58-62 years old, nineteen or 13.48% are between 53-57 years old, also, nineteen or 13.48% are between 48-52 years old, twenty or 14.18% are between 43-47 years old, twenty-four or 17.02% are between 38-42 years old, twenty-four or 17.02% are between 33-37 years old, seventeen or 12.06% are between 28-32 years old and eleven or 7.80% are between 23-27 years old. This implies that most of the mathematics teacher-respondents are between 33-42 years old.

Table: 2
Gender of the respondents

Male	Female
27	114

From the above table, it is found that from the total of 141 respondents most of them are female with 80.85% and male are 19.15%. This implies that most of the mathematics teachers in public high school in Congressional District 4 of Nueva Ecija are female and more females are interested and predominant to the teaching profession than males. This finding is similar to the previous study conducted by Abrami and Appollonia (1999). They stated however that teachers' gender characteristics may not influence student's learning. This observation is supported by Centra and Caubatz (2002) and Kite (2001). This finding is also in line with Kong (2008) who declared that no research has connected test results to teacher gender.

Table: 3
Civil Status of the respondents

Single	Married	Widowed
33	105	3

From a total of 141 respondents, thirty-three or 23.4% are single, one hundred five or 74.5% are married and three or 2.10% are widowed. This implies that most of the mathematics teacher-respondents are married. General impression is that married teachers are more patient in teaching than unmarried ones. On the factor of marital status, students' achievement was significantly influenced by teacher marital status. However, the difference between the scores of the students was not significant, but the difference between the scores of the unmarried and married teachers on one hand and divorced on the other hand, was significant. Thus, the separated and divorced teachers negatively impacted on the students' academic achievement in English language, while the single and married teachers positively impacted on students' academic achievement. This finding is supported by Kong (2008), who observed that unmarried teachers are more vigorous and dedicated to their job. However, Ayeop (2003) posited that married teachers have higher satisfaction in their job.

3. RESULTS AND DISCUSSION

Table: 4
Highest educational attainment of the respondents

Bachelor's Degree	Masteral Undergraduate	Masteral Graduate	Doctoral Undergraduate	Doctoral Graduate
63	54	20	1	3

From the above table, it is evident that sixty-three or 44.7% of the respondents are bachelor's degree holder only, fifty-four or 38.3% are masteral undergraduate, twenty or 14.2 are masteral graduate, only one or 0.7% is doctoral undergraduate and only three or 2.1% of the respondents are doctoral graduate. The data implies that teachers are still in the early steps of their education. They still have time ahead of them to gain more knowledge and grow professionally.

Table: 5
Years of teaching experience

1-5 years	6-10 years	11-15 years	16-20 years	21-25 years	26-30 years	31-35 years	36-40 years
20	38	23	22	14	13	10	1

Twenty or 14.2 of the respondents are between 1-5 years in teaching, thirty-eight or 27.0% are between 6-10 years in teaching, twenty-three or 16.3% are between 11-15 years in teaching, twenty-two or 15.6% are between 16-20 years in teaching, fourteen or 9.9% are between 21-25 years in teaching, thirteen or 9.2% are between 26-30 years in teaching, ten or 7.1% are between 31-35 years in teaching and only one or o.7% is between 36-40 years in teaching. This suggests that most of the mathematics teachers in Congressional District 4 of Nueva Ecija are teaching between 6-10 years. On the study of Unal (2012), the impact of years of teaching experience on the classroom management approaches showed that in attitudes toward classroom management are based on the years of teaching.

Table: 6
Eligibility of the respondents

LET/PBET	LET/PBET and CSC/Engineering Board
136	5

It is shown by the table that one hundred thirty-six or 96.55% of the respondents are licensed professional teachers and only five or 3.5% are licensed professional teachers and Civil Service professional or registered engineers at the same time. This implies that all of the mathematics teacher-respondents are qualified to teach the subject. Since they are all qualified to teach the subject, they are expected to perform their teaching functions effectively and efficiently.

Table: 7
Year level taught of the respondents

One year level	Two-year levels	Three-year levels	Four-year levels
103	29	6	3

Out of 141 respondents, one hundred three or 73.0% taught one year level only, twenty-nine or 20.6% handled two-year levels, six or 4.3% taught three-year levels and three or 2.1% handled four-year levels. This implies that most of the mathematics teachers in Congressional District 4 of Nueva Ecija handled only one year level. This also implies that they are more focused on the content of the curriculum guide for the year level they handled.

Table: 8
Subjects handled by the respondents

Mathematics Only	Mathematics and other subjects
116	25

From the total of 141 respondents, one hundred sixteen or 82.3% are handling Mathematics subject only and twenty-five or 17.7% are handling Mathematics along with other subjects. This data suggests that most of the mathematics teachers in Congressional District 4 of Nueva Ecija are handling the subject they majored in their bachelor's degree and able to focus on the subject itself.

Table: 9
Content Knowledge of Mathematics Teachers

Statement	**Weighted Mean**	**Verbal Interpretation**
1. I have sufficient knowledge about Mathematics.	4.04	Agree
2. I can use a mathematical way of thinking.	4.04	Agree
3. I have various ways and strategies of developing my understanding of Mathematics.	4.04	Agree
4. I reason mathematically when I solve problems in my daily life.	3.81	Agree
5. I can make mathematical connections with the problems outside of Mathematics.	3.84	Agree
6. I am able to communicate mathematically.	3.84	Agree
7. I use multiple mathematical representations when I solve problems.	3.83	Agree
Average weighted mean	***3.92***	***Agree***

Mathematics teacher-respondents have proficient content knowledge as shown with its mean of 3.92. As shown in the table the respondents perceive that they have sufficient knowledge, ways and strategies in developing their knowledge of Mathematics. The respondents can use a mathematical way of thinking as shown in the mean of 4.04. Respondents can also communicate mathematically and make mathematical

connections on problems outside with a mean of 4.5. It can be gleaned from the result that respondents use multiple mathematical representations in solving problems as reflected in the mean of 3.83. Also, they agree that they can apply Mathematics in solving their problems in daily life with mean of 3.81. It implies that the content knowledge of the mathematics teacher-respondents is sufficient and could help them solve problem not only inside the classroom but also in their day-to-day life.

Ponte and Chapman (2008) stated that having a strong knowledge of Mathematics does not guarantee that one can be an effective Mathematics teacher. Teachers who do not have such knowledge are likely to be limited in their ability to help students develop relational and conceptual understanding.

Table: 10
Pedagogical Knowledge of Mathematics Teachers

Statement	Weighted Mean	Verbal Interpretation
1. I know how to assess student performance in a classroom.	4.35	Strongly Agree
2. I can adapt my teaching based-upon what students currently understand or do not understand.	4.21	Strongly Agree
3. I can adapt my teaching style to different learners.	4.26	Strongly Agree
4. I can assess student learning in multiple ways.	4.22	Strongly Agree
5. I am familiar with wide range of teaching approaches in a classroom setting.	4.06	Agree
6. I am familiar with common student understandings and misconceptions.	4.15	Agree
7. I know how to organize and maintain classroom management.	4.18	Agree
8. I can use a wide range of teaching approaches in a classroom setting.	4.09	Agree
Average weighted mean	***4.19***	***Agree***

Mathematics teacher-respondents have proficient pedagogical knowledge as shown with its mean of 4.19. Assessing student performance in classroom is one of the major functions of teachers which the respondents reflected in the result with a highest mean of 4.35. They can also adapt teaching style to different learners and able to assess student learning in multiple ways with mean of 4.26 and 4.44 respectively. Respondents can also adapt their teaching considering student's understanding with mean of 4.21. It implies that being flexible is one of the characteristics of effective teachers needed for effective teaching-learning process and to address the diversity and differences of the learners. It is also evident in the data that respondents know how to organize and manage classroom and use wide range of teaching approaches in classroom settings.

According to Rodgers & Raider-Roth (2006), having pedagogical knowledge is the way to decompress the subject matter knowledge of teachers that makes this knowledge accessible to their students. This implies that teachers should not only know the content of the subject but, most importantly, know the strategies and approaches in dealing with numerous and diverse learners.

Table: 11
Pedagogical Content Knowledge of Mathematics Teachers

Statement	Weighted Mean	Verbal Interpretation
1. I can select effective teaching approaches to guide student thinking and learning in Mathematics.	4.13	Agree
2. I have a good understanding of teaching Mathematics so that students are able to learn.	4.22	Strongly Agree
3. I have a good understanding of instructional strategies that best represent mathematical topics.	4.11	Agree
4. I have a good understanding of students' conceptual and practical understanding of mathematical concepts.	4.06	Agree
5. I have a good understanding of the mathematics curriculum that meets students' needs for learning Mathematics.	4.09	Agree
Average weighted mean	***4.12***	***Agree***

Mathematics teacher-respondents have proficient pedagogical content knowledge as shown with its mean of 4.12. Respondents gave the highest mean of 4.22 to item no. 2," I have a good understanding of teaching Mathematics so that students are able to learn". This shows that students are able to learn the subject if the teachers have enough understanding on the subject they

are teaching. They can also select effective and appropriate teaching strategies to guide the students think and learn Mathematics as reflected with the mean of 4.13. They also believe that good understanding of instructional strategies, Mathematics curriculum and students' practical and conceptual understanding are necessary to meet the student needs for learning the subject.

This finding implies that understanding the subject allows the teacher to design, apply and evaluate variety of strategies and techniques in presenting particular content or topic that will cater to the needs of the learners.

Ball, et.al (2017) stated that pedagogical content knowledge involves much more than just content and pedagogical knowledge. PCK involves the knowledge of content and students, as well as the knowledge of content and teaching. This combine knowing how students think and knowing about Mathematics content.

Table: 12

Content Knowledge, Pedagogical Knowledge and Pedagogical Content Knowledge of Mathematics Teachers

Knowledge In terms of:		Weighted Mean	Verbal Interpretation
1	**Content Knowledge**	3.92	Agree
2	**Pedagogical Knowledge**	4.19	Agree
3	**Pedagogical Content Knowledge**	4.12	Agree
	Average Mean	***4.08***	***Agree***

The respondents have proficient knowledge as shown with its mean of 4.08. It can be gleaned from the table that respondents believe that they have sufficient pedagogical knowledge with a mean of 4.19, pedagogical content with mean of 4.12 and content knowledge with a mean 3.92. They agree that they possess the three contributory factors in teaching Mathematics effectively and efficiently. Respondents are proficient in their content, pedagogical and pedagogical content knowledge which are some of the contributory factors to effective and efficient teaching.

Mathematics content knowledge, pedagogy, and pedagogical content knowledge are certainly important aspects of teaching and teacher education. Teacher education programs should also consider the pedagogical content knowledge by combining pedagogical content knowledge and general knowledge in stages to prepare a more effective teacher.

Table: 13

Relationships of Teachers' Profile to Content Knowledge, Pedagogical Knowledge and Pedagogical Content Knowledge

Personal Attributes/ Attitude		Knowledge			
		Content	Pedagogical	Pedagogical Content	OVER-ALL
Age	r	.039	-.042	-.022	-.009
	p-value	.645	.621	.800	.916
Gender	r	-.057	-.108	-.040	-.075
	p-value	.502	.201	.636	.378
Civil status	r	-.018	-.098	-.078	-.070
	p-value	.833	.249	.360	.410
Educational Attainment	r	.063	.109	.099	.098
	p-value	.458	.199	.243	.249
Years of Teaching Experience	r	.099	-.014	.014	.036
	p-value	.244	.866	.873	.675
Year level taught	r	-.041	-.088	-.089	-.079
	p-value	.629	.297	.292	.351
Subjects handled	r	-.009	-.065	.011	-.023
	p-value	.916	.443	.896	.784

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

It can be seen that respondents' personal profile or attributes have nothing to do with their content knowledge, pedagogical knowledge and pedagogical content knowledge. The hypothesis of no significant relationship is accepted.

Teaching experience can only be associated with classroom management approaches. Indeed, age may not be a factor to an educator's attitude towards teaching. As one gets older, his or her attitude towards teaching might be associated either positively or negatively according to Ortega (2016). Ortega's study is contradictory to studies that have shown that teachers' gender has its role on the effectiveness of teachers. According to Norlander – Case, Regan and Case (1999) women tend to perform better in teaching than their male counterparts.

Conclusion

Based on the findings, the following conclusions are drawn:

Majority of the Mathematics teacher-respondents are between 33-42 years old and females; married; have only their bachelor's degree and not pursue graduate studies; with between 6 – 10 years in service and are licensed professional teachers; experienced to handle one year level only and teach Mathematics subject.

The mathematics teacher-respondents were aware that they possess the content knowledge in Mathematics and rated themselves proficient with 3.92 mean. They believe they have sufficient knowledge, ways and strategies in developing their knowledge of Mathematics. The study revealed that the respondents are proficient in using different strategies and techniques in teaching to address the needs for learning the subject with mean of 4.19. It also implies that teachers knew proper assessment of the students and familiar with different teaching styles for diverse students. The result revealed that the respondents believed that they have proficient pedagogical content knowledge with a mean of 4.12. They also believed that good understanding of instructional strategies, Mathematics curriculum and students' practical and conceptual understanding are necessary to meet the student needs for learning the subject.

The mathematics teacher-respondents content knowledge, pedagogical knowledge and pedagogical content knowledge are very useful combination to deliver and address the needs of students in learning Mathematics subject. These three types of knowledge should be applied in teaching the subject.

The study also revealed that there is no significant relationship between the personal attributes of the teacher-respondents to their content knowledge,

pedagogical knowledge and pedagogical content knowledge.

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