INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH
2023, Vol. 4, No. 7, 2401 – 2419
http://dx.doi.org/10.11594/ijmaber.04.07.22

Research Article

Examining the Teaching Competencies and their Relation to the Mathematics Performance of Primary School Students

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Article history:
Submission April 2023
Revised July 2023
Accepted July 2023

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ABSTRACT

The teachers' role is to influence, engage, commit, and support the students toward a positive outlook of Mathematics as a discipline. This suggests that students' understanding, acknowledgment, and achievement in the discipline primarily depend on the teachers. Considering teachers' roles and students' achievement, the study aimed to determine the teaching competencies affecting teachers' performances and their association with the students' mathematics performance. The study utilized a survey questionnaire, and the obtained data were analyzed using descriptive and inferential analysis. The respondents involved 51 primary school teachers from Grades 4 – 6 in Tinoc District, Tinoc, Ifugao, Philippines. Results showed that the teachers always observed the teaching competencies in their Mathematics teaching. Conclusively, assessment of learning was the most observed competency, followed by personality traits, teaching pedagogy, and instructional material (IM) utilization. Results also showed no significant difference in the teaching competencies based on demographic factors. Moreover, results indicated a lower average (45.80%) Mathematics performance of the primary school students. Consequently, further analysis revealed a non-association between the teaching competencies and the students' mathematics performance. These results infer that the students' mathematical ability was at the beginning level, and mathematical concepts were not fully grasped. It also indicates that teachers were not able to affect the students' performances regardless of always observing the competencies. Nonetheless, a firm view of the teacher's ability to impact the students' understanding and achievement in mathematics is still sustained.

Keywords: *Mathematics, Mathematics performance, Mathematics teaching, Primary school students, Teaching competencies*

How to cite:
Libiado, F. D. & Canuto, P. P. L. (2023). Examining the Teaching Competencies and their Relation to the Mathematics Performance of Primary School Students. *International Journal of Multidisciplinary: Applied Business and Education Research*. *4*(7), 2401 – 2419. doi: 10.11594/ijmaber.04.07.22

Introduction

Mathematics is regarded as the queen and servant of sciences. It is one of the serving foundations for science and technology and the progress of society (Li & Schoenfeld, 2019). Though Mathematics is abstract knowledge (Yeh et al., 2019), it stands alone among other disciplines (Diedrichs, 2019). It can be viewed as a universal language since its contexts are the same across nations, and no cultural boundaries and viewpoints can limit it (Parker Waller & Flood, 2016). In this 21st century, students are encouraged to be scientific, critical, and analytical (Abreh et al., 2018). This is where mathematics offers a groundwork for students' cognition, skills, and development, making it a compulsory part of the curriculum across the globe.

Despite the significance of mathematics, most students perceive it as a naturally challenging (Jameel & Ali, 2016; Michael, 2015). Indeed, the result of the Programme for International Student Assessment (PISA) in 2015 disclosed that the United Kingdom (UK) performed at the lowest level of proficiency in Mathematics compared to some Asian countries (Blausten et al., 2020). The United States of America (USA) also reported that high-achieving Mathematics students were still below among the industrialized nations. This is despite the fact that USA is among the leading countries in its expenditures for the K to 12 Curricula (Hanushek et al., 2010). During the PISA 2012, Japan ranked second in Mathematics performance (Organization for Economic Cooperation and Development, 2012), emphasizing problem-solving and adopting constructive pedagogy (Gardner, 2016). In China, Mathematics was further reinforced at the early beginning of the 21st century when the country highlighted its practical applications by emphasizing the association between the subject and real-life (Tang et al., 2021). Singapore maintains high Mathematics performance on international tests because its initiatives and policies are guided by research evidence, educational systems of other countries, and supportive leaders (Kaur, 2014).

The focus of Mathematics in Philippine education includes facilitating contributions to productive life activities and providing a way of making sense of the world. However, it is alarming that most Filipino students' actual achievement in Mathematics does not correspond to their intellectual capabilities despite being average or above average (Suan, 2018). It implies that the students demonstrate exemplary performance in knowledge attainment but are significantly low in higher-order thinking skills. During the Trends in International Mathematics and Science Study (TIMSS) test in 2003, the Philippines ranked 67th in Mathematics and Science, while it ranked 79th in 2016-2017. These results indicate that the country had low performance in these areas over the years (Dela Cruz, 2017).

The latest survey of PISA 2018 showed that Filipino students ranked second to last in Mathematics. This highlights what many experts have long believed—the country's education system is in crisis. Correspondingly, it was revealed that the Mathematics performance of Filipinos is at the beginning level (Cordova & Tan, 2018), indicating that the country's K to 12 competencies is not fully grasped. Hence, the Philippine K to 12 Curriculum is seen as inefficient and needs to be reviewed (Torregoza, 2022). Similarly, the Philippine National Achievement Test (NAT) results from 2006-2013 exemplified a national average indicating low mastery. For instance, the result of NAT in the previous years showed low performance of Bicolano students in Mathematics (Estonato et al., 2017). The Department of Education (DepEd) supposed that the PISA results reflect the students' performance in NAT, accentuating the urgency to address issues and gaps to attain quality basic education. In the Cordillera Administrative Region (CAR), the proficiency level in Mathematical literacy of students is only 46.98% (Department of Education, 2019).

The low Mathematics performance may be attributed to the non-exposure of students to the beauty and application of Mathematics in real life. This makes students perceive it as a dry subject, void of real-world applications (Noorani et al., 2010), and irrelevant outside school (Hunter, 2021). However, the students' perceptions may change depending on the teachers' role in delivering Mathematics instruction, manifested through teaching competencies. It is acknowledged that teaching

competencies significantly impact students' academic performance (Waseka et al., 2016), and it has a powerful influence on the students' attitude toward a subject (Sinay & Nahornick, 2016). After all, individual teachers and their educational practices can enhance or negate Mathematics. It depends on the teacher's view of the subject and their capabilities, dramatically affecting the students.

Literature Review

Teaching competencies are the knowledge and skills that enable a teacher to be successful, including effectiveness, lesson preparedness, and classroom management. It may involve more knowledge than skill or attitude, whereas others may involve more skill or performance-based. Moreover, the teachers' competencies have been broadening concerning reform studies in education (Selvi, 2012). These competencies are observable and measurable, making it possible to assess a specific competency based on the teacher's performance (Nesipbayeva, 2012).

Personality traits are one of the teaching competencies. It describes a teacher's attitudes, behaviors, and social traits toward the students (Khan et al., 2016). Teachers with firmer self-efficacy beliefs showed a higher level of effort and persistence with students (Nurlu, 2015), which can create positive interactions and relationships in the classroom. Teachers who maintain positive mathematical attitudes can affect the students' perceptions (Sinay & Nahornick, 2016). Building effective relationships is an effective means to improve emotional and social engagements between teachers and students (Ibad, 2018).

Teaching pedagogy pertains to attributes and characteristics that aid a teacher in transferring knowledge among the students (Cankoy, 2010). For a Mathematics teacher to be effective, a complete comprehension of teaching pedagogy must be done (Morales et al., 2003). Being able to simplify mathematical concepts enabling the students to learn, manifests teacher with good teaching pedagogy. It can affect the students' understanding and avoid difficulties (Hill et al., 2005). Teachers may also allow collaboration among the students to promote active listening and sensemaking, including enhancing the students' study skills (Hunter, 2021).

The approach of instructional materials (IMs) utilization positively impacts the development of long-term mastery skills in Mathematics (Adipo, 2015). Students taught with proper IMs performed better (Akpan & Okoli, 2017). In the same way, there was a significant difference in the academic performance of students in Mathematics between those who experienced computer-aided instruction and those who were taught using the traditional method (Lashley, 2017). Additionally, the use of teaching aids such as educational games (Kebritchi, 2008) is instrumental in the development of mathematical skills and abilities and the learning habits of the students.

Assessment of learning describes the teacher's ability to utilize assessment methods to determine learning needs and may influence the students' grades (Buhagiar & Murphy, 2008; Pang, 2022). It can also be viewed as helping students in their quest for knowledge, monitoring progress, making teaching decisions, and enhancing the curriculum (Jimaa, 2011). However, it is noted that most teachers spend much time focusing on summative assessment when what matters is conducting diagnostic and formative assessments (Dabell, 2021). As such, teachers need to take an active role in making decisions about the purpose of the assessment and the content being assessed.

The relationship between teachers' competencies and students' academic performance is strongly associated with predicting mathematics achievement (Hill et al., 2005; Piopunik et al., 2014). Teachers of schools offering Mathematics curricula equipped with appropriate teaching strategies that promote critical thinking and problem-solving skills are perceived by students as the most influential factor in satisfactory academic performance (Pascual, 2014). Studies revealed that gender does not affect the effectiveness of Mathematics teachers. Although, some studies found that male teachers were more effective in teaching, whereas females were average. In contrast, other studies revealed that females were more effective than males (Islahi & Nasreen, 2013).

Accordingly, studies indicated that the teachers' age influenced the students' achievement. However, teachers' age needs to account more for the variation in students' performance (Odiembo & Simatwa, 2014). This suggests that teachers' age does not significantly predict students' Mathematics performance (Waseka et al., 2016). Conversely, teachers above 30 tend to make decisions in teaching mathematical concepts (Chiang & Wang, 2014). A 2016 report from the National Assessment of Educational Progress (NAEP), the largest nationally recognized assessment of student performance, indicated that teachers who hold master's degrees produce students who consistently outperform students of teachers with only a bachelor's degree. It reflects that attaining a master's degree or higher will positively affect students' achievement in Mathematics (Horn & Jang, 2017). Moreover, having a master's or doctorate impacts the teachers' view of themselves as educators (Dial, 2008; Kowalczuk-Walędzia et al., 2017; Tucker & Fushell, 2013). In general, teachers with more than 20 years of experience were more effective but were less effective than those with five years of experience (Rice, 2010). It was found that students with teachers with more years of experience in any level of education showed higher post-test Mathematics scores (Clotfelter et al., 2007). Similarly, teachers' effectiveness increases with experience, especially in the early years of their profession under favorable circumstances, and continues to increase over their entire career (Avvisati, 2018). More experienced teachers support significant student learning, their colleagues, and the school.

Research Aim and Research Questions

With the seemingly continuous low performance of students in Mathematics and the capability of the teachers to influence the students, there is a further need to understand how the students' performances relate to the teachers' educational practices. This study is then developed to assess teaching competencies and their relation to students' academic performance. Specifically, the study aims to answer the following:

1. What are the teaching competencies employed by primary school teachers in Mathematics teaching?
2. Are there significant differences in the teaching competencies according to demographic factors of the primary school teachers?
3. What is the academic performance in Mathematics of the primary school students?
4. Is there an association between the teaching competencies and the students' mathematics performance?

Research Methodology

Research Design

The study used quantitative approach in collecting and analyzing data. Descriptive-survey, inferential, and correlational designs were utilized to attain the research aim and answer the research questions. Descriptive-survey was used to explore the characteristics of the sample population (Anastas, 1999) in terms of teaching competencies and the primary school students' academic performance in Mathematics subject. The study used a modified questionnaire that was tested to be valid and reliable. Inferential analysis was used to examine the significant differences (Trochim, 2023) in the teaching competencies according to the teachers' gender, age, highest earned degree, and years in service. On the other hand, correlational analysis was used to study the association (Prematunga, 2012) between the teaching competencies and the students' mathematics performance.

Further, total enumeration among the sample participants was used. The data collection process was conducted for four months, that is, from June to September 2020. Though the participants involved a small sample, the collection of data took too long due to the observance of health protocols and restrictions affected by the COVID-19 pandemic.

Participants

The participants involved 51 primary school teachers in Tinoc District, Tinoc, Ifugao, Philippines. The study only considered the Grades 4 – 6 Mathematics teachers among the state-owned or public primary schools in the district. This is in the interest of understanding

how the students' performances relate to the teachers' educational practices in the district where one of the researchers is employed. Though the study involved total enumeration, the small number of involved teachers reflected the small populations of primary school students which consisted of one or two class sections during the school year 2019-2020. The participants came from the 15 different elementary schools and one central school in Tinoc District. In the country, institutions offering primary education of Grades 1-6 are known as 'elementary schools (ES)'. Meanwhile, a 'central school (CS)' is still a primary school, though it has greater population of students and bigger school area compared to an elementary school. Particularly, the teachers were comprised of: 7 (14%) from Tinoc CS; 4 (8%) from both Eheb ES and Palabayan ES; 3 (6%) from Binablayan ES, Tulludan ES, Manaan ES, Luhong ES, Tukucan ES, Impugong ES, Gumhang ES, Cocoy ES, Ahin ES, and Wangwang ES; and lastly, 2 (4%) from Danggo ES, Huhlucan ES, and Dengao ES.

Further, Table 1 shows the data on the distribution of the teacher-respondents according to their demographic factors. In terms of gender, there are more female teachers compared to the male group. Regarding age, the largest population is 20 – 30 years old, then 41 – 50 years old, 31 – 40 years old, and the minor population is 51 – 60 years old. As for the highest earned degree, there are more teachers with a bachelor's degree compared to a master's degree. Lastly, teachers with 1 – 10 years of service have the largest population, followed by 11 – 20 years, 21 – 30 years, and 31 – 40 years of service.

Table 1. Distribution of the participants according to demographic factors

Demographics		N	Percentage
Gender	Female	43	84%
	Male	8	16%
Age (in years old, y/o)	20-30	17	33%
	31-40	14	28%
	41-50	16	31%
	51-60	4	8%
Highest earned degree	Bachelor's	33	65%
	Master's	18	35%
Years in service (in years)	1 to 10	30	59%
	11 to 20	16	31%
	21 to 30	4	8%
	31 to 40	1	2%

Instrument and Procedures

A 15-item structured questionnaire designed explicitly for Mathematics subject by Balbalosa (2010) was adopted. It was modified to befit the conditions of the study and had an inter-rater reliability of 95%. The modified questionnaire was found reliable through pilot testing, with an overall Cronbach's Alpha of .819, signifying an excellent internal consistency among the items. Moreover, the questionnaire was divided into two parts (Appendix 1). The first part included demographic factors about gender, age, highest earned degree, and years in service. The second part consisted of the 15 items referring to teaching competencies that were classified into four categories: personality traits, teaching pedagogy, IMs utilization, and assessment of learning.

Before the commencement of data gathering, permissions were sought from the department officials, principals, and school heads of the Tinoc District. Likewise, permissions were also sought from the class advisers requesting to collect data of Grade 4-6 students' academic performance in Mathematics subjects. After all permissions were granted, consent forms were

forwarded to the respondents, informing the purpose of the study and their voluntary participation. The researchers personally gathered the data to attain a higher percentage of the return of answered questionnaires. The results were then tabulated, analyzed, and interpreted, which served as the basis for coming up with the conclusions.

Data Analysis

The 4-point Likert scale denoted the level of teaching competencies that reflected the teachers' performance. The statistical limits shown in Table 2 serves as the equivalent range of scores describing the results of the computed weighted mean values. The weighted means were interpreted as Always (A), Sometimes (So), Seldom (Se), and Never (N) practiced.

Table 2. Distribution of Equivalent Range of Scores

Numerical Rating	Statistical Limits	Descriptive Equivalent
4	3.26 – 4.00	Always (A)
3	1.76 – 2.50	Sometimes (So)
2	1.76 – 2.50	Seldom (Se)
1	1.00 – 1.75	Never (N)

On the other hand, the students' Mathematics performances were determined through Mean Percentage Scores (MPS). The MPS indicates the ratio between the number of correctly answered items in a test and the total number of items. Table 3 shows the distribution of scores divided into four equal percentages: Superior, Upper Average, Lower Average, and Poor (Department of Education, 2015).

Table 3. Range Distribution of Mean Percentage Scores (MPS)

Quartile Distribution	Descriptive Equivalent
76 – 100%	Superior
51 – 75%	Upper Average
26 – 50%	Lower Average
0 – 25%	Poor

In analyzing the data, Analysis of Variance (ANOVA) was used to test if there was a significant difference in the level of teaching competencies that affected the teachers' performance when grouped according to their demographic profiles. Then, the Pearson-product-moment correlation (PPMC) was employed to test the association between the teachers' competencies and the students' MPS.

Results and Discussion

Table 4 shows the assessment of learning (M = 3.62) as the most competency affecting the teaching performance in Mathematics. Personality traits (M = 3.59) ranked second, while teaching pedagogy (M = 3.53) and IMs utilization (M = 3.28) are ranked third and fourth, respectively. It is also identified that teachers' competencies are described as always observed, regardless of rank.

As gleaned in Table 5, the result shows that there is no significant difference at $p<.05$ level in the perceived effect of personality traits ($f = .31$, $p = .820$), teaching pedagogy ($f = .09$, $p = .772$), IMs utilization ($f = 2.78$, $p = .102$), and, assessment of learning ($f = .21$, $p = .646$) in the teachers' performance according to gender. When it comes to the teachers' age, results in Table 6 shows no significant difference, also at $p<.05$ level, in the perceived effect of personality traits ($f = .22$, $p = .883$), teaching pedagogy ($f = 1.31$, $p = .282$), IMs utilization ($f = .25$, $p = .863$), and assessment of learning ($f = .77$, $p = .515$).

Results in Table 7 reveals a significant difference at $p<.05$ level in the effect of teaching

pedagogy (f = 8.43, p = .005) on teaching performance considering the highest earned degree of the teachers. On the other hand, there is no significant difference, also at p<.05 level, in personality traits (f = 1.38, p = .246), IMs utilization (f = .82, p = .369), and assessment of learning (f = .01, p = .941).

Table 4. Teaching Competencies Affecting Teaching Performance

Teaching Competencies	M	Descriptive Equivalent	Rank
Personality traits	3.59	Always (A)	2
Teaching pedagogy	3.53	Always (A)	3
IMs utilization	3.28	Always (A)	4
Assessment of learning	3.62	Always (A)	1

Table 5. Teaching Competencies Affecting Performance according to Gender

Teaching Competencies	Male		Female		f-value	p-value
	M	DE	M	DE		
Personality traits	3.67	A	3.57	A	.31^{ns}	.820
Teaching pedagogy	3.50	A	3.53	A	.09^{ns}	.772
IMs utilization	3.10	So	3.32	A	2.78^{ns}	.102
Assessment of learning	3.58	A	3.63	A	.21^{ns}	.646

Note: DE = Descriptive Equivalent; A = Always; So = Sometimes; Se = Seldom; N = Never; * = significant (p<.05); ns = not significant (p>.05)

Table 6. Teaching Competencies Affecting Performance according to Age

Teaching Competencies	20-30 y/o		31-40 y/o		41-50 y/o		51-60 y/o		f-value	p-value
	M	DE	M	DE	M	DE	M	DE		
Personality traits	3.59	A	3.62	A	3.56	A	3.58	A	.22^{ns}	.883
Teaching pedagogy	3.42	A	3.60	A	3.57	A	3.54	A	1.31^{ns}	.282
IMs utilization	3.31	A	3.32	A	3.24	S	3.21	S	.25^{ns}	.863
Assessment of learning	3.61	A	3.71	A	3.58	A	3.54	A	.77^{ns}	.515

Note: DE = Descriptive Equivalent; A = Always; So = Sometimes; Se = Seldom; N = Never; * = significant (p<.05); ns = not significant (p>.05)

Table 7. Teaching Competencies Affecting Performance according to Highest Earned Degree

Teaching Competencies	Bachelor's Degree		Master's Degree		f-value	p-value
	M	DE	M	DE		
Personality traits	3.57	A	3.63	A	1.38^{ns}	.246
Teaching pedagogy	3.45	A	3.67	A	8.43*	.005
IMs utilization	3.25	So	3.34	A	.82^{ns}	.369
Assessment of learning	3.63	A	3.62	A	.01^{ns}	.941

Note: DE = Descriptive Equivalent; A = Always; So = Sometimes; Se = Seldom; N = Never; * = significant (p<.05); ns = not significant (p>.05)

As seen in Table 8, there is no significant difference at p<.05 level in the perceived effect of personality traits (f = .18, p = .910), teaching pedagogy (f = 1.22, p = .312), IMs utilization (f = .01, p = .998), and assessment of learning (f = .05, p = .983) in the performance of teachers when grouped according to years in service.

Table 9 summarizes the Mathematics MPS of 231 students from Grades 4, 5, and 6. The results show that all grade levels obtained a lower average MPS, thus, yielding an overall

mean of 45.80%, indicating a lower average level of Mathematics performance. Lastly, the result of the PPMC shown in Table 10 indicates no significant association at p<.05 level between the perceived level in all the teaching competencies, that is, personality traits (r = -.2128, p = .1338), teaching pedagogy (r = -.2130, p = .1334) IMs utilization (r = -.2166, p = .1268), and assessment of learning (r = -.2415, p = .0878) that affects the teachers' performance and the Mathematics performance of students. It can also be seen that correlational r-values are negative, indicating inverse relationship between the teaching competencies and the students' mathematics performance. However, further analysis of the p-values indicates shows non-association between the two variables.

Table 8. Teaching Competencies Affecting Performance according to Years in Service

Teaching Competencies	1-10 yrs		11-20 yrs		21-30 yrs		31-40 yrs		f-value	p-value
	M	DE	M	DE	M	DE	M	DE		
Personality traits	3.58	A	3.60	A	3.54	A	3.67	A	0.18^{ns}	.910
Teaching pedagogy	3.47	A	3.61	A	3.63	A	3.50	A	1.22^{ns}	.312
IMs utilization	3.28	A	3.29	A	3.29	A	3.33	A	0.01^{ns}	.998
Assessment of learning	3.63	A	3.61	A	3.58	A	3.67	A	0.05^{ns}	.983

Note: DE = Descriptive Equivalent; A = Always; So = Sometimes; Se = Seldom; N = Never; * = significant (p<.05); ns = not significant (p>.05)

Table 9. MPS in Mathematics of Grade 4 – 6 Students

Grade Levels	N	MPS	Descriptive Equivalent
4	73	45.75%	Lower Average
5	79	41.96%	Lower Average
6	79	49.69%	Lower Average
Total/Mean	231	45.80%	Lower Average

Table 10. Association between the Teaching Competencies and Students' Mathematics Performance

Teaching Competencies	r-value	p-value
Personality traits	$-.2128^{ns}$	.1338
Teaching pedagogy	$-.2130^{ns}$	.1334
IMs utilization	$-.2166^{ns}$	.1268
Assessment of learning	$-.2415^{ns}$	.0878

Note: * = significant (p<.05); ns = not significant (p>.05)

Discussion

The identification of assessment of learning as the most competency that affected the teachers' performance in Mathematics (Table 4) recognizes the positive effect of assessment on the quality of learning (Buhagiar & Murphy, 2008; Jimaa, 2011). Through varied assessments, teachers could monitor students' progress (Buhagiar & Murphy, 2008), help the students to learn, and aids in decision-making to enhance instruction (Jimaa, 2011; Pang, 2022). It suggests that the teachers developed scoring guides/rubrics with the students allowing sufficient time for instruction. Feedback was used to communicate assessment results to the students, which helped to identify the students' strengths and weaknesses (Pang, 2022).

Results points-out that gender does not affect teaching competencies and effectiveness (Table 5). This is in contrast to studies identifying that male teachers were more effective in teaching, or that female teachers were more effective than males (Islahi & Nasreen, 2013). Though the results of this study indicate no relationship between teaching competencies and gender, there were still variances in the result.

The result shows that female teachers scored higher in the assessment of learning while male teachers scored higher in personality traits. This exemplifies that female teachers prefer to communicate results to the students, while male teachers encourage them to participate in classes. Moreover, the groups of male and female teachers obtained similar results in teaching pedagogy and IMs utilization, indicating that both groups have mastery of the subject matter and provided practical and concrete mathematical examples.

It was indicated that age does not affect the teachers' perception of the competencies affecting their performance (Table 6). It confers that teachers' age does not significantly affect the students' academic performance (Waseka et al., 2016). However, it disagrees with results indicating that teachers' age influences students' achievement (Chiang & Wang, 2014; Odiembo & Simatwa, 2014). Additionally, assessment of learning was most observed by teachers aged 20-50 years old, while personality traits affected those 51-60 years old. This signifies that the teachers aged 20-50 years were better at providing feedback, returning results to the students, and using varied assessments. On the other hand, the teachers who were 51-60 years old preferred to impose proper discipline and needed to be more lenient in following the rules. The results also indicate that teachers seldom used IMs regardless of age. However, part of the result suggests a shift from traditional to technology-based IMs recognizing that it can positively affect students' Mathematics performance (Lashley, 2017).

Regardless of educational attainment, the teachers share the same perception among the teaching competencies (Table 7). This contrasts the positive correlation between the highest earned degree and students' Mathematics performance. It disagrees that the higher the teachers' educational attainment, the better the students' performance (Dial, 2008; Horn & Jang, 2017; Kowalczuk-Walędzia et al., 2017; Tucker & Fushell, 2013). This also does not reflect the NAEP 2016 report indicating that teachers with master's degrees produce better-performing students (Horn & Jang, 2017). Furthermore, results disclose the presence of a significant difference in teaching pedagogy among the teachers with master's degrees. This suggests that they were more organized in presenting subject matters, updated with the present trends relevant to the subject matter, able to use various strategies, IMs, and techniques, and related the lessons to students' lives and needs. Nevertheless, personality traits, IMs utilization, and learning assessment show no significant relationship with teachers' performance regardless of their highest earned degree.

Results reflect the non-significance among the teaching competencies according to years in service (Table 8). This contrasts with studies revealing the association between the teachers' years of service and the students' achievement. It does not agree with the results that long years of experience in teaching mean better students' performance (Avvisati, 2018; Clotfelter et al., 2007; Rice, 2010). Regardless of the years in service, the competencies in the performance of teachers are rated the same. It generally suggests that the teachers maintained a good relationship with the students, clearly explained the lesson's objectives, used practical and concrete examples, and developed scoring guides/rubrics with the students.

Based on the findings (Table 9), the mathematics performance of students is lower average. This result highly reflects the beginning-level performance of Filipino students in Mathematics (Cordova & Tan, 2018; Dela Cruz, 2017). The finding also parallels the results of national assessments (Department of Education, 2019; Estonato et al., 2017) and international tests that were conducted. The result reflects the students' low proficiency level and low mastery of mathematical concepts among the Grade 4-6 students (Department of Education, 2019). The results of related studies and the current undertaking justify the urgency to employ necessary measures to address the low performance of students and the need to help them improve their mathematical knowledge.

As determined, there is the absence of a significant relationship between the teachers' competencies and the mathematics performance of students (Table 10). Surprisingly,

though the teachers always practiced the teaching competencies, these competencies did not affect the students' Mathematics performance. The result does not agree that teacher competencies are vital components (Hill et al., 2005; Piopunik et al., 2014) and can influence (Waseka et al., 2016) students' academic performance in the said subject. Furthermore, the lack of association signifies that teaching competencies did not affect and had no role in the students' academic performance. This result does not confer with the goals and objectives of content and performance standards of the learning competencies covered in the Philippine K-12 curriculum. Results suggest that teaching competencies do not affect the students' need to demonstrate understanding and appreciation of critical concepts and principles of Mathematics as applied, using appropriate technology in problem-solving, critical thinking, communicating, reasoning, making connections, representations, and decisions in real life.

Conclusion

The teacher's role and capability are critical to motivating and honing the students' mathematical skills. This is why teaching competencies are essential and must reflect on what the teachers are expected to perform. The study unveiled that primary school teachers always observed the teaching competencies during their Mathematics instruction, whereby the assessment of student learning was identified as most observed. Results also indicated no significant differences in the teachers' perceived effect of the teaching competencies according to demographic factors. Moreover, it was determined that primary school students performed lower average in Mathematics. Further, the study disclosed that the teachers' competencies have no significant association with the students' Mathematics performance.

The low average performance of the students conforms with evaluations indicating that Filipino students perform at a beginning level. This may be an index of the observations that Mathematics lessons focus on broader breadth rather than depth. If this condition is not immediately addressed, students' pessimism towards the subject may linger and persist, affecting their analytical and critical development. We recommend that teachers go beyond their instructional practices and provide support through continuing professional development activities. Such activities will equip the teachers to enhance their students' mathematical knowledge and skills. A proposal of program of activities aligned to enhance the teaching competencies in Mathematics is provided herein (see Appendix 2). The proposed activity may be used for future endeavours. Further, it is crucial for teachers to engage students to associate mathematical concepts with daily activities. Teachers must choose practical and real-life applications and tasks beyond what the students may already know and think they can do. The non-association of the teaching competencies and the students' academic performance in this study does not concur with the generally accepted principle that teachers can influence students. Nevertheless, the researchers still believe in a teacher's capability to impact the student's perspective and academic achievement in Mathematics. With varying results compared with earlier studies, the conduct of the study has limitations and does not represent the general academic population. A broader scope of the study should be undertaken.

Acknowledgment

The authors were grateful to the primary school teachers of DepEd Tinoc District, Ifugao who participated in the conduct of the study.

Authors' contributions

All authors contributed equally to this manuscript.

Declaration of conflicting interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendix 1

Sample Questionnaire

I. Profile

Directions: Fill-in and tick or check the information that best describes you.

Name (Optional):_____ School: _____
Gender: ( ) Male ( ) Female
Age: ( ) 20-30 ( ) 31-40 ( ) 41-50 ( ) 51-60
Highest Earned Degree: ( ) Bachelor's ( ) Master's ( ) Doctorate
Years in service: ( ) 1-10 ( ) 11-20 ( ) 21-30 ( ) 31-40

II. Teaching Competencies

Direction: For each of the following items, circle the response which best reflect your responses to the questions.

1- Never (N) 2- Seldom (Se) 3- Sometimes (So) 4- Always (A)

Items	Scales			
A. Personality Traits				
1. I have a good relationship with the students.	1	2	3	4
2. I encourage students to participate in class discussions.	1	2	3	4
3. I impose proper discipline and is not lenient in following rules.	1	2	3	4
4. I have an appealing personality with good sense of humor.	1	2	3	4
5. I am open to suggestions or opinions.	1	2	3	4
6. I have a strong personal standard and I continue to be a student throughout life.	1	2	3	4
B. Teaching Pedagogy				
1. I explain the objectives of the lesson in Mathematics clearly at the start of each period.	1	2	3	4
2. I have mastery in Mathematics subject matter.	1	2	3	4
3. I am organized in presenting subject matters by systematically following course syllabus.	1	2	3	4
4. I am updated with the present trends, relevant to the subject matter.	1	2	3	4
5. I use various strategies, teaching aids/devices and techniques in presenting the lessons.	1	2	3	4
6. I adapt teaching procedures and relate the lesson content to students' lives and needs.	1	2	3	4
C. Instructional Material Utilization				
1. I use chalk and blackboard in explaining the lessons in Mathematics	1	2	3	4
2. I use workbooks and textbooks in teaching Mathematics.	1	2	3	4
3. I use PowerPoint Presentations as visual aids in teaching Mathematics.	1	2	3	4
4. I use practical and concrete examples during the lesson.	1	2	3	4
5. I use materials for project development.	1	2	3	4
6. I use improvised materials in teaching Math subject.	1	2	3	4

1- Never (N) 2- Seldom (Se) 3- Sometimes (So) 4- Always (A)

Items	Scales			
D. Assessment of Learning				
1. I use assessments such as diagnostic, formative and summative to test students' performance in Mathematics.	1	2	3	4
2. I use assessment results to guide instruction.	1	2	3	4
3. I develop scoring guides/rubrics with the students.	1	2	3	4
4. I communicate assessment results to the students.	1	2	3	4
5. I use varied assessments that allows students to have enough time to think and to learn.	1	2	3	4
6. I allow students to use feedback to improve their work before a grade is assigned.	1	2	3	4

Appendix 2

Activity Proposal for Enhancing Teaching Competencies in Mathematics

Title of Activity: **Onwards to Education 4.0: Upgrading Innovations in Teaching Mathematics**

Objectives: At the end of the training, participants are expected to:

a. adapt innovations in Mathematics teaching-learning; and
b. create interactive presentations/game-based activities and improvised teaching materials in Mathematics.

Outputs:

a. Return demonstration on interactive presentations/game-based activities and other innovations in teaching Mathematics.

Training Matrix

Session 1: Introduction on New Trends of Pedagogies and Strategies in Teaching Mathematics, Review on the learning competencies in Mathematics from Grades 4-6 and Presentation of Interactive Mathematics Tools	
Key Understanding to be Developed	• Employ the different innovative strategies that are vital and efficient in teaching Mathematics.
Learning Objectives	• The participants are expected to: 1. keep a note on the new trends and strategies in Teaching Mathematics; 2. acquaint themselves on the learning competencies in Mathematics from Grades 4-6 and adapt strategies and techniques in presenting lessons in Mathematics; and 3. get familiar with the interactive Mathematics tools.
Resources	• PowerPoint Presentation, notebook and ballpen, K-12 curriculum guide/MELC
Strategies	• Lecture on the new trends of pedagogies and strategies in teaching Mathematics. • Review on the learning competencies in Mathematics from Grades 4-6 and learning strategies and techniques to adapt in presenting lessons in Mathematics. • Presentation of interactive Mathematics tools such as BuzzMath Quiz, Geoboard, BookWidgets, Crossword Widget, and Pair Matching Game.
Activity	• Have a film viewing and lecture with participants regarding the new trends of pedagogies and strategies in teaching Mathematics. • Introduce the session about the learning competencies to the participants by asking the following questions:

Session 1: Introduction on New Trends of Pedagogies and Strategies in Teaching Mathematics, Review on the learning competencies in Mathematics from Grades 4-6 and Presentation of Interactive Mathematics Tools	
	a. How familiar are you with the learning competencies in Mathematics that you are handling? b. What strategies and techniques do you consider in teaching your learners? • Be familiar with the content of K-12 learning competencies in Mathematics that is handled by the teacher. Analyze teaching strategies and techniques to adopt in teaching the lessons in Mathematics. • Present the interactive Mathematics tools such as BuzzMath Quiz, Geoboard, BookWidgets, Crossword Widget, and Pair Matching Game.
Analysis	• Ask questions to encourage the participants to give their remarks regarding the film. • Ask clarifications to participants on their remarks regarding the interactive Mathematics tools.
Abstraction	• Generalization on the new trends of pedagogies and strategies in teaching Mathematics. • After familiarizing the content of K-12 learning competencies in Mathematics, the participants can now analyze teaching strategies and techniques to adopt in teaching the lessons in Mathematics. • Abstraction in the interactive Mathematics tools.
Application	• Pair-share on the new trends of pedagogies and strategies in teaching Mathematics. • Sharing on the best practices in teaching Mathematics. • Operating the interactive Mathematics tools such as BuzzMath Quiz, Geoboard, BookWidgets, Crossword Widget, and Pair Matching Game.
Time Allotment/Duration	1 hour

Session 2: Using Digital-Based Instructional Material in Mathematics Instruction	
Key Understanding to be Developed	• What are the digital-based teaching materials that can be used in Mathematics instruction? How do we utilize them?
Learning Objectives	• The participants are expected to: a. develop digital-based instructional materials/use PowerPoint to create Interactive Mathematics Quiz Game-Game Show.
Resources	• PowerPoint Presentation, K-12 Curriculum Guide, downloaded graphics and clip arts, art materials
Strategies	• Present the steps in developing digital-based instructional material using PowerPoint. • Tutorial on how to use PowerPoint to create Interactive Mathematics Quiz Game-Game Show.

Activity	• Tutorial on how to use PowerPoint to create Interactive Mathematics Quiz Game-Game Show.
Analysis	• Consider the topics that are suited in making interactive quiz and the topics where improvised materials can be utilized. • Give the steps on how to use PowerPoint to create interactive quiz game.
Abstraction	• Familiarize the steps in creating a game show.
Application	• Create an interactive game in Mathematics using PowerPoint-Game Show and Flying Numbers.
Time allotment	4 hours and 45 minutes
Session 3. Crafting of Interactive Mathematics Game Using Improvised Materials	
Key Understanding to be Developed	• Creating of engaging activities in Mathematics.
Learning Objectives	• The participants are expected to: • develop a game-based activity in Mathematics.
Resources	• Art materials
Strategies	• Present the steps in creating improvised material in Mathematics.
Activity	• Introduce the session to the participants by asking the following question: 1. What game-based activities do you use? How did these help the learners? 2. To what extent do you use improvised materials in Mathematics instruction?
Analysis	• Introduce the steps and tips in creating improvised teaching materials.
Abstraction	• Present the steps in crafting Multiplication Table Wheel and 'Tic-Tac-Toe' Mathematics. • Present the steps in crafting apple tree Mathematics game.
Application	• Proceed to the workshop. Facilitate and assist the participants until they fully apply the steps.
Time Allotment	1 hour and 45 minutes