Exploratory Analysis of Teachers’ Variables Characterizing Students’ Performance in Mathematics Challenge

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Abstract
This study characterized the students’ performance in the Metrobank-MTAP-DepEd Mathematics Challenge in the Schools Division of Dapitan City in Zamboanga del Norte, Philippines based on the teachers’ personal and professional variables using exploratory data analysis involving 380 Mathematics teachers. The study employed frequency count, percent, Mann-Whitney Test, and Kruskal-Wallis Test with post hoc analysis and Bonferroni-Adjusted significant level. The study revealed that students’ performance in the 2017 Metrobank-MTAP-DepEd Mathematics Challenge was poor. However, students’ performance was characterized significantly in terms of teachers’ personal variables, namely: age, civil status, and monthly income and professional variables, namely: educational qualification, length of service, position, seminars/training, and extent of Mathematics review. The study concludes that teachers’ personal variables help to explain why different people behave differently even when apparently in the same situation and seemingly having the same experiences. Likewise, teachers’ professional development is a way of acquiring effective teaching processes. Saturday Mathematics Program for Regular and Talented Students conceptualized by the Mathematics Teachers Association of the Philippines is highly recommended to be implemented in the Schools Division of Dapitan City as a mechanism of change in the students’ performance.

Keywords: Personal Variables, Professional Variables, Mathematics Performance.

Introduction
Mathematics competitions are competitive events where participants sit a test. They are used as part of the multiple method identification processes in the teaching and learning of Mathematics. They also serve as a battlefield for students who are mathematically gifted. Essentially, they offer students the opportunity to strive for personal achievement and to compare themselves with others.

Grassl and Mingus as cited by Bicknell (2008) asserted that Mathematics competitions are a means for providing an encouraging environment in which gifted students compete, excel, and are honored for their abilities. Karnes and Riley as pointed out by Bicknell (2008) also stressed that Mathematics competitions enhance students’ self-directed learning skills and sense of autonomy. In the Philippines, Metrobank–
Mathematics Teachers’ Association of the Philippines (MTAP) – Department of Education (DepEd) Mathematics Challenge is a nationwide annual competition to contribute to improving the quality of Mathematics Education in the Philippines through awakening greater interest in Mathematics among elementary and secondary school learners, encouraging learners to strive for excellence in Mathematics, discovering mathematical talents among the learners, developing the values of hard work, perseverance, honesty, teamwork, and sportsmanship, and providing the learners with opportunities in leadership and cooperative undertaking (DepEd Memorandum Order No. 141, s. 2015). Ocampo (2014) added that Mathematics competitions increase motivation, excitement, and interest; provide schools and parents with information about more able students; and are the potent tool in improving not only the teachers’ professional competencies but students’ performance as well.

However, in Schools Division of Dapitan City in the Philippines, students’ performance in the annual Metrobank-MTAP-DepEd Mathematics Challenge showed a very bleak picture in both written and oral phases. A performance review made by the researcher revealed that students found the subject difficult to comprehend. In a broader sense, Mathematics continues to be viewed as abstract and the most difficult subject (Galleto and Descallar, 2017). Hence, performance improvement among the students in the subject is a challenge facing most Mathematics teachers in the school. Moreover, it is hypothesized that poor students’ performance in Mathematics could be attributed to the personal and professional factors among Mathematics teachers in the school.

Imbued with the above premise, this study was conducted to characterize the students’ performance in the Metrobank-MTAP-DepEd Mathematics Challenge in the Schools Division of Dapitan City in the Philippines based on the teachers’ personal and professional factors. In so doing, a research-based output regarding the attributes of these factors to students’ Mathematics performance can be established as basis for Jose Rizal Memorial State University and the Schools Division of Dapitan City to formulate a plan of action to enhance the bleak picture of students’ Mathematics performance and to address the needs of the students and teachers.
To simply conceptualize the main purpose of the study, a schema of the study is presented in Figure 1. The figure presents three overlapping circles. The innermost circle contains the teachers’ personal and professional factors. The second circle is divided into two parts in which the first part contains the teachers’ personal factors, namely: sex, age, civil status, monthly income, religious affiliation, and ethnic affiliation while the second part of the circle contains the teachers’ professional factors, namely: educational qualification, specialization, length of service, position, number of seminars/training in Mathematics attended, and number of hours for Mathematics review conducted. Metrobank-MTAP-DepEd Mathematics Challenge students’ performance contained in the outer circle is characterized based on teachers’ personal and professional factors.

Materials and Methods

This study employed exploratory data analysis to find out the teachers’ personal and professional factors and the students’ performance in the 2017 Metrobank-MTAP-DepEd Mathematics Challenge in the Schools Division of Dapitan City, Zamboanga del Norte, Philippines. There were 336 elementary and 44 secondary teachers from the division who were involved as the Mathematics coach-respondents of this study.

Frequency count and percent were used to quantify the teachers’ personal and professional factors. Percent was calculated by getting the frequency of each category divided by the total number of cases. On the other hand, students’ performance in the 2017 Metrobank-MTAP-DepEd Mathematics Challenge was categorized based on the Standards-Based Assessment: DepEd’s Perspective (Fernandez, 2013) description of ratings as follows:

<table>
<thead>
<tr>
<th>Performance Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>96 – 100</td>
<td>Mastered</td>
</tr>
<tr>
<td>66 – 95</td>
<td>Closely Approximating/Moving Towards Mastery</td>
</tr>
<tr>
<td>36 – 65</td>
<td>Average Mastery</td>
</tr>
<tr>
<td>5 – 35</td>
<td>Low/Very Low Mastery</td>
</tr>
<tr>
<td>0 – 4</td>
<td>Absolutely No Mastery</td>
</tr>
</tbody>
</table>

Moreover, Mann-Whitney U test was used to characterize students’ Mathematics performance differences in terms of sex, religious affiliation, specialization, and number of seminars/trainings in Mathematics attended while Kruskal-Wallis H test with post hoc analysis and Bonferroni-Adjusted significant level was employed in characterizing students’ Mathematics performance differences by age, civil status, monthly income, educational qualification, length of service, position, and extent of Mathematics Review conducted.

Results

Figure 2 reveals that Mathematics teaching in Dapitan City was dominated by females (77%). This means that Mathematics teaching is most preferred by females. The finding actually confirms population data in the Philippines where more females are found over the males in the country. Further, no one among the Mathematics teachers belonged to the age range 25 years old and below. However, the result indicates that there were more Mathematics teachers (53.9%) who were in the age range 26 - 35 years old. This means that there are more young Mathematics professionals and young breed of Mathematics teachers in the field of Mathematics teaching. This implies that Mathematics teaching in the Schools Division of Dapitan City is engaged in by mature Mathematics teachers.
The figure also shows that 75 percent of the Mathematics teachers were married. This means that Mathematics teaching in the division is engaged in by married professionals. This implies that Mathematics teaching force in the division is composed of healthy married teachers. But, about 73 percent of the Mathematics teachers (72.8%) were receiving a monthly salary of PhP 25,000 and below. This means that teachers’ monthly income dominantly belonged to the lowest teachers’ salary scheme of the government.

Furthermore, the figure shows that more than 90 percent of teachers (93%) in the Division of Dapitan City were Catholic. Finding supports that the Philippines consistently has displayed a “low” level of government restrictions on religion. The finding also supports the fact that the Philippines is one of only two nations in Asia with Roman Catholicism as the predominant religion, and is the third largest Catholic country in the world (Inquirer Global Nation, 2011). Moreover, Mathematics teachers in the Division of Dapitan City were all Cebuano. This means that Mathematics teachers in Dapitan City come from a common group of
people with common characteristics despite the fact that the population of the Philippines is one of the ethnically most diverse in the world. This supports that the Mindanao Island is dominantly inhabited by Cebuano/Bisaya ethnic groups.

![Educational Qualification](chart1)

**Educational Qualification**

- Bachelor's Degree: 94
- Bachelor's Degree with MA/MS units/CAR: 35
- Master's Degree: 26
- Master's Degree with Doctoral units/CAR: 34
- Doctorate Degree: 191

![Specialization](chart2)

**Specialization**

- Math: 12%
- Non-Math: 88%

![Length of Service](chart3)

**Length of Service**

- 5 years & below: 150
- 6 - 10 years: 100
- 11 - 15 years: 50
- 16 - 20 years: 16
- 21 - 25 years: 26
- 26 years & above: 70

![Position](chart4)

**Position**

- Teacher 1: 34
- Teacher 2: 60
- Teacher 3: 70
- Master Teacher 1: 26
- Others: 190

![Seminars in Mathematics](chart5)

**Seminars in Mathematics**

- Less than 5: 27%
- 5 or more: 73%

![Extent of Review](chart6)

**Extent of Review**

- Never: 27
- Rarely: 110
- Sometimes: 225
- Often: 9
- Always: 9

Figure 3. Teachers’ Professional Profile

Figure 3 shows that 25 percent of the Mathematics teachers in the Schools Division of Dapitan City completed graduate education, yet 50 percent was still ongoing with their master’s degree while there were still a considerable number of teachers (25%) who did not bother about taking graduate education. This means that DepEd has to go over their hiring and promotion policies and procedures as there are teachers who are not really attending graduate studies and, in the advent of ASEAN integration and the Senior High
implementation, teachers have to attend graduate education for them at least updated with the educational
trends. Further, new knowledge and updated learning are important for one who engaged in teaching the
new generation. The figure shows further that only 12 percent of the Mathematics teachers were
Mathematics major. This means that students who participated in the 2017 Metrobank–MTAP–DepEd
Mathematics Challenge were coached and handled mostly by non-Mathematics major.

The figure shows also that about 50 percent of the Mathematics teachers (49.5%) were in the service for 10
years with teacher 1 position. This means that there were younger Mathematics professionals and novice
Mathematics teachers in the field of Mathematics teaching. This implies that Mathematics teachers need to
work harder and obtain excellent performance to get promoted.

On the other hand, more than 70 percent of the Mathematics teachers in Dapitan City (73%) attended more
than 5 seminars/training in Mathematics. Interview of the researcher revealed that majority of these
seminars and training were related to teaching pedagogies and assessment techniques. Likewise, it was also
pointed out that seminars and training in curriculum reforms and challenges were also attended as one of
the highlights in Mathematics Curriculum Framework under the new K to 12 Basic Education Curriculum.
This construes that Mathematics teachers are equipped with the necessary knowledge and skills in the
teaching of Mathematics.

However, about 60 percent of the Mathematics teachers in the Schools Division of Dapitan City conducted
Mathematics review only “sometimes” before the Metrobank–MTAP–DepEd Mathematics Challenge.
Further, about 30 percent of the Mathematics teachers (28.9%) in the division conducted review classes
“rarely”. Interview conducted by the researcher disclosed that Mathematics teachers found a hard time to
schedule the review classes due to some other assignments that were given to Mathematics teachers which
caused them to give less priority to Mathematics review. Moreover, review materials were also found
limited to meet the needs of the students to the competition.

Table 1. Level of Students’ Performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge

<table>
<thead>
<tr>
<th>Weight</th>
<th>Performance Level</th>
<th>Description of Ratings</th>
<th>Frequency</th>
<th>Mean</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>96-100</td>
<td>Mastered</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>66-95</td>
<td>Closely Approximating/Moving Towards Mastery</td>
<td>-</td>
<td>1.13</td>
<td>Poor</td>
</tr>
<tr>
<td>3</td>
<td>36-65</td>
<td>Average Mastery</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5-35</td>
<td>Low/Very Low Mastery</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0-4</td>
<td>Absolutely No Mastery</td>
<td>338</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 reveals that students obtained poorly in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge. This means that the students performed poorly in the competition. This implies that the students in the Schools Division of Dapitan City were not competitive. It can be construed that Mathematics teachers in the division have to look for possible remedies to address this alarming poor performance among student–participants in the Metrobank–MTAP–DepEd Mathematics Challenge.

Table 2 reveals that male and female Mathematics teachers and their religious affiliation did not differ in their students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge. This means that students’ performance did not vary when students were taught and coached by male or female and catholic or non-catholic Mathematics teachers. It implies that students’ performance in the competition was similar regardless of sex and religion of the Mathematics coach-teachers.
Table 2. Characterization of Students’ Performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge Based on Teachers’ Personal Factors

<table>
<thead>
<tr>
<th>Personal Factors</th>
<th>Computed U-value</th>
<th>Computed H-value</th>
<th>p-value</th>
<th>Characterization of Students’ Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>11285.500</td>
<td></td>
<td>0.129&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>Students’ performance was similar whether the students were taught by male or female Mathematics teachers.</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>38.504</td>
<td>0.000*</td>
<td>Performance of students who were taught by older teachers was higher than those taught by the young ones.</td>
</tr>
<tr>
<td>Civil Status</td>
<td></td>
<td>19.593</td>
<td>0.000*</td>
<td>Students’ performance varied when students were taught by single, married, or widow/widower Mathematics teachers where higher performance was obtained by the students taught by married Mathematics teachers.</td>
</tr>
<tr>
<td>Monthly Income</td>
<td></td>
<td>100.044</td>
<td>0.000*</td>
<td>Performance of students who were taught by teachers with monthly income above Php 30,000 was higher.</td>
</tr>
<tr>
<td>Religious Affiliation</td>
<td>3999.500</td>
<td></td>
<td>0.263&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>Students’ performance was similar whether the students were taught by catholic or non-catholic Mathematics teachers.</td>
</tr>
</tbody>
</table>

<sup>ns</sup> = not significant @ p > 0.05  
<sup>*</sup> = Significant @ p ≤ 0.05

However, students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge differed as analyzed according to the age of the Mathematics Teachers. This means that age of the Mathematics teachers significantly characterizes students’ performance. Further, characterization revealed that performance of students who were taught by older teachers was higher than those taught by the young ones. In a similar vein, civil status of Mathematics teachers significantly characterized their students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge. It means that the disparity of students’ performance occurs when students are taught by single, married, or widow/widower Mathematics teachers where higher performance is obtained by students taught by married Mathematics teachers.

Moreover, monthly income of Mathematics teachers significantly differentiated students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge. This means that students’ performance significantly differs as to the monthly income received by Mathematics teachers in which performance of students who are taught by teachers with monthly income above Php 30,000 is higher. It can be construed that monthly income of Mathematics teachers significantly characterizes students’ performance in the challenge.

Table 3 presents that students’ performance differed as analyzed according to the educational qualification of the Mathematics Teachers. This means that students’ performance varies when students are taught and coached by highly professionally advanced Mathematics teachers. It implies that characterizing students’ performance is significant as to the educational qualification of the Mathematics teachers. Analysis of the result disclosed that performance of students who were taught by teachers with master’s degree was higher. It can be inferred that educational qualification of Mathematics teachers is imperative to characterizing students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge.

Similarly, length of service of Mathematics teachers distinguished their students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge. Analysis of the result revealed further that students
taught by Mathematics teachers with 11–15 years in the service obtained higher performance than the counterparts. This means that the variation in performances of students is caused by the disparity of Mathematics teachers’ teaching experience. It implies that length of service of Mathematics teachers significantly characterizes students’ performance in the 2017 Metrobank – MTAP – DepEd Mathematics Challenge.

Table 3. Characterization of Students’ Performance in the 2016 Metrobank–MTAP–DepEd Mathematics Challenge Based on Teachers’ Professional Factors

<table>
<thead>
<tr>
<th>Professional Factors</th>
<th>Computed U–value</th>
<th>Computed H–value</th>
<th>p – value</th>
<th>Characterization of Students’ Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Qualification</td>
<td></td>
<td>85.041</td>
<td>0.000*</td>
<td>Performance of students who were taught by teachers with master’s degree was higher.</td>
</tr>
<tr>
<td>Specialization</td>
<td>7315.500</td>
<td></td>
<td>0.911 ns</td>
<td>Performance of students was similar whether the students were taught by Mathematics or non-Mathematics major.</td>
</tr>
<tr>
<td>Length of Service</td>
<td></td>
<td>97.942</td>
<td>0.000*</td>
<td>Students taught by Mathematics teachers with 11–15 years in the service obtained higher performance.</td>
</tr>
<tr>
<td>Position</td>
<td></td>
<td>95.109</td>
<td>0.000*</td>
<td>Performance of students who were taught by teachers with master teacher position was higher.</td>
</tr>
<tr>
<td>Number of Seminars/Training in Mathematics Attended</td>
<td>8004.000</td>
<td></td>
<td>0.000*</td>
<td>Performance of students who were taught by teachers with higher number of seminars/training in Mathematics attended was higher.</td>
</tr>
<tr>
<td>Extent of Mathematics Review Conducted</td>
<td></td>
<td>163.624</td>
<td>0.001*</td>
<td>Performance of students who had enough exposure to Mathematics review was higher.</td>
</tr>
</tbody>
</table>

ns = not significant @ p > 0.05  * = Significant @ p ≤ 0.05

Looking at the table further, it shows that position of Mathematics teachers differed in their students’ performance in the 2017 Metrobank – MTAP – DepEd Mathematics Challenge where the performance of students who were taught by teachers with master teacher position was found higher. This means that position of the Mathematics teachers significantly characterizes the performance of the students in the competition. This implies that teachers’ teaching experience is attributable to students’ success.

Furthermore, a number of seminars/training of Mathematics teachers caused the variation in their students’ performance in the 2017 Metrobank – MTAP – DepEd Mathematics Challenge where the performance of students who were taught by teachers with higher number of seminars/training in Mathematics attended was higher than their counterpart. It means that characterizing students’ performance is significant as to the number of seminars/training of the Mathematics teachers attended. It can be deduced that the number of seminars/training of Mathematics teachers attended categorizes higher students’ performance. It can be concluded that training of teachers influences their ability to characterizing students’ achievement.

Moreover, the extent of Mathematics review conducted by Mathematics teachers was significantly splitting students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge. The study
disclosed that performance of students who were taught by teachers with the higher number of seminars/training in Mathematics attended was higher. It can be construed that characterizing students’ performance is significant as to the extent of Mathematics review conducted by Mathematics teachers. It can be inferred further that enough exposure of students to Mathematics review helps improve students’ performance.

However, specialization of Mathematics teachers did not significantly characterize students’ performance in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge. Analysis revealed further that performance of students was similar whether the students were taught by Mathematics or non-Mathematics major. The result is supported by the fact that elementary Mathematics teachers are general education teachers who are believed capable of teaching Mathematics to elementary pupils. These teachers claimed as the non-Mathematics major, yet they are equipped with the knowledge and skills like the high school Mathematics teachers to train and coach participants to the annual conduct of the Metrobank–MTAP–DepEd Mathematics Challenge.

**Discussion**

Students’ performance in Mathematics in the Schools Division of Dapitan City in the 2017 Metrobank–MTAP–DepEd Mathematics Challenge is generally poor. However, the performance of the division is comparable to other schools in the division of schools in Western Mindanao and even at the national level. In a broader sense, Mathematics continues to be viewed as abstract and the most difficult subject. Hence, performance improvement among the students in the subject is a challenge facing most Mathematics teachers in the school.

Essentially, as a school subject, Mathematics must be learned comprehensively and with much depth. It is for this reason that the K–10 Curriculum Guide in Mathematics from Kindergarten to Grade 10 is anchored on the twin goals of Mathematics in the basic education levels, namely: critical thinking and problem solving. Scriven and Paul as cited in the K–10 Curriculum Guide in Mathematics (2013) defined critical thinking as the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. On the other hand, Polya as cited in the K–10 Curriculum Guide in Mathematics (2013) defined mathematical problem solving as finding a way around a difficulty, around an obstacle, and finding a solution to a problem that is unknown. These two goals are to be achieved with organized and rigorous curriculum content, a well-defined set of high-level skills and processes, desirable values and attitudes, and appropriate tools, recognizing as well the different contexts of Filipino learners, teachers’ personal upbringing, and teachers’ professional development.

In a similar vein, the framework is supported by the underlying learning principles and theories, namely: experiential and situated learning, reflective learning, constructivism, cooperative learning and discovery and inquiry-based learning. This means that the Mathematics curriculum is grounded in these theories. Hence, the framework supports the annual conduct of the Metrobank–MTAP–DepEd Mathematics Challenge to convey the twin goals towards success with the personal and professional support of Mathematics teachers.

The study concludes that teachers’ personal factors help to explain why different people behave differently even when apparently in the same situation and seemingly having the same experiences. Likewise, teachers’ professional development is a way of acquiring effective teaching strategies of prime importance.
This necessitates that effective teaching strategies should be used by teachers with a sound personal factors to help activate students’ curiosity about a class topic, engage students in learning, develop critical thinking skills, keep students on task, engender sustained and useful classroom interaction, and, in general, enable and enhance the learning of course content. Secondly, Mathematics teachers should utilize teaching tools and instructional materials for students to take more responsibility for their own learning and enhance the process of teaching for learning. Moreover, Mathematics teachers who are professionally advanced should create learning environments that are more interactive, more applicable to the learning experience, and more appropriate to respond the demands of the constantly changing community. Saturday Mathematics Program for Regular and Talented Students conceptualized by the Mathematics Teachers Association of the Philippines is highly recommended to be implemented in the Schools Division of Dapitan City as a mechanism of change in the students’ performance.

References

Inquirer Global Nation (2011). "Philippines still top Christian country in Asia, 5th in world".