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Assessing the Mathematics Performance of Grade 8 Students as Basis for Enhancing Instruction and Aligning with K to 12 Curriculum

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Abstract: This study sought to determine the performance and the difficulties of the Grade 8 students during the first conduct of the new K to 12 Mathematics. Results of this study served as basis for enhancing instruction and aligning the Grade 8 Mathematics competencies to Instruction and Assessment. Students' scores in the Formative Tests (FT) and the Mathematics Achievement Test (MAT) measured their mathematics performance while interpretation of their mistakes in the least-mastered contents of the new K to 12 Mathematics identified their difficulties. Results indicate that most of the Grade 8 students were in the Beginning level of achievement only. Moreover, half of the tested contents were least-mastered. Incorrectly applying the formulas, properties, theorems, and/or laws and incompletely solving the problem despite correctly doing the initial procedure are their common difficulties. The general recommendation to align the Grade 8 Mathematics Competencies to Instruction and Assessment was to include the missed instructional objectives during the past instruction in the next Curriculum Planning. The recommended strategies to improve instruction included needs assessment, more practice for automation, conduct review classes for mastery and retention, explicit instruction, and peer-assisted mathematics instruction.

Key Words: mathematics performance; instructional enhancement; curriculum alignment; K to 12 Mathematics Curriculum

1. INTRODUCTION

Education plays an important role to every individual because it equips him/her with the necessary knowledge and skills needed to become a functional member of the society. According to the World Bank, education can also be one of the strongest instruments for reducing poverty, thereupon improving the well-being of the people. However, to establish and maintain a high-quality education system, proper investments must be made (Philippine Institute for Developmental Studies, 2012). More so, there is a need to highlight the competence of students in subjects that prepares them for the world, including Mathematics.

Mathematics is one subject that pervades life at any age and in any circumstance. Thus, its value goes beyond the classroom and the school. Mathematics as a school subject, therefore, must be learned comprehensively and with much depth (Department of Education, 2013).

The achievement scores, whether in local or international examinations, are means to measure

comprehension on different subject areas and highlight students' over-all academic performance. The National Achievement Test (NAT) results for grade 6 in SY 2009-2010 showed only a 69.21% passing rate while the NAT results for high school is at a low 46.38%. Moreover, in international test results such as the 2003 TIMSS (Trends in International Mathematics and Science Study), the Philippines ranked 34th out of 38 countries in HS II Math and ranked 43rd out of 46 countries in HS II Science; for grade 4, the Philippines ranked 23rd out of 25 participating countries in both Math and Science. In 2008, even with only the science high schools participating in the Advanced Mathematics category, the Philippines ranked lowest (Department of Education, 2010).

As part of the efforts of the government to respond to the perceived needs of the education sector, the Department of Education (DepEd) had pushed for the change in the basic education curriculum—the implementation of the "Enhanced K to 12 Basic Education Program".

Truly, in the Philippine context, education remains a top priority. However, in implementing academic curricular changes specifically in Mathematics, many factors need to be considered. For one, there is a need for carefully planned programs of exchange in the curriculum. Also, there must be an examination of the place of formative process and summative evaluation of curriculum programs and of the practical materials for the actual process of installing new curricula in schools (Andres and Francisco, 2008).

As presented by Biggs (2003), the implementation of the curriculum should follow the Principle of Alignment. It describes teaching as a balanced system in which all components support each other, as they do in any ecosystem. To work properly, the three components, namely Objectives, Instruction, and Assessment, must be aligned with each other.

In aligned teaching, there is maximum consistency throughout the system. The objectives must be clearly stated in a manner that the level of understanding is properly defined and not simply a list of topics to be covered. The instruction or the teaching and learning tasks chosen must be those that are likely to realize the stated objectives. Finally, the assessment tasks must address the objectives so that one can identify if the students have learned what was intended for them to learn.

Imbalance in the system will lead to poor teaching and surface learning. Non-alignment is signified by inconsistencies, unmet expectations, and practices that contradict what we preach.

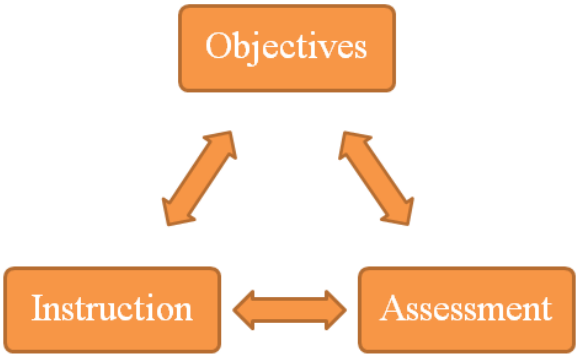

Figure 1. The principle of alignment

Thus, this research would address the need of identifying of the level of success of the implementation of the Enhanced K to 12 Basic Education Program through the assessment of Grade 8 students' performance in K to 12 Mathematics.

2. METHODS

The descriptive design was used in this study to determine the mathematics performance of the Grade 8 students. This design is the most appropriate since this study deals with recording and tabulating data to come up with factual results.

A research and development study was also utilized because of the recommendations that were proposed and developed after finding out the least-mastered and most-mastered competencies of the Grade 8 students in MAT.

The respondents of the study were one of the pioneer batches of K to 12 in the Philippines—the two hundred seventy-nine (279) Grade 8 students of Don Bosco Technical Institute – Makati (DBTI). This study used total enumeration so that below average, average, and above average students are well-represented.

Two research instruments were used in this study—the Formative Tests (FT) and the Mathematics Achievement Test (MAT). Both instruments have the same competencies being tested. However, their difference is only in test type.

FTs were mostly given in open-ended form—Problem Solving. Although there were still some type of tests such as True or False, Multiple Choice, Identification, and Fill-in the Blank. The MAT, on the other hand, were all given in Multiple Choice type.

The FTs being described in this study were all designed by the two Grade 8 Mathematics

teachers and validated by the Mathematics Coordinator of Don Bosco Technical Institute–Makati. They are experts in the field of Mathematics Teaching and are in the business for more than 15 years.

On the other hand, the Mathematics Achievement Test (MAT) was designed by the Grade 8 Mathematics Area teachers of Salesian Philippines North Province, wherein the researcher is a member.

A round-table discussion was organized to consolidate the constructed multiple choice test items for MAT. The distractors in these questions were based on the students' common mistakes in their problem solving.

The first draft of MAT was then validated by the other grade/year level Mathematics Area Teachers and the Mathematics Area Heads of Salesian Philippines North Province using Face Validation and Content Validation. They ensured that the items were based on the competencies required by the Department of Education (2013) for Grade 8. From their evaluation, test items which were out of scope were deleted or revised. Furthermore, some items which were completely deleted had been replaced by those in their Item Bank. These processes completed the final draft of the MAT.

Consequently, the reliability of the final test draft was established using Internal Consistency Method. This was the most appropriate method to use since the test consists of dichotomously scored items—the examinee either passes or fails in an item. The computed reliability of the instrument was 0.84 using Cronbach Alpha, indicating that the instrument has a good internal consistency (George & Mallery, 2003).

The MAT required students to answer 70 multiple choice questions. It was limited to the competencies for Grade 8—Patterns and Algebra, Geometry, and Probability and Statistics.

The students' responses to MAT were scored as one (1) point for correct answer and no point for incorrect answer. This gives seventy (70) points as the highest possible score and zero (0) as the lowest possible score. After utilizing the 70-item Mathematics Achievement Test (MAT), the descriptive method was applied using mean, standard deviation, frequency, percentage distribution, and normalized gain.

To interpret qualitatively the formative test scores and the mathematics achievement test score of the students, the grading system in the K to 12 curriculum, as prescribed by DepEd Order No. 31, s. 2012 was adopted—Beginning level (74.99% and below); Developing level (75.00% - 79.99%); Approaching Proficiency level (80.00% - 84.99%); Proficient level (85.00% - 89.99%); and Advanced level (90.00% and above).

To determine the least-mastered and most-mastered contents of the students according to MAT, this research adopted the parameters used in determining the level of difficulty of an item as recommended by Gabuyo (2012).

The students have mastered a specific content the least if only less than sixty percent (60%) of them got an item correctly. On the other hand, the students have mastered a specific content the most if sixty percent (60%) of them or more got an item correctly.

In order to determine the students' misconception in a specific content in MAT, the researchers analyzed the test items' distractors which were answered more than the correct answer. The analysis of the misconception was validated by the other experts in the field of mathematics. This procedure was only done in the least-mastered contents. For contents with more than one competency being tested, the average percentage of correct responses was obtained.

3. RESULTS AND DISCUSSIONS

Table 1 shows the mean score, standard deviation, and level ofachievement of the Grade 8 students in the Formative Tests (FT).

Among the three areas, Patterns and Algebra turned out to be the more mastered content area (77.45%). Meanwhile, both Geometry and Statistics and Probability are below the passing 75% mark by just a significant value, which could mean that students had difficulty grasping content of these areas during discussions.

Summarizing the level of achievement of the Grade 8 students in the overall FT, they are placed at the Developing level of achievement (75.72%). It means that in general, students have minimum knowledge and skills and core understandings in during the conduct of the FTs.

Table 1. Mean score, standard deviation, and level of achievement of the Grade 8 students in the FTs (N = 279)

Content Area	FT Mean Score	FT Standard Deviation	Level of Achievement
Patterns and Algebra	77.45%	8.30	Developing
Geometry	74.59%	8.22	Beginning
Statistics and Probability	74.56%	7.30	Beginning
Overall	75.72%	7.71	Developing

Table 2 probes on the Mathematics Achievement Test (MAT) scores of the students. Mean scores were determined to facilitate the performance evaluation.

Contrary to the results of the formative tests, Geometry has been determined as highest in the MAT (78.92%). It could be assumed that this area has been more mastered by the students. Meanwhile, Patterns and Algebra was lowest (72.73%). This could be the least mastered. However, it is a fact that the turnout of the examination was low, the level of achievement only being in the Beginning and Developing stages. These figures signify that there is difficulty among students on mastering the content areas because they differ slightly from each other.

Summarizing the level of achievement of the Grade 8 students in the overall MAT, they are only at the Beginning level of achievement (74.08%). This means that students struggle with their understanding; pre-requisite and fundamental knowledge and/or skills have not been acquired or developed adequately to aid understanding.

Table 2. Mean score, standard deviation, and level of achievement of the Grade 8 students in the MAT (***N* = 279**)

Content Area	MAT Mean Score	MAT Standard Deviation	Level of Achievement
Patterns and Algebra	72.73%	7.73	Beginning
Geometry	78.92%	8.50	Developing
Statistics and Probability	75.38%	9.77	Developing
Overall	74.08%	7.29	Beginning

When results for both FTs and MAT are compared, it is clear that results during regular classroom works and quizzes (FTs) may not be reciprocal with that of the the summative test (MAT). As shown in Table 1, Patterns and Algebra was highest. However, when the result of the MAT is investigated, it was ranked lowest. The remaining two content areas—Geometry and Statistics and Probability—both yielded below passing results in the formative tests but turned out positive in the summative.

Formative tests are, in nature, easier than summative tests simply because lessons are still fresh from students' memories and teacher's guidance is present. If this premise is to be held true, we could therefore say that Patterns and Algebra is easier for students, since results on formative tests are higher. However, since it garnered the lowest score in the summative test, it may be attributed to another factor which is retention of information (Nickson, 2004).

Calculating the Average Normalized Gain in the students' score to determine whether there is a gain or loss in students' scores in MAT from FT, it showed that there was no gain in scores (-0.12) since the result was negative.

Based from the result of the Average Normalized Gain, it can be concluded that students really lack retention of the skills learned before instruction. The lack of retention of the skills learned by the students should therefore be addressed as their performance to the next assessments may yield a low score again.

Looking into the least-mastered contents of the Grade 8 students according to the results of their MAT in Figure 2, the number of least-mastered and most-mastered contents for the three areas was of equal degree. Overall, 50% of the contents were most-mastered (got a 60% and above correct response) while the remaining 50% were least-mastered (got lower than 60% correct response). When analyzed per area, Patterns and Algebra has the most number of least-mastered contents, with 11 out of 17 (64.71%) contents falling below the mastery level. Geometry meanwhile got the least, with only 2 out of 9 (22.22%) content considered as least-mastered. Number of least-mastered and most-mastered content areas for the Statistics and Probability is on a 50:50 ratio.

Noteworthy to mention, the extremities of the result appear that the most mastered content is the "Rectangular Coordinate System" (91.04%) under the umbrella of the Patterns and Algebra area. On the other hand, the content "Quadrilaterals that are Parallelograms" of the Geometry area was least-mastered of all (21.15%).

The results were quite alarming because of the low results in students' achievement and mastery. As Biggs (1996) presented in his Principle of Alignment, if expectations were unmet, there might be misalignment among Objectives, Instruction, and Assessment.

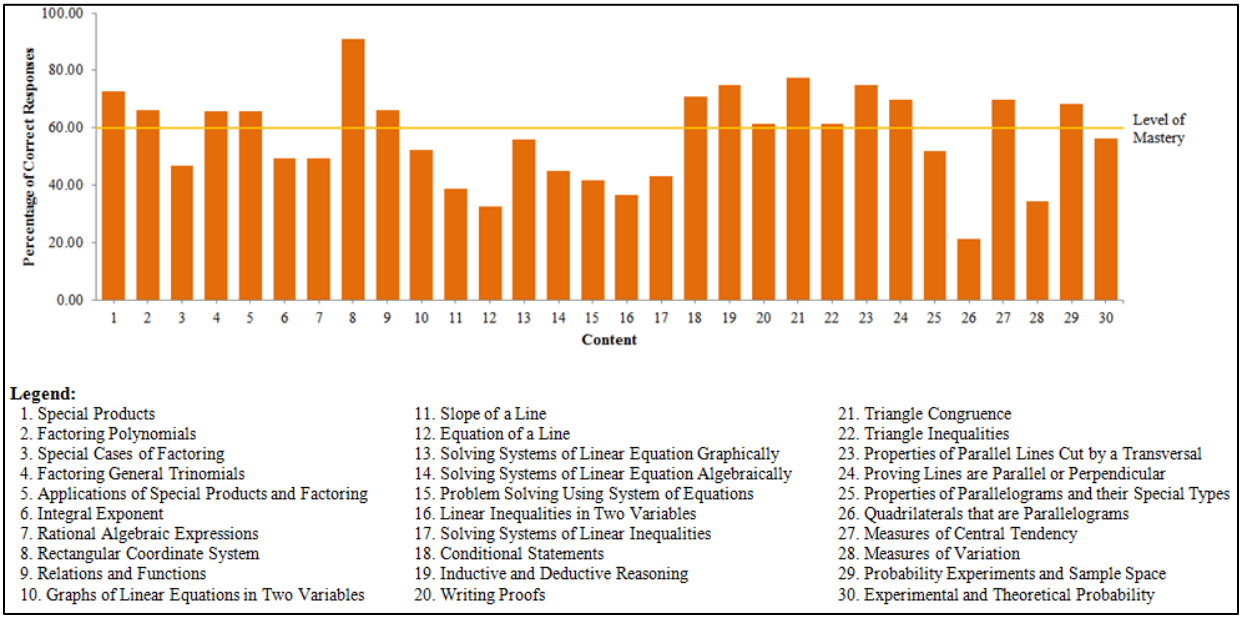

Figure 2. Percentage of correct responses in each of the tested contents

The planned curriculum objectives (Objectives) and the instructional objectives (Instruction) were compared. The basis of the planned curriculum objectives are the objectives stated in the Curriculum Guide prepared by the Grade 8 Mathematics Teachers during the start of the School Year. On the other hand, the instructional objectives are based on the objectives stated in the Instructional Plans drafted by the Grade 8 Mathematics Teachers and are implemented weekly.

Upon comparing Objectives to the Instruction, there were discrepancies between them on the seven contents namely, Rational Algebraic Expressions; Slope of a Line; (Solving Systems of Linear Inequalities; Properties of Parallelograms and their Special Type; Quadrilaterals that are Parallelograms; Measures of Variation; and Experimental/Theoretical Probability.

If there were discrepancies in any of the three components, there will be imbalance in the system. This had been evident in the results of the Mathematics Achievement Test (MAT). The 7 contents which were said to have discrepancies between the Objectives and the Instruction were also part of the 15 least-mastered contents of the MAT.

Noteworthy to mention, the 3 contents, namely, Solving Systems of Linear Inequalities; Quadrilaterals that are Parallelograms; and Experimental/Theoretical Probability, had completely dissimilar planned curriculum objectives and instructional objectives. Looking into the previously discussed least-mastered contents, Quadrilaterals that are Parallelograms became least-mastered of all.

The misconception and/or difficulty of the students in answering some questions in the Mathematics Achievement Test (MAT) were also probed. The teachers' previous encounter of students' common mistakes in their problem solving was the basis for the construction of the distractors. Thus, the misconceptions and/or difficulties were already pre-empted by the teachers. The analysis of the misconceptions was also validated by two experts in the field of Mathematics Teaching.

When the incorrect responses of the students in some of the least-mastered contents were examined, it could be noted that misconceptions and difficulties vary in many forms. In most cases, especially in the items for Patterns and Algebra and Geometry, what is common is that they were just missing to completely solve the problem but they were correctly doing the procedure. This shows that the expected students' attitude of rechecking their answer to the problems is not evident.

In some other cases for Patterns and Algebra and Statistics and Probability, students were incorrectly applying the formulas, properties, theorems, and/or laws. This is evident in the items about Integral Exponents, Rational Algebraic Expressions, Equation of a Line, and Experimental and Theoretical Probability.

In terms of the nature of assessment, test

items' distractor which was answered more than the correct answer shows only that these are good distractors. However, many students were answering an incorrect distractor. It only reflects that they are not critical problem solvers. It could really be reiterated that the root cause of misconceptions is retention of skills learned during instruction as the Objectives and the Instruction are misaligned.

4. CONCLUSIONS

Based on the findings of the study, the researcher derived the following conclusions:

1. The results of the formative tests and the Mathematics Achievement Test (MAT) showed that students' achievement is in the Beginning and in the Developing level for the three content areas of the Grade 8 Mathematics curriculum. These imply that they struggle with their understanding or possess only the minimum knowledge and skills and core understandings; pre-requisite and fundamental knowledge and/or skills have not been acquired or developed adequately to aid understanding.
2. Most of the least-mastered contents of the Mathematics Achievement Test were because of the non-alignment between the Objectives and the Instruction. There was an imbalance in the system that led to poor surface learning. The non-alignment signified inconsistencies, unmet expectations, and practices that contradict what is preached.
3. In terms of the nature of assessment, test items' distractor which was answered more than the correct answer shows only that these are good distractors. However, many students were answering an incorrect distractor. It only reflects that they are not critical problem solvers to be able discern the correct answer. Furthermore, the root cause of misconceptions is retention of skills learned during instruction.

5. RECOMMENDED ACTIONS

In order to address the low performance of the Grade 8 students in K to 12 Mathematics, firstly, the objectives must be clearly stated in a manner that the level of understanding is properly defined and not simply a list of topics to be covered. Secondly, the instruction or the teaching and learning tasks chosen must be those that are likely to realize the stated objectives. Finally, the assessment tasks must address the objectives so that one can identify if the students have learned what was intended for them to learn.

To sum up, whatever objective is stated, it should be realized during instruction. Consequently, the assessment method should be according to how a specific mathematical problem is taught and should be according to the stated objective. Teachers must not change the Planned Curriculum Objectives as this will be the basis for assessment.

Thus, as a general action in the next school years, the following are recommended:

1. Don Bosco Technical Institute – Makati should already include the misses in the past instruction to the next Curriculum Planning, on the following contents, Rational Algebraic Expressions; Slope of a Line; Solving Systems of Linear Inequalities; Properties of Parallelograms and their Special Type; Quadrilaterals that are Parallelograms; Measures of Variation; and Experimental/Theoretical Probability.
2. The Subject Coordinator should ensure the alignment among the K to 12 Mathematics Competencies provided by DepEd to the stated instructional objectives of the teachers in their Instructional Plan and to the constructed assessment tool being administered to the students.

The following strategies are also recommended according to stating learning objectives, developing teaching and learning activities, and constructing assessment methods (Entwistle & Tait, 1990; Trigwell & Prosser, 1991; De Winstanley & Bjork, 2002; Lizzio et al., 2002; Newmaster, et al., 2006; Weiman, 2007; Kember, et.al., 2008; Revell & Wainwright, 2009).

Stating Objectives	Developing Instruction	Constructing Assessment
• Establish and communicate clear learning objectives throughout the course • Establish and communicate clear standards for performance (e.g. rubrics and grading guidelines) • Provide opportunities for independence and choice in learning content and process	• Conduct review classes for mastery and retention Provide opportunities for peer interaction and discussion • Repeat and space key information within and between lectures • Vary and structure learning activities to focus attention • Model each step in the process of reaching the solution to a problem and	• Provide opportunities to receive frequent feedback and to scaffold learning • Identify the prior knowledge of the students before learning the new concept through diagnostic teaching • Use the information on students' formative mathematics performance to identify what they needed more. Teachers

	think aloud about the strategies they use during problem solving • Discuss the common misconceptions of the students when solving a specific problem	could then decide whether a re-teaching should be done or whether to proceed to the next lesson

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