

Extent of Readiness of Grade 10 Students for General Mathematics of Senior High School in Sorsogon City, Philippines

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Abstract - A state with citizens equipped with scientific and mathematical skills is on its way to industrialization. Equipping citizens with these skills needs effective science and mathematics education which can be achieved by putting into priority the education sector of a country. Republic Act No. 10533 paved the way for the implementation of the K to 12 Education in the Philippines. Senior High School (SHS) starts this June, 2016 and questions on readiness among schools, teachers and students are being raised. This descriptive – developmental research utilized unstructured interview and survey to the purposively selected 21 Grade 10 Math teachers and 350 randomly selected Grade 10 students of the Sorsogon City Division. The gathered data were treated statistically using frequency count, percentage and mean. Findings revealed that students are moderately ready on 17 out of 25 prerequisite competencies of General Mathematics and not ready on 9 of them. An over – all MPS of 40% is attained which means that they are moderately ready for SHS's General Mathematics. There is an identified least mastered competency per content topic of General Mathematics and a set of Strategic Intervention Materials, AniMath is proposed as an intervention material in order to help the students master the least mastered competencies. Teachers should be aware of the specific prerequisite competencies of SHS's General Mathematics and together with educational leaders, they should make sure that the prerequisite competencies are mastered before teaching the new competencies in order to ensure readiness.

Keywords: readiness, grade 10 students, general mathematics, senior high school, Descriptive-developmental, Sorsogon

INTRODUCTION

A state with scientifically - inclined and technologically – capable citizens has an edge for industrialization. Developing such human resource requires an effective mathematics and science education which can only be attained if a country prioritizes its educational system. First world countries are known to have quality and effective system of instruction, focusing more on the acquisition of knowledge and skills in science, technology and mathematics which are the competencies these states want their citizens to have.

Article XIV, Section 2 of the 1987 Constitution of the Philippines states that the State shall establish, maintain and support a complete, adequate and integrated system relevant to the needs of the people and the society. This stipulation in the country's highest law is one of the legal bases of the Republic Act 10533, also known as the Enhanced Basic Education Act of 2013 which paved the way for upgrading the 10 – year basic education to a 12 – year program. It introduced Senior High School which is from Grade 11 to Grade 12 in the country. [1]

Senior High School students have to take two compulsory Mathematics subjects in Grade 11. These subjects are General Mathematics which is offered in the first semester, and Statistics and Probability, offered in second semester. Department of Education's Curriculum Guide list the following as the covered topics under General Mathematics, namely functions; rational functions; exponential, inverse and logarithmic functions; basic business mathematics; and logic. [2] These topics are already advanced since the curriculum developers have assumed students' minimum mastery of the skills covered in the Junior High School. These topics were

organized in this way due to the constructivist nature of the curriculum.

Gray [3] said that constructivist teaching is based on the belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction rather than passively receiving information. Learners are the makers of meaning and knowledge. Constructivist teaching fosters critical thinking and creates motivated and independent learners. This strategy ensures learners of readiness in learning new concepts and skills. Readiness is one of Thorndike's laws of learning. It points out that learners learn best when they are physically and mentally ready. One of the most important tasks of a teacher is to determine first if a learner is ready to learn the new lesson based on what the student already know. The teacher will then have to teach the new skills and concepts based on what the child knows [4].

Difficulty can then be experienced if students are lacking of the needed prerequisite skills for a particular lesson. This is supported by Sampang and Moseros [5] who studied about redesigning diagnostic tests as developmental assessment instruments when they found out that mastery of prerequisite skills at a certain level prepares the learner to cope with the demands of more difficult concepts and applications in the succeeding level. Because of this, reviewing the learners of the prerequisites could largely contribute on the learning of the students. Once these skills are already familiarized to the learners, building up the new concepts and skills on the prerequisites and on what they already knew would lead to total learning. This process is called scaffolding. Firestone [6] said that when students are given the support they need while learning something new, they stand a better chance of using that knowledge independently and mastery and retention of the concepts and skills is assured.

New K to 12 modules are constructed using the process of scaffolding and constructivism. Students are encouraged to answer activities which are about the previous lessons discussed in the lower years before learners are taught with the new lessons. Students who did not completely master basic mathematics skills will have great difficulties learning new math lessons. Once these difficulties are left unchecked, students will lose their interest in the subject [7] which is one of the causes of learners' low mastery of mathematics.

The Department of Education mandates teachers to determine whether the prerequisite knowledge or skills critical to understanding have been developed [8]. If not, teachers should provide appropriate interventions to address the deficiencies. This is supported by DepEd Order No. 08, Series of 2015 which encourages teachers to conduct remediation when learners are already experiencing difficulties in a subject as manifested by low ratings in any learning area. Pondalis [9] supports this by recommending that pupils' unmastered skills be given attention by the teachers by adopting appropriate intervention program and by enhancing readiness through remedial instruction. Remediation has been proven effective by various studies. One of which is the study conducted by Mejia [10] who concluded that the proficiency level of the students on the concerned topics has increased after remediation.

During remediation, several instructional materials can be used in order to catch the students' interest to the lesson. Bermundo [11] recommended after her study on development of instructional materials that teachers be more innovative in developing varied instructional materials that would cater to the needs of teachers and students. Bagadiong [12] also recommended on her study on the effectiveness of games that teachers must utilize innovative tools in teaching and re – teaching concepts and skills to raise the performance level of the students. One of the most studied instructional materials is the Strategic Intervention Material (SIM).

Dy [13] defined SIM as a teaching aid introduced into the teaching methods to stimulate the activity of the students and thereby increase their level of understanding. Strategic Intervention Materials are constructed in such a way that it scaffolds the learner to the focus skill. The activities in it prepare the students to tackle the main skill with little difficulty, allowing them to perform better in a given objective. SIM has been proven effective by different studies. Lagata [14] concluded in her undertaking that SIM is an effective tool or aid to develop or enhance the skills of students in solving word problems.

Filipino learners register low performance in Mathematics in almost all levels nationwide. This claim is supported by the drop in the National Achievement Test (NAT) performance from 50.7% in school year 2007 – 2008 to 46.3% in school year 2011 – 2012 of high schools in the country and its low rank of 115th out of 142 states in the Global Competitiveness Report [15].

Pura [16] found out in her study on Least Learned Mathematical Skills of Students that the level of proficiency of the students in five mathematical skills, namely describing, performing operations, solving worded problems and illustrating is all at the beginning level. All of these skills are considered least learned. As released by the National Educational Testing and Research Center (NETRC), secondary students of Sorsogon City Division got a mean percentage score (MPS) in National Achievement Test in Mathematics of 54.30% in 2011, 58.65% in 2012, 60.23% in 2013 and 53.57% in 2014. This result is far below the national target of at least 75% MPS. Furthermore, as the data shows, there is an increase in Math MPS for two years from 2011 but a sudden drop was incurred from 2013 to 2014.

The abovementioned statements require schools to make sure that all means are done to ensure that a student in the Sorsogon City Division is really learning in order to attain what DepEd envisions of a 21st century learner. If unmastery of skills is diagnosed, interventions must be implemented in order to avoid more learning difficulties and problems in the future. The availability of intervention materials like SIM could benefit both the learners and the teachers.

OBJECTIVES

This study determined the extent of readiness of Grade 10 students in General Mathematics for Senior High School in Sorsogon City, S.Y 2015 – 2016. The following are specific objectives: (1) identify the prerequisite competencies in the SHS General Mathematics as identified by the teacher – respondents, (2) determine extent of readiness of the students in SHS general mathematics relative to the identified prerequisite competencies, (3) identify the least mastered skills among the identified prerequisite competencies per content topic, and (4) propose an intervention materials based on the pursuit of the study.

MATERIALS AND METHODS

This study used the descriptive – developmental study. It is descriptive because it determined the extent of readiness of Grade 10 students for General Mathematics of Senior High School. According to Sevilla [17], the descriptive method is designed for the investigator to gather information about the present existing conditions. Likewise, it is developmental because it developed Strategic Intervention Materials

(SIMs) in the topics found to be least mastered by the majority of Grade 10 students.

Purposive sampling was used in choosing the 21 Grade 10 Mathematics teacher – respondents in the Division. The teacher – respondents answered the questionnaires in order to identify the prerequisite competencies of the topics of SHS General Mathematics. The sample size for the student – respondents was determined using the Slovin's Formula. With 2802 students enrolled in eighteen secondary schools in the Sorsogon City Division during School Year 2015 to 2016, 350 students constituted the sample size using 5% margin of error. To determine the number of samples in every secondary schools, the stratified random sampling with proportionate allocation is applied.

Unstructured interview, survey and test administration were used in gathering the data. The instruments were the survey questionnaire and the assessment tool administered to Grade 10 Mathematics teachers and Grade 10 students of the Sorsogon City Division, respectively.

In developing the first instrument, the proponent tentatively identified the prerequisite competencies of General Mathematics guided by the JHS Curriculum Guide as basis. A questionnaire that aimed to identify the prerequisite concepts and skills was developed. The said questionnaire was reviewed through a focus group discussion with non – Grade 10 mathematics teachers of Sorsogon National High School. Suggestions were consolidated to come up with the final questionnaire which was distributed among the Grade 10 Mathematics teachers of the Sorsogon City Division.

After consolidating the results of the questionnaire, an item distribution per competency identified as prerequisite was framed to come up with a 60 -item first draft of the assessment tool. The said draft was checked by Grade 10 Mathematics teachers of the Sorsogon National High School. The test draft was tried out to Grade 10 regular students of Sorsogon National High School. The test items were analyzed wherein some questions which are either very difficult or very easy are discarded. The original item distribution per competency is attuned to the changes after it was item – analysed. A second try out was conducted to another set of Grade 10 students of Sorsogon National High School for face validity. The second try – out also aimed to determine the number of hours needed by the students to answer the test, to determine vague questions and to determine the

problems that may be encountered during the administration of the test. Some items were edited based from the result of the last try – out until a 50 – item assessment tool is finalized.

An assessment test was administered among the selected Grade 10 students of the 17 secondary schools in Sorsogon City. The results of the test were tallied, tabulated and analyzed in order to determine the extent of readiness of the students for the SHS general mathematics. It also determined the least mastered competencies of the students.

Frequency count was used in identifying the prerequisite competencies of SHS General Mathematics. The analysis is supported by the results of unstructured interview with the teacher – respondents. To determine the extent of readiness of the students, mean percentage score (MPS) of the student – respondents per prerequisite competencies were computed by getting the ratio of the mean to the number of items for a particular competency. In order to describe the MPS per prerequisite competency, the seven – descriptive equivalent of Achievement Level based on the National Education Testing and Research Center (NETRC) was adapted to determine the extent of readiness of Grade 10 students for General Mathematics of Senior High School.

MPS (%)	DESCRIPTORS	REMARKS
96 – 100	Mastered	Ready
86 – 95	Closely Approximating Mastery	Ready
66 – 85	Moving Towards Mastery	Moderately Ready
35 – 65	Average Near Mastery	Moderately Ready
15 – 34	Low Mastery	Not Ready
5 – 14	Very Low Mastery	Not Ready
0 – 4	Absolutely No Mastery	Not Ready

The prerequisite competency which garnered the lowest MPS per main content of General Mathematics, namely, Functions; Rational Functions; Inverse Functions, Exponential Functions and Logarithmic Functions; Basic Business Mathematics; and Logic constituted the least mastered math prerequisite competencies. These competencies were the basis of the set of the Strategic Intervention Materials that the researcher developed.

RESULTS AND DISCUSSIONS

Prerequisite Competencies in SHS General Mathematics as Identified by the Teacher - Respondents

Table 1 shows that there are twenty – five (25) prerequisite competencies in the Senior High School General Mathematics as identified by Grade 10 Mathematics teachers of the Sorsogon City Division. All 21 teacher – respondents have agreed that the following twenty – four competencies are prerequisites to SHS General Mathematics: perform fundamental operations on integers, perform operations on rational numbers, evaluate algebraic expressions for given values of the variables, add and subtract polynomials, multiply and divide polynomials, translate English sentences to mathematical sentences and vice versa, verify if a given relation is a function, illustrate linear functions, quadratic functions and polynomial functions, model real – life situations using linear functions, quadratic functions and polynomial functions, among others. Nineteen respondents agreed that finding solution of any linear equation or inequality in one variable is a prerequisite. This could mean that not all teachers are familiar of the prerequisite competencies for the topics in SHS General Mathematics. This is probably because of the country’s first year of implementation of Senior High School.

It is generally accepted that if the students mastered the identified competencies, learning the contents of SHS’s General Mathematics topics will be easier. Cruz [18] stated that “Math” in Grades 7 to 10 prepares students for the SHS core subjects on “General Math” and “Statistics and Probability.” Grade 7 to 10 is collectively called as Junior High School in the Philippine Educational System.

The above statements are supported by Sampang and Moseros [5] who stated that the mastery of prerequisite skills at a certain level prepares the learner to cope with the demands of more difficult concepts and applications in the succeeding level. As one progresses through the learning experiences of higher levels, more opportunities become available for mastering increasingly more complex concepts and competencies and for optimizing the development of higher thinking skills.

**Table 1. Prerequisite Competencies of SHS
General Mathematics Topics**

Prerequisite Competencies	a	b	c	d	e
1. Performs fundamental operations on integers.	21	21	21	21	-
2. Performs operations on rational numbers.	21	21	21	21	-
3. Evaluates algebraic expressions for given values of the variables.	21	21	-	-	-
4. Adds and subtracts polynomials.	21	-	21	-	-
5. Multiplies and divides polynomials.	21	-	21	-	-
6. Translates English sentences to mathematical sentences and vice versa.	21	21	21	-	-
7. Verifies if a given relation is a function.	21	-	-	-	-
8. Illustrates linear functions, quadratic functions and polynomial functions.	21	-	-	-	-
9. Models real – life situations using linear functions, quadratic functions and polynomial functions.	21	-	-	-	-
10. Differentiates between equations and inequalities.	-	21	-	-	-
11. Find solution of any linear equation or inequality in one variable.	-	19	-	-	-
12. Factors completely different types of polynomials.	-	21	-	-	-
13. Illustrates rational algebraic expressions.	-	21	-	-	-
14. Simplifies rational algebraic expressions.	-	21	-	-	-
15. Performs operations of rational algebraic expressions.	-	21	-	-	-
16. Finds the domain, range, and intercepts of a functions.	-	21	-	-	-
17. Graphs linear functions, quadratic functions and polynomial functions.	-	21	21	-	-
18. Applies the laws of exponents.	-	-	21	-	-
19. Solve word problems involving simple interest.	-	-	-	21	-
20. Describes well – defined sets, subsets, universal sets, and the null set and cardinality of sets.	-	-	-	-	21
21. Illustrates the union and intersection of sets and the difference of two sets.	-	-	-	-	21
22. Transform a statement into an equivalent if – then statement.	-	-	-	-	21
23. Determines the inverse, converse, and contrapositive of and if – then statement.	-	-	-	-	21
24. Uses inductive or deductive reasoning in an argument.	-	-	-	-	21
25. Writes a proof	-	-	-	-	21

Legend: **a** – Functions; **b** – Rational Functions; **c** - Inverse Functions, Exponential Functions and Logarithmic Functions; **d** – Basic Business Mathematics; **e** – Logic- - Non-prerequisite

**Table 2. Extent of Readiness of Grade 10 Students
per Competency**

Prerequisite Competencies	MPS %	Remarks
1. Perform fundamental operations on integers.	54	Moderately Ready
2. Perform operations on rational numbers.	50	Moderately Ready
3. Evaluate algebraic expressions for given values of the variables.	56	Moderately Ready
4. Add and subtract polynomials.	35	Moderately Ready
5. Multiply and divide polynomials.	49	Moderately Ready
6. Translate English sentences to mathematical sentences and vice versa.	40	Moderately Ready
7. Verify if a given relation is a function.	26	Not Ready
8. Illustrate linear functions, quadratic functions and polynomial functions.	35	Moderately Ready
9. Model real – life situations using linear functions, quadratic functions and polynomial functions.	29	Not Ready
10. Differentiate between equations and inequalities.	35	Moderately Ready
11. Find solution of any linear equation or inequality in one variable.	56	Moderately Ready
12. Factor completely different types of polynomials.	41	Moderately Ready
13. Illustrate rational algebraic expressions.	30	Not Ready
14. Simplify rational algebraic expressions.	49	Moderately Ready
15. Perform operations of rational algebraic expressions.	47	Moderately Ready
16. Find the domain, range, and intercepts of a functions.	31	Not Ready
17. Graph linear functions, quadratic functions and polynomial functions.	24	Not Ready
18. Apply the laws of exponents.	58	Moderately Ready
19. Solve word problems involving simple interest.	49	Moderately Ready
20. Describe well – defined sets, subsets, universal sets, and the null set and cardinality of sets.	28	Not Ready
21. Illustrate the union and intersection of sets and the difference of two sets.	40	Moderately Ready
22. Transform a statement into an equivalent if – then statement.	33	Not Ready
23. Determine the inverse, converse, and contrapositive of and if – then statement.	47	Moderately Ready
24. Use inductive or deductive reasoning in an argument.	30	Not Ready
25. Write a proof	21	Not Ready
OVER – ALL	40	Moderately Ready

Table 2 shows the result of the test given to Grade 10 students in the Sorsogon City Division. As shown, the first column gives the prerequisite competencies in

General Mathematics while the second column shows Mean Percentage Score (MPS). The fourth column gives the extent of readiness of the students per identified prerequisite competencies.

The mean percentage scores of the Grade 10 students are moderately ready on seventeen out of twenty – five of the prerequisite competencies. This means that the students acquired the minimum knowledge and skills on the aforementioned prerequisite competencies of General Mathematics. Possible reason for this is that students were sufficiently motivated and encouraged during the discussion [19]. This could also be attributed to early detection of unmastery which is immediately given intervention since teachers are recommended to strive more to improve the mastery level of the students in mathematics [20]. This would make learning GenMath topics where these competencies are prerequisites easier to learn for the students and easier to teach for the teachers.

Meanwhile, the students' MPS fall under *not ready* on nine or 32% of the prerequisite competencies. This means that the students did not acquire mastery of the aforementioned prerequisite competencies. They are not ready on the General Mathematics' topics with these 32% as prerequisites. Possible reason for this is that the students did not master the prerequisite skills for these competencies since mathematical skills are built on one another [21]. Learning topics for the SHS General Mathematics might be very difficult as these are prerequisites. In order to avoid that, intervention materials are proposed in this study in order to help the learners master some of those least mastered skills.

The students got an over – all MPS of 40% which means that the respondents are moderately ready for General Mathematics of Senior High School. This could be attributed to the child – friendly nature of secondary schools of the Sorsogon City Division as the Department of Education mandates them to be. This also means that, in general, the students acquired the knowledge and skills needed in studying General Mathematics of Senior High School. However, these skills should be further enhanced in order to ensure smooth flow of learning the topics in the said subject.

This result is not far from the results of the National Achievement Test (NAT) for the Sorsogon City Division in the four succeeding years of 2011, 2012, 2013 and 2014 as released by the National Educational Testing and Research Center (NETRC). Secondary students of Sorsogon City Division got a

mean percentage score (MPS) in mathematics of 54.30% in 2011, 58.65% in 2012, 60.23% in 2013 and 53.57% in 2014. These results could also be interpreted as under “Average Near Mastery” using the seven – descriptive equivalent of Achievement Level. As the data shows, there is an increase in Math MPS for two years from 2011 but a sudden drop was incurred from 2013 to 2014.

Least mastered skill among the identified prerequisite competencies

Table 3 shows the least mastered skill for each content topic of General Mathematics of the Senior High School, namely, Functions; Rational Functions; Inverse Functions, Exponential Functions and Logarithmic Functions; Basic Business Mathematics; and Logic.

Table 3. Least Mastered Skills among the Identified Prerequisite Competencies per Content Topic

CONTENT	COMPETENCIES	MPS (%)
Functions	Verify if a given relation is a function.	26
Rational Functions Inverse, Exponential and Logarithmic Functions	Graph linear functions, quadratic functions and polynomial functions.	24
Basic Business Mathematics	Solve word problems involving simple interest.	49
Logic	Write proof.	21

Under the topic, Functions, the competency on verifying if a given relation is a function (26%) turned out as the respondents' least mastered skill. Graphing linear functions, quadratic functions and polynomial functions (24%) is the least mastered among the prerequisite competencies for both rational function and the inverse functions, exponential functions and logarithmic functions. In basic business mathematics, solving word problems involving simple interest (49%) is the least mastered prerequisite competency. Writing a proof (21%) turned out as the least mastered among the identified prerequisite competencies under Logic of General Mathematics.

All the above mentioned skills are least mastered by the respondents. This could mean that much difficulty could be experienced when the topics where these competencies are prerequisites are taught. This is supported by Hubilla [21] who concluded that mathematical skills are built on one another and pupils

need to build a strong mathematical skill or concept that they learn will be built on that foundation.

The identified least mastered skills all fall under the five mathematical skills as identified by Pura[16], namely verifying if a given relation fall under describing and identifying, graphing linear, quadratic and polynomial functions falls under performing operations and illustrating, writing proof is under illustrating and solving worded problems involving simple interest fall under solving worded problems, She found out in her study that all the skills is at the beginning level. All of the skills are considered least learned. Reymundo [22] also revealed that pupils have low performance level in solving word problems in mathematics.

Pondalis [9] said that pupil's unmastered skills be given attention by the teachers attending English to meet the 75% proficiency level. Appropriate reading intervention program be adapted. Reading readiness be enhanced through remedial instruction using varied activities for better teaching learning process. Bermundo [11] recommended after her study that teachers be more innovative in developing varied instructional materials that would cater to the needs of teachers and students.

Proposed Intervention Materials

Strategic Intervention Materials (SIMs) were developed after determining the readiness of Grade 10 students for the General Mathematics of Senior High School and the least mastered prerequisite skills of the said subject. Janovsky [23] defined instructional materials as the tools used in educational lessons, which include active learning and assessment. Basically, any resource a teacher uses to help him teach his students is an instructional material. Rivera and Sambrano [24] said that a teacher's competence, to a certain extent, can be gauged by the number and variety of aids he uses and in the way he utilizes them; however, only those that are related to a lesson should be used. Dy [13] defined Strategic Intervention Material (SIM) as teaching aid introduced into the teaching methods to stimulate the activity of the students and thereby increasing their level of understanding.

The materials developed aim to help incoming Grade 11 students to master the identified least learned math competencies of Junior High School. It also has a goal to change the negative perception of majority of students in mathematics. Generally, the Strategic Intervention Materials are aimed in helping

the incoming Grade 11 students master the prerequisite skills in studying the topics included in General Mathematics of Senior High School. These materials are also aimed in helping teachers in making lessons much easier to teach due to the students' possible mastery of the prerequisite skills.

Specifically, these Strategic Intervention Materials (SIMs) are aimed in providing both teachers and learners with remediation materials on the following topics identified as least mastered, namely, (1) Verify if a given relation is a function; (2) Graph quadratic and polynomial functions; (3) Solve word problems involving simple interest; (4) Write a proof.

CONCLUSIONS AND RECOMMENDATIONS

Based from the findings, the following conclusions were drawn: (1) the mathematics teachers identified twenty – five prerequisite competencies for General Mathematics of Senior High School; (2) the Grade 10 students of the Sorsogon City Division are moderately ready for Senior High School General Mathematics; (3) there is an identified least mastered competencies in the prerequisites per content topic; and (4) a set of Strategic Intervention Materials, *AniMath* is proposed as an intervention material in order to help the students master the least mastered competencies.

The following recommendations are offered by this study: (1) teachers should be aware of the specific prerequisite competencies of General Mathematics of Senior High School; (2) teachers and educational leaders should make sure that the prerequisite competencies for Senior High School General Mathematics are mastered by the Junior High School completers; (3) a program to remediate students with least mastered prerequisite competencies should be planned and implemented in order to avoid math anxiety among students in the future; (4) validation of the developed Strategic Intervention Materials (SIMs) is recommended to establish its effectiveness for classroom use; (5) further studies is encouraged along this undertaking in order to enrich the findings and conclusions of the research.

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