

Mirabueno & Boyon, 2020

Volume 5 Issue 3, pp. 840-849

Date of Publication: 24th February 2020

DOI- <https://doi.org/10.20319/pijss.2020.53.840849>

This paper can be cited as: Mirabueno, J. A. S., & Boyon, M. C. L., (2020). Senior High School Academic Progression in Mathematics. PEOPLE: International Journal of Social Sciences, 5(3), 840-849.

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SENIOR HIGH SCHOOL ACADEMIC PROGRESSION IN MATHEMATICS

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Abstract

One of the strategies in accelerating the country's human capital development is to achieve quality accessible, relevant, and liberating basic education for all. This can be done through various programs in the department which develop and improve and continue curricular reforms. Hence, developing an intervention suited to 21st century learners' needs specifically for the new basic education curriculum can be challenge. The study describes the trends of Senior High School Academic Progression in Mathematics of a school district in a Province of the Philippines through quantitative analysis that tracks students' performance in Grade 9, Grade 10 and Grade 11 mathematics using National Career Assessment Examination (NCAE) Mathematical Ability results, National Achievement Test (NAT) Mathematics results, General Mathematics and Statistics and Probability ratings. Logical Reasoning Test (LRT) results was used as an additional explanatory variable for a Grade 11 Mathematics performance regression equation. Research results revealed that there are pairwise significant relationships between Grade 11 General Mathematics and Statistics and Probability academic performance with a) NCAE Mathematical Ability, b) NAT Grade 10 Mathematics and c) Logical Reasoning. Recommended interventions, for improving Senior and Junior High Mathematics suited to learner's needs were designed.

Keywords

Mathematics Education, Senior High School, Mathematical Performance, NCAE Mathematical Ability, NAT Mathematics, Logical Reasoning Test

1. Introduction

Education is key to elevate the social status of a people, to lessen poverty incidence and to contribute effectively to economic and social development of society. It serves as a fundamental link in attaining national progress. (The Philippine Statistical Yearbook, 2017). The Enhanced Basic Education Act of 2013 or Republic Act No. 10533 is the largest government reform in the history of the Philippine educational system. (DepEd K-12 Conference, 2017). Many view this Act as just an additional two (2) years of secondary education.

The Enhanced Basic Education Act of 2013, aim to develop productive and responsible citizens equipped with the essential competencies, skills and values for life-long-learning and consequently for employment. (DepEd Order No. 43 S. 2013). The K-12 program implementation recorded progressive improvements in the educational system based from the 2016 DepEd Reports. (Andaya, 2016).

One of the indicators of students learning is student performance assessment. Several assessment tools are administered by the DepEd for the purpose. One of these is the National Career Assessment Examination (NCAE) or simply Career Assessment. NCAE is an inherent ability check meshed toward providing data through results of self-assessment, career awareness and career steerage of junior high school students. The National Achievement Test (NAT), an Exit Assessment, is a Philippine- made standardized test designed to determine students' achievement level, strengths and weaknesses in five curricular subject areas (English, Mathematics, Science, Filipino, and Social Sciences) at the end of the school year. (NETRC, 2016).

However, based on the 2016 Philippine Statistics Authority report on the Overall NAT for the past years, learners did not meet the standard set by the DepEd. Data show huge gaps between the elementary NAT and secondary NAT results from 2010 to 2015 as shown in Table 1.

Table 1: NAT Results in Elementary and Secondary Level (2010-2015) National Level

Elementary	SY 2010-11	SY 2011-12	SY 2012-13	SY 2013-14	SY 2014-15
	68.2	66.8	68.9	70.0	69.1
Secondary	SY 2010-11	SY 2011-12	SY 2012-13	SY 2013-14	SY 2014-15
	47.9	48.9	51.4	53.8	49.5

Data retrieved from https://psa.gov.ph/sites/default/files/StatDev%202016_Final_v2_0.xlsx

This research used NCAE and NAT as assessment tools of the DepEd in determining the academic progression of Senior High students in Mathematics from Grade 9 to Grade 11. The study focused on 2018-2019 graduates of a Senior High Schools in a school district. Based from the given data, 65% of students in the said district are in the Technical-Vocational- Livelihood strand. This research analyzed how students’ Mathematical Ability affect senior high school performance. The units of study of this research is a class that completed the Grade 10 NAT examinations in 2017-2018. Also, the performance in NCAE Mathematical Ability, and Grade 11 General Weighted Average (GWA) in General Mathematics, Statistics and Probability were tracked to determine changes in students’ performance from Grade 9 to Grade 11. Finally, based on the results, implications in improving the Senior High School program were recommended.

This study supports the Philippine Development Plan for 2017- 2022 under the pillar of Inequality- Reducing Transformation or “*Pagbabago*”. It emphasizes the aim for accelerating the country’s human capital development thru achieving quality accessible, relevant, and liberating basic education for all. Specifically, it was a plan towards developing and improving interventions and supporting continuous curricular reforms in the basic education. (Philippine Development Plan 2017-2022). With the aforementioned reasons, this study was aligned for a purpose.

2. Methodology

2.1 Research Designs

The study employed the descriptive and inferential methods of research. It considered secondary and primary data to generate the correlation and regression models.

2.2 Respondents

The study utilized data from 2018-2019 senior high school students of a school district in the Province of the Philippines. These students have taken the NCAE and NAT in their Grade 9 and Grade 10, respectively. Data sets were tracked for student respondents with NCAE for Grade 9 Mathematical

Ability, NAT for Grade 10 (extracted from the National database DepEd Central Office) to Final Grades in Grade 11 General Mathematics and Statistics and Probability.

2.3 Research Instruments

The study used a logical reasoning test (also an abstract reasoning test) that was adopted to measure students' logical reasoning skills. It was a 25-item culture-fair and language free measure of ability. It encompasses reasoning by analogy and serial reasoning. (Newton & Bristoll, 2019).

2.4 Procedures

Since the study relied mostly on secondary data sources, the researcher prepared letters of request addressed to the Schools Superintendent for permission to access and to retrieve records of the NCAE and Grade 11 Final Grades in General Mathematics; and Statistics and Probability ratings of the randomized Grade 12 student respondents from six schools of the school district; and to conduct the study in the said district. Subsequently, the researcher informed the respective schools, through individual school heads. NAT for Grade 10 results were requested from the DepEd Central Office-Bureau of Educational Assessment and extracted from the National database. A logical reasoning test was administered to the study units by the researcher.

2.5 Data Analysis

The statistical tools of analysis consisted of frequency count, percentage mean, Pearson r product moment of correlation, scatter plots, and regression analysis. The measures used were guided by a rating scale, a criteria and descriptive ratings to categorize the student's performance in the NCAE and NAT with DepEd students' performance cut-off as reference. The researcher recalibrated Grade 11 rating to even-out range of measures for all the variables using the 0-100%. (Burke, 2001).

3. Results and Discussion

3.1 Relationship of Grade 11 Mathematical Performances, NCAE Mathematical Ability, NAT in Mathematics and Logical Reasoning

This study tracked a set of variables namely NCAE Mathematical Ability for Grade 9, NAT Mathematics for Grade 10, Final Grades for Grade 11 (General Mathematics and Statistics and Probability) and LRT for Grade 12. These variables are described below to provide necessary contexts on each variable as a relevant background for the understanding of their unique contributions to the measure of mathematical competency of senior high students.

Table 2 presents the matrix of characteristics of the study variables NCAE, NAT, Final Grades and the logical reasoning test with respect to their general characteristics, objectives, test design, target

clientele, measures and range of measures. Through this matrix, initial comparability of the data sets was established subsequently consistency of the data measures was ensured.

Information in Table 2 highlight the cross-cutting characteristics of the ratings as standardized measures particularly for NCAE Grade 9 and NAT Grade 10. Final Grade for Grade 11, given that the DepEd instituted rubrics for grading, is relatively standardized. These general characteristics account for comparability of measures in this component. As with the general characteristics so is the design similarly profiled for the four ratings: NCAE Grade 9, NAT Grade 10, Final Grades Grade 11 and Logical Reasoning Test Grade 11. The measures are originally not comparable due to non- uniformity in range of measures thus, it was calibrated to achieve comparability.

Differentiating the study variables, the researcher applied a statistical tool that allow the data to be comparable hence correlation measures may be more refined. Calibration of the data provided the consistency of the variables' measures.

Table 2: Characteristics of NCAE, NAT, Final Grades and Logical Reasoning Test

Mode of Comparison	NCAE	NAT	Final Grades	Logical Reasoning Test
<i>General Characteristics</i>	National Career Assessment Examination also Career Assessment ₁	National Achievement Test also Exit Assessment ₁	Standard and competency based ₂	Abstract reasoning Culture Fair Test ₄
<i>Objectives</i>	-guidance to individual learners for educational and career choices; -basis for profiling learners' aptitude in the four Senior High School tracks: ABM, STEM, HUMSS, TVL, Sports and Arts and Design ₃	-determine if learners meet the learning standards -provide information to improve instructional practices -assess/evaluate effectiveness and efficiency of education service -provide empirical information as bases for curriculum, learning delivery, assessment and policy reviews, and policy formulation ₁	-track and measure learner's progress and identify well suited instruction ₂	-to measure innate ability to perceive relationships and patterns ₄
<i>Test Design</i>	Multiple- choice format ₁	Multiple- choice format ₁	Written, performance task and quarter assessment ₂	Multiple- choice format ₄
<i>Target Learners</i>	Grade 9 ₁	Grade 6, 10 and 12 ₂	Grade 1-12 ₂	

				General Public
<i>Measures</i>	Percentile Rank (position) ₃	Mean Percentage Score ₁	Transmuted Score ₂	Mean Percentage Score
<i>Range of Measures</i>	0-99+ ₃	0-100	60-100 ₂	0-100

1 Department of Education. DepEd Order No. 55 S. 2016: Policy Guidelines on the National Assessment of the Student Learning for the K to 12 Basic Education Program. June 30, 2016.

2 Department of Education. DepEd Order No. 8 S. 2015: Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program. April 1, 2015.

3 Perkins, G. (2015). *2015 National Conference on the Administration of the NCAE, PEPT and TEPT-PST Dr. NELIA V. BENITO, CESO IV Director III*. Retrieved from <https://slideplayer.com/slide/6617523/>

4 Newton, P., & Bristoll, H. (2019). Retrieved from Psychometric Success: <https://www.psychometric-success.com/apptitude-tests/abstract-reasoning-tests>

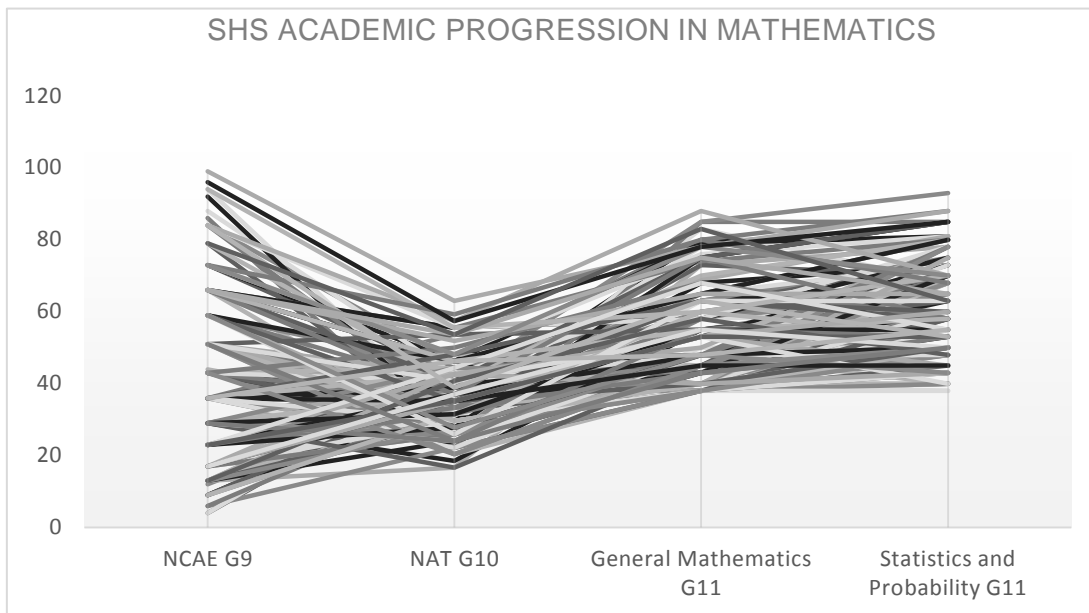
Table 3 presents the correlation test results for SHS Mathematical Performance, NCAE Mathematical Ability, NAT Result in Mathematics and Logical Reasoning Test. General Mathematics and Statistics and Probability were taken individually. Implications of the results could be inferred on how to improve senior high mathematics learning. K-12 learners benefit from the results of this study including from the recommended intervention material.

Table 3: *Correlation Test for Results NCAE Mathematical Ability, NAT Mathematics, and Logical Reasoning Test with SHS Mathematics Performance*

Variables		Correlation Coefficient	P- Value	Significance at $\alpha=0.05$
NCAE Mathematical Ability	General Mathematics	0.5670	0.0000	Significantly Related
	Statistics and Probability	0.5240	0.0000	Significantly Related
NAT Mathematics	General Mathematics	0.3297	0.0000	Significantly Related
	Statistics and Probability	0.2280	0.0051	Significantly Related
Logical Reasoning Test	General Mathematics	0.4226	0.0000	Significantly Related
	Statistics and Probability	0.4241	0.0000	Significantly Related

The correlation tests determined significant relationships between sets of variables considered in this study. The test revealed that Grade 11 final ratings in General Mathematics and in Statistics and Probability are pairwise significantly related to NCAE Mathematical Ability, NAT for Grade 10

Mathematics and Logical Reasoning Test results at $\alpha=0.05$. The highest positive correlation is between NCAE Mathematical Ability and G11 final rating in General Mathematics at $r = 0.5670$. While the weakest correlation is for Grade 10 NAT Mathematics and G11 final rating in Statistics and Probability at $r = 0.2280$. The results imply that students who perform well in an NCAE Mathematical Ability, NAT Mathematics or LRT will more likely have good academic performance ratings in General Mathematics and in Statistics and Probability. Several studies on correlations of the study variables obtained the similar results. These findings affirm that the results obtained in NCAE are consistent with succeeding final ratings in Grades 10 and 11.



<i>M</i>	41.89	37.30	32.38	42.05
<i>SD</i>	23.50	9.37	18.23	18.23

Figure 1: Trends of Senior High School Academic Progression in Mathematics

Taking wider perspective, individual data were utilized to arrive at Figure 1 which depicts the performance trend of senior high students, the school district, in Mathematics in the standard exams NCAE for Grade 9, NAT for Grade 10 and the final grades in General Math and Statistics and Probability for Grade 11. Also, mean and standard deviations further highlight parameters of learners’ progress in the four (4) time periods in high school Mathematics learning.

Figure 1 illustrates that the senior high student's NCAE Grade 9 results were highest evident by its mean and standard deviation. This finding verifies that NCAE as a career assessment, is intended to account for learners' interest not on a set of standard competencies but that it precisely respects learners' individual differences. Also, NCAE by its nature is expected to record relatively higher standard deviation than the other variables in Figure 1. Meanwhile, Grade 10 NAT has lowest mean and lowest standard deviation which indicate that the learners' mathematical competency is significantly lower than their NCAE ratings because NAT Grade 10 does not account for variation in learners' field of interest. The Final ratings for General Mathematics and for Statistics and Probability reveal significant mean. These results in Grade 11 ratings further confirm that the more content-structured General Mathematics course is less easy to understand than the more content-flexible Statistics and Probability course which allows for learner interest-based applications. The foregoing findings imply that for learner's optimal learning as to maximize students' mathematics learning potential, learners must be able or guided to realize its application in their fields of interest and practical realities.

3.2 Recommended Intervention for SHS Mathematics Program

Based on the analysis of the data gathered, presented and interpreted, there is a need to elevate the standard of mathematics education in the school district. Variations in the mean results of NCAE Mathematical Ability, NAT for Grade 10 in Mathematics, and Mathematics performances show that learners find difficulty in reaching proficient mathematics learning levels. Numbers and number sense, is one of the main foundations of mathematics learning selected as the target content that the researcher will focus on based on the least mastered domain in mathematics as an initial stage towards mathematics learning. Self-paced Learning Worksheets in Mathematics is one of the proposed interventions from the results of this study; self-paced e-learning along with conventional teaching is one of the best teaching methods. (Soyemi et al. 2008), thus the proposed intervention.

4. Conclusions and Recommendations

Based from the foregoing results and discussions, it can be inferred that the standard competency cut-off set by the DepEd were not met by the school district, therefore also its students, thus teachers and facilitators of learning need to reflect on how to attain better competency ratings. Low performance in NAT for Grade 10 is indicative that DepEd should continue the existing reviews and reforms for the improvement of SHS program implementation. Also, providing interventions for Mathematical skills development must start from basic education to secondary education.

Since students were not able to apply the mathematical concepts learned necessary in their career path and real world application, optimal learning which maximize students' mathematics learning potential will be attained if learners would be able to realize its application in their fields of interest or practical realities. Thus, development of intervention for SHS General Mathematics and Statistics and Probability can be designed in such a way that it is in line with the students' interest and skills thus, making it applicable in their chosen field of study or SHS track. Also, the use of logical reasoning test starting from Junior High School through SHS is encouraged to develop the learners' critical thinking skills.

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