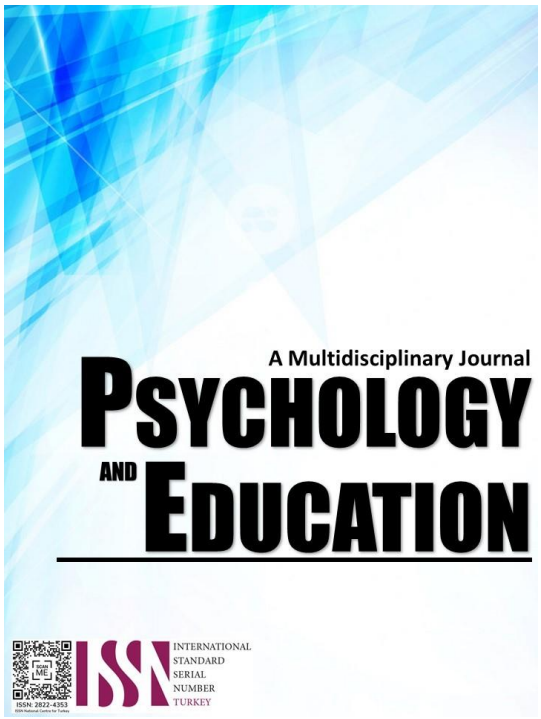
AN ASSESSMENT OF THE NUMERICAL AND ANALYTICAL SKILLS OF GRADE 11 SENIOR HIGH SCHOOL STUDENTS



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Research Article

An Assessment of the Numerical and Analytical Skills of Grade 11 Senior High SchoolStudents

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Abstract

The ability to think logically and solve problems is a skill that students can improve through learning mathematics. It can be used in a wide range of real-world situations: formal and casual. It can be used in business, engineering, sciences, and technologies. The research aimed to determine the level of proficiency of the students' numerical and analytical skills among Grade 11 senior high school students at Talisay City National High School. A non-experimental research design engaging in a descriptive approach was utilized in this study, with 293 students responding using Slovin's formula and the stratified random sampling method. The gathered data were analyzed using the mean and percentage scores to determine the level of proficiency and competence of the students' numerical and analytical skills. The findings revealed that the students in both the Academic and TVL tracks were developing levels of proficiency in numerical skills. On the other hand, the Academic Track students were approaching proficiency in analytical skills, while the TVL Track students were at the developing level of proficiency, which clearly implies that they had a foundational understanding of numbers and operations, but this was insufficient because accurate calculations also involve the interpretation of mathematical data. The researchers concluded that developing mathematics program plans such as remediation and enrichment must be conceptualized in response to the existing mathematical gaps and learning needs of the students and then applied with these skills for practical uses in daily life.

Keywords: *enrichment, remediation, analytical, numerical, mathematics program plan*

Introduction

Learning mathematics aids students in developing their capacity for logical thought and problem-solving. It has a wide range of practical uses in daily life. The most significant aspect of our lives is the basic mathematical operations, such as addition, subtraction, multiplication, and division. In recent years, there has been an increase in enthusiasm for the study of mathematics and its accomplishments due to the subject's significance in the school curriculum and its value as a prerequisite for the growth of numerical and analytical skills.

Problem-solving requires the use of mathematical skills like language, number facts, information, and arithmetic. Mathematics may be difficult for students who lack any of these skills. Moreover, inadequate computation skills, a lack of conceptual understanding of math, difficulty communicating knowledge, difficulty connecting disparate pieces of information, an inability to transform data mathematically, an incomplete command of mathematical terms, insufficient comprehension of mathematical language, and difficulty comprehending and visualizing mathematical concepts can all lead to difficulties (Garnett, 1998; Nathan et al. 2002, as cited in Tambychik & Meerah 2010). In Malaysia, students have difficulties in mathematics due to a deficiency in any of these skills in problem-solving, such as number-fact, visual-spatial, or information skills (Tambychik & Meerah, 2010). Students must be capable of problem-solving since it is crucial for the growth of human skills. In real life, they will be encountering problems, and they must be able to find solutions because it is necessary in order to survive in our everyday lives.

The Programme for International Student Assessment (PISA) is a triennial worldwide test which focuses on the core subjects of mathematics, reading, and science given to 15-year-old students who are nearing the completion of their obligatory basic education, includes DepEd in its 2018 cycle. The significant findings of the assessment are that mathematical literacy scores among Filipino pupils were on average 353 points, far below the OECD average of 489 points, and only 1 in 5 students (19.7%) in the Philippines achieved the required mathematical literacy competency level (Level 2). Indeed, one of the subjects that young Filipinos still find challenging is mathematics.

Teachers handling General Mathematics subjects in Talisay City National High School reported that some Grade 11 students do not have a strong foundation in basic mathematics, which is reflected in their poor academic performance in the subject. Based on the Quarterly Assessment Report in General Mathematics of the Second quarter in the 1st semester of the school year 2022-2023 revealed that 218 out of 1100 which

indicates 19.82% of the students belong to Outstanding, 260 or 23.64% are Very Satisfactory, 317 or 28.82% are Satisfactory, 240 or 21.82 % are Fairly Satisfactory, and 65 or 5.91% of the students Did Not Meet Expectation. It is apparent from the report that some students have difficulties learning mathematics.

In this study, the researchers aimed to determine the level of proficiency in numerical and analytical skills of grade 11 senior high school students at Talisay City National High School. The findings will serve as the basis for the proposed mathematical program, which helps to fill existing gaps and enrich the learning of mathematics subjects.

Research Questions

The research's primary objective was to determine the level of proficiency in numerical and analytical skills of senior high school students in grade 11. Specifically, it addressed the following sub-problems:

1. What is the student's level of proficiency in terms of:
   1.1 numerical; and
   1.2 analytical skills?
2. Based on the study's findings, what mathematical program can be proposed?

Literature Review

Mathematical competence is an expression of an individual's mathematical ability through the acquisition of knowledge, the ability to recognize meanings, roles, and basic properties of mathematics, as well as the use of that knowledge to solve problems (Tong et al., 2020). The process of applying previously acquired knowledge relies on the use of mathematical thinking skills, which include problem analysis, idea summation, comparison with related knowledge, abstraction of the problem, and generalization of its solution. The capacity for individual mathematical thought varies due to the dependence on knowledge acquisition, thinking, analyzing, comparing, abstracting, effectively generalizing the problem by shaping it into assumptions, and problem-solving in various contexts. The most crucial abilities that are formed during the process of teaching mathematics are numerical and analytical skills, a problem-solving mindset, and critical thinking. These abilities are also the foundations of sustainability.

Numerical Skills

Wortha et al. (2023) argued that students' numerical development is driven by the acquisition of basic numerical skills. These fundamental numerical abilities are thought of as the foundation for further numerical and mathematical success. Basic numerical abilities, such as symbolic and non-symbolic magnitude knowledge, spatial magnitude representation using the mental number line as a metaphor, comprehension of the Arabic number system's place-value structure, acquisition of arithmetic fact knowledge, and procedural and conceptual numerical knowledge skills, have all been proven to be crucial for successful numerical development. Moreover, the numerical ability is an ability related to accuracy and speed in using basic functions and also relates quickly and precisely in calculating mathematical basis calculation operations (Irawan and Kencanawaty 2016 as cited in Tsani et al., 2020)

We live in a world full of numbers, so being numerate—that is, having a solid understanding of and ability to use numbers—is crucial for us to properly manage our lives. Bynner et al. (1997) found that people without numeracy skills left school early, frequently lacked qualifications, and had more difficulty getting and maintaining full-time employment. The jobs entered were generally low-level, with limited training opportunities and poor pay and prospects.

Analytical Skills

According to Montaku (2012), analytical thinking is the activity of examining and breaking down information into smaller parts by identifying causes, drawing conclusions, and finding evidence to support generalizations. Moreover, Robbins (2011) defined the analytical-thinking aspects that are needed to solve the problem through problem identification and further investigation. Rahman (2019) suggested that problem-solving consisted of two major skills: observation, which refers to collecting data and understanding and interpreting the meaning of the information using all the senses, while critical thinking involves the individual's ability to do the following: conceptualize, apply logical reasoning, apply strategy, use analytical thinking, make decisions, and synthesize to solve any problem.

The process of making decisions and solving problems requires students to apply and integrate a variety of mathematical concepts and skills. Conceptual understanding and procedural knowledge are essential to problem-solving skills (Geary, 2004, as cited in

Tambychik & Meerah, 2010). Solving problems became tough due to a lack of numerous mathematical skills. In Malaysia, many students struggled in mathematics due to a lack of problem-solving skills such as number-fact, visual-spatial, or information skills (Tambychik & Meerah, 2010). On the other hand, according to Leongson and Limjap (2003), Filipino pupils are found to do alarmingly poorly in subjects demanding higher order thinking skills, despite being excellent at acquiring knowledge. The students' difficulties with recalling and comprehending concepts, formulas, facts, and procedures, as well as their inability to visualize problems and concepts, made mathematics a difficult subject for them to learn.

Aunio and Räsänen (2015) outlined a practical model for core mathematical skill teachers that focuses on four main areas: (1) symbolic and non-symbolic number sense; (2) comprehending mathematical linkages; and (3) problem-solving abilities. (early mathematical-logical principles, arithmetic principles, mathematical operational symbols, place-value, and the base-ten system); (3) counting skills (knowledge of number-symbols, number word-sequence, and an enumeration with concrete objects); and (4) fundamental mathematical abilities (arithmetic combinations, addition and subtraction skills with number symbols). By implementing this working model, educators will be able to plan their support more thoroughly and increase the student's mathematical competence.

In order to survive in the modern world, it is found to be important to develop 21st-century skills like communication, creativity, innovation, metacognition, and problem-solving (Rahman, 2019). Furthermore, problem-solving is a necessity in daily life and is regarded as the language of mathematics. Therefore, this study incorporates the significance of numerical and analytical skills not only in academic success at school but also in the general prospects of life.

Methodology

A non-experimental research design involving a descriptive approach was used in this study to determine the level of proficiency of numerical and analytical skills of grade 11 senior high school students.

Participants

The respondents of the study were grade 11 senior high school students at Talisay City National High School. It has a total population of 1119 students. 622 of which were from the Academic Track, composed of 145 Accountancy, Business, and Management (ABM) students, 146 General Academic Strand (GAS) students, 249 Humanities and Social Sciences (HUMSS) students, and 82 Science, Technology, Engineering, and Mathematics (STEM) students. In addition, 497 of these were Technical, Vocational, and Livelihood Track (TVL), composed of 203 Computer System Servicing (CSS), 98 Front Office Services (FOS), 43 Dress Making (DM), 104 Electrical Installation and Maintenance (EIM), and 49 Electronic Product Assembly and Servicing (EPAS) students. The researchers used Slovin's formula with a 5% margin of error to calculate the sample size (Slovin, 1960). Hence, there were 295 respondents in this study. A stratified random sampling was utilized in determining the number of respondents for each strand, of which there were: 38 ABM, 54 CSS, 11 DM, 27 EIM, 13 EPAS, 26 FOS, 38 GAS, 66 HUMSS, and 22 STEM students. The Grade 11 students were chosen as respondents to determine their numerical and analytical skills as they will be dealing with the mathematics subject in the second semester.

Instruments of the Study

To determine the level of proficiency in numerical and analytical skills of Grade 11 senior high school students, the researchers utilized a modified questionnaire (a hybrid measure) adopted from various numerical and analytical assessments as an instrument for data collection. To confirm its reliability and validity, the research instrument was validated and approved by the Master Teacher. The instrument is composed of 20 items, 10 of which are numerical problems and 10 are analytical problems. The researchers determined the level of proficiency of the learners' numerical and analytical skills through the following categories of achievement: (81%-100%) Advanced, (61%-80%) Proficient, (41%-60%) Approaching Proficiency, (21%-40%) Developing, and (0-20%) Beginning.

Procedure

Data collection involved several processes. Primarily, the researchers secured a letter of permission to carry out the study from the school research coordinator and school head of Talisay City National High School. After the permission has been granted, a research instrument would be created and undergo a validation process by the subject expert since this is a researcher-made questionnaire. On a voluntary basis, informed consent for the study's participants would be obtained

after ensuring that the research tool is already valid and reliable. The researchers then conducted the survey. Upon the retrieval of the survey questionnaires from the respondents, the gathered data were tallied, tabulated, and analyzed using the most accurate statistical tools by getting the average percentage score and level of proficiency in numerical and analytical skills of grade 11 senior high school students.

Ethical Considerations

The researcher adhered to all guidelines in conducting the study, including those related to ethics. This study would be subject to an ethical assessment and approval by the relevant authorities before it was carried out. The researcher asked the respondent if they would be willing to participate in the study with their full consent. The researcher would make sure that all research operations, especially those that involve data collection (survey questionnaires), adhered to the highest standards for safeguarding human rights and safety. Participant rights had to be fully expressed as part of the survey procedure, which the researchers ensured that respondents were safeguarded from unintended harm in the areas of confidentiality and informed consent. Finally, they were given a guarantee that all study materials would be taken down when the course was over.

Results and Discussion

The results of the study's research question are presented in this section. A mean and percentage score were utilized in this study to determine the proficiency level of numerical and analytical skills in grade 11.

Respondents' Proficiency Level of Numerical and Analytical Skills

This part is composed of four different tables for the level of proficiency in numerical and analytical skills. Tables 1-2 show the numerical skills, while tables 3-4 show the analytical skills of the academic and TVL tracks.

Numerical Skills. Determining the level of proficiency in numerical skills of the students was based on the scores of the written examination, which covered basic knowledge of numbers, calculation skills, interpreting mathematical information, and measurement and data analysis.

Table 1. *Mean score and interpretation of the level of proficiency of numerical skills of the Academic Track*

Academic Track	*Numerical Skills*		*Interpretation*
	Mean Score	*Percentage Score*	
Accountancy, Business, and Management	4.58	46%	Approaching Proficiency
General Academic Strand	3.45	35%	Developing
Humanities and Social Sciences	2.92	30%	Developing
Science, Technology, Engineering, and Mathematics	5.00	50%	Approaching Proficiency
Grand Mean	3.99	40%	Developing

Table 1 shows the level of proficiency of the academic track in terms of numerical skills. As reflected in the table, the grand mean of the academic track is 3.99, or 40%, which is categorized as developing. The STEM has the highest mean score of 5.00, or 50%, with an interpretation of "approaching proficiency. Next, the ABM got a mean score of 4.58, or 46%, with an interpretation of "approaching proficiency." Lastly, the GAS and HUMSS strands were at the developing level of proficiency with a mean score of 3.45, or 35%, and 2.92, or 30%, respectively. It is apparent that they were approaching proficiency levels, which means that they acquired basic knowledge of numbers and operations, but these were not enough skills as it also requires the interpretation of mathematical information to have the right calculation. It is also evident that ABM and STEM are approaching proficiency levels for the reason that the students in these strands are mathematically inclined, as this program deals with numbers. However, the GAS and HUMSS have Developing Proficiency levels since these students were more focused on honing their minds and their social skills. According to Cerbito (2020), STEM and ABM students were in the advanced and proficient levels of proficiency in mathematics competency, which implies they had a favorable attitude toward mathematics and a strong belief in its utility. On the other hand, Espino et al. (2017) pointed out that students who are unsure of the field they wish to study in college are included in the GAS, and because HUMSS offers few arithmetic courses in its curriculum compared to ABM and STEM, which both provide more math subjects, students with math phobia choose HUMSS as their professional path. Moreover, Sison et al. (2017) highlighted that the HUMSS strand is committed to helping students develop a strong liberal arts background, explore the theoretical underpinnings of their chosen careers, and gain practical work experience.

Table 2. *Mean score and interpretation of the level of proficiency of numerical skills of the Technical, Vocational, and Livelihood Track*

Technical, Vocational, and Livelihood Track	*Numerical Skills*		*Interpretation*
	Mean Score	*Percentage Score*	
Computer System Servicing	3.56	36%	Developing
Dress Making	2.25	23%	Developing
Electrical Installation and Maintenance	1.93	19%	Beginning
Electronic Product Assembly and Servicing	2.93	29%	Developing
Front Office Services	3.15	32%	Developing
Grand Mean	2.76	28%	Developing

Table 2 shows the level of proficiency of the TVL track in terms of numerical skills. The TVL track's grand mean is 2.76 or 28%, which is categorized as "developing," as seen in the results. The CSS, FOS, EPAS, and DM strands were at the developing level of proficiency with a mean score of 3.56 or 36%, 3.15 or 32%, 2.93 or 29%, and 2.25 or 23%, respectively. On the other hand, the EIM strand got the lowest mean score of 1.93, which is interpreted as Beginning. The developing proficiency level in numerical skills of TVL track students means that these students may have basic knowledge of numbers but are limited in their calculation skills. It is also shown that the CSS strand performed better than the other strands in the TVL track because they also have an affinity for arithmetic, the arts, information technology, and office jobs. Mamolo (2019) asserts that Computer Servicing System (CSS) is demonstrated to have more knowledge than Home Economics and other strands in the TVL track since their preferences are also to mathematics, the creative arts, information technology, and office work. The Information and Communication Technology (ICT) strand, which includes Computer System Servicing (CSS), has a preference for office work, the creative arts, mathematics, and information technology. The other strands, such as Home Economics (HE), Agri-fishery, and Industrial Arts, tend to emphasize manual work, outdoor agriculture, physical activity, risk-taking, and skilled trades (Magno and Piosang, 2016).

Analytical Skills. Determining the level of proficiency in analytical skills was based on the scores of the written examination, which covered identifying the problem, gathering information, and developing and testing solutions.

Table 3. *Mean score and interpretation of the level of proficiency of analytical skills of the Academic Track*

Academic Track	*Analytical Skills*		*Interpretation*
	Mean Score	*Percentage Score*	
Accountancy, Business, and Management	7.08	71%	Proficient
General Academic Strand	4.88	49%	Approaching Proficiency
Humanities and Social Sciences	5.08	51%	Approaching Proficiency
Science, Technology, Engineering, and Mathematics	7.57	76%	Proficient
Grand Mean	6.15	62%	Approaching Proficiency

Table 3 shows the level of proficiency of the academic track in terms of analytical skills. It is evident from the results that the grand mean of the academic track is 6.15, or 62%, which is categorized as proficient. The STEM and ABM strands were at the proficient level with a mean score of 7.57 or 76% and 7.08 or 71%, respectively. However, the HUMSS and GAS strands were at the "approaching proficiency" level with a mean score of 5.08, or 51%, and 4.88, or 49%, respectively. The Academic Track's proficiency level in analytical skills, which is approaching proficiency, implies that they have satisfactory knowledge and skills in being analytical. They could identify the problem, gather information on the situation, and find a solution, but it was not likely the right solution to the problem. It is undeniable from the result that the STEM strand got the highest mean score in analytical skills. Mamolo (2019) found that STEM students appeared to be more knowledgeable in the area of mathematics compared to the other strands in the academic track, including ABM, GAS, and HUMSS. It might be due to STEM students exhibiting superior aptitude relative to the other strands, which have diverse aptitudes in number and letter series, visual discernment, and mathematics. It is proven that the academic track puts substantially more effort into math than the vocational track does (Carbonaro, 2015).

Table 4. *Mean score and interpretation of the level of proficiency of analytical skills of the Technical, Vocational, and Livelihood Track*

Technical, Vocational, and Livelihood Track	*Analytical Skills*		*Interpretation*
	Mean Score	*Percentage Score*	
Computer System Servicing	4.07	41%	Approaching Proficiency
Dress Making	3.25	33%	Developing
Electrical Installation and Maintenance	3.17	32%	Developing
Electronic Product Assembly and Servicing	4.21	42%	Approaching Proficiency
Front Office Services	4.04	40%	Developing
Grand Mean	3.75	38%	Developing

Table 4 shows the level of proficiency of the TVL track in terms of analytical skills. The grand mean of the TVL track is 3.75, or 38%, as shown by the results, and is labeled as "developing". The EPAS and CSS strands were at the approaching proficiency level with a mean score of 4.21 or 42% and 4.07 or 41%, respectively, while the FOS, DM and EIM strands were at the developing level of proficiency with a mean score of 4.04 or 40%, 3.25 or 33%, and 3.17 or 32%, respectively. The developing level of proficiency in the analytical skills of the TVL track suggests that they have insufficient skills in identifying the problem and gathering information. It is clear that these skills were not mastered. Hence, developing and testing solutions had been more challenging for them. It is evident that the analytical skills of TVL are lower compared to the academic track. One reason for this could be that they are more focused on developing their practical skills. The TVL track differs greatly from the academic track and has a fair competency in mathematics because they are more focused on developing skills for vocational occupations (Mamolo, 2019). Additionally, Guill et al. (2017) revealed that the mean IQ score in mathematics competencies of the matched group of non-academic track students was considerably lower than that of academic track students.

Conclusion

This study was formulated to determine the student's level of proficiency in numerical and analytical skills among Grade 11 senior high school students. The study's findings revealed that the students in both the academic and TVL tracks were developing levels of proficiency in numerical skills. On the other hand, the Academic Track students were approaching proficiency in analytical skills, while the TVL Track students were at the developing level of proficiency, which clearly implies that they had a foundational understanding of numbers and operations, but this was insufficient because accurate calculations also involve the interpretation of mathematical data. To fill the gap left by the provided results, a corresponding action must be taken. Hence, designing a mathematical program such as remediation and enrichment to respond to the specific needs of the students is highly recommended to enable them to use these skills in their next endeavor

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