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# Development and Validation of Assessment Tasks and Rubrics to Enhance Students' Proficiency in Solving Problems Involving Similarity of Triangles

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**Abstract**

The study focuses on developing and validating assessment tasks and rubrics to enhance students' mathematical proficiency to solve real-world problems involving the lessons about the Similarity of Triangles. The assessment tasks and rubrics were developed to test their effectiveness in the mathematical proficiency level of Grade 9 students in geometry. This was undertaken using an embedded experimental mixed-methods research design. The quantitative data collection is the primary phase, while the qualitative data collection is the supplementary phase. The qualitative phase consisted of in-depth interviews before, during and after the quantitative phase. The researcher developed four assessment tasks and rubrics that involve lessons on the similarity of triangles. These were validated before the data collection procedure. When all the preliminaries were cleared, the respondents answered the pretest examination, including real-world problems involving the Similarity of Triangles. Assessment tasks and rubrics were utilized for four weeks before taking the post-test examination. A T-test for paired two samples for mean was used to determine the significant difference between students' mathematical proficiency before and after the intervention phase. Results showed that the developed rubrics have positive effects on the level of proficiency of the respondents by improving their confidence level and by enhancing the accuracy of getting the correct answers to the problems. It was concluded that the tool may be used to guide and enhance students' mathematical proficiency in solving problems involving the Similarity of Triangles. It is recommended that Grade 9 students may incorporate assessment tasks and rubrics as a learning guide in solving problems involving Similarity of Triangles.

**Keywords:** Assessment Tasks and Rubrics, development, validation, similarity of triangles

## Chapter 1
## Introduction

The Philippine education system aims for learners to address the needs of the 21st century learners. This makes the learners globally competitive and directs them to think critically, creatively, collaboratively, and innovatively. In line with the two main objectives of the mathematics curriculum in the basic education levels, critical thinking, and problem-solving skills, an individual can unveil these twenty-first-century skills by promoting logical and real-life applications.

According to the Department of Education's (DepEd) K to 12 Curriculum Guide in Mathematics issued in August 2016 (Pelaez, 2018), the focused competencies that a Filipino learner can develop are the critical thinking and problem-solving skills. Moreover, these goals must be accomplished through well-organized curriculum and a clear set of advance abilities. Darling-Hammond et al. (2019) stated that problem-solving remains a prominent emphasis of K-12 mathematics education reform, as it is one of the abilities that is becoming more prevalent during the primary education years. On the other hand, critical thinking seems like it could be better developed in many learners and is less emphasized in curricula (Ma et al., 2023).

Based on the results of international, national and local assessments, most Filipino learners have low mathematical proficiency. For international assessments, the Program for International Student Assessment (PISA), administered every three years, examines the proficiency of 15-year-old students in mathematics, reading, and science. This assessment determines students' proficiency to solve problems, to think critically, and to communicate clearly (PISA 2022 Results - Country Notes: Philippines, 2022). The Philippines started to join the PISA program in 2018 and has continued to be involved in PISA 2022. Moreover, Trends in International Mathematics and Science Study (TIMSS) is another international assessment that evaluates students' skills and knowledge in Mathematics and Science (TIMSS - TIMSS, 2015). This study is administered every four years, and the participants are coming from Grades 4 and 8. These international assessments give an important understanding of students' performance and educational practices worldwide. They aim to assess and compare educational systems, allowing countries to see how their students fare relative to international peers. By analyzing the international results, DepEd, curriculum developers, school administration, and teachers in the Philippines can gain insights from other countries' educational strategies and practices.

The PISA 2018 results revealed that the Philippines had a low performance in mathematics as compared to the other included Organization for Economic Cooperation and Development (OECD) countries (Schleicher, 2019). The Philippines is at 78$^{th}$ rank out of 79 countries participating and scored 353 points in Mathematics Literacy in contrast to the OECD average of 489.

In the recently concluded PISA 2022, the Philippines ranked 76$^{th}$ among the 81 associating countries and economies in terms of students' mathematical proficiency. It revealed that the Philippines scored 355 points in Mathematics Literacy, while the OECD average was 472, as reported in the study of Acido and Caballes (2024). It was also stated that 16% of students reached a minimum Level 2 proficiency in mathematics, a vast difference from the OECD average of 69%. At this proficiency level, students are expected to interpret and represent simple mathematical situations independently. Students can independently compare distances between objects or convert money into different currencies. Furthermore, a negligible proportion of students reached the top proficiency levels, Levels 5 or 6, in contrast to the OECD average of 9% (PISA 2022 Results (Volume I and II) - Country Notes: Philippines, 2022).

Another international assessment in math and science, the TIMSS 2019, showed that the Philippines ranked the lowest out of 58 countries in fourth-grade Mathematics with a score of 297, which is significantly lower than any other participating countries, while it did not participate in the eighth grade (Karali et al., 2022). As Mullis (2020) reported, results show that only 1% of Filipino students reached the highest performance level. This small proportion of students can apply advanced conceptual understanding to solve complex problems. Also, these students are proficient at using their knowledge of whole numbers to solve two-step word problems. Other skills of the students under this performance

level are the following: having a solid understanding of the lessons about number patterns, divisibility, approximations, and calculations involving fractions and decimals.; skilled at solving fundamental measurement problems; analyzing geometric fundamentals about shapes and angles; and interpreting data from various charts and graphs.

Conversely, 6% of Filipino students attained the intermediate level. This implied that students demonstrate their ability to apply basic mathematical concepts to more straightforward situations. Finally, 19% of Filipino students fell within the lower performance benchmarks. These students can perform addition, subtraction, multiplication, and division with one- and two-digit numbers, solve simple real-world word problems, have an elementary grasp of fractions and geometric shapes, interpret simple bar graphs.

Locally, the following were the results of some national assessments in the Philippines. This includes the Early Language, Literacy, and Numeracy Assessment (ELLNA), Exit Assessments for Grade 6, Grade 10 and Grade 12, and Career Assessments. ELLNA is administered at the end of Grade 3 to check the understanding of the learners in early language, literacy, and numeracy areas. On the other hand, Exit Assessments are administered to determine whether the learning competencies for Elementary, Junior High School and Senior High School are achieved. Lastly, Career Assessments are administered in Grade 9 to identify the learners' skills, abilities, and occupational interest for career guidance.

In Cordillera Administrative Region (CAR), the results are as follows: ELLNA S.Y. 2016-2017, the Mean Percentage Score (MPS) was 42.57 with an average of 8.51 and a standard deviation of 4.85; for ELLNA S.Y. 2017-2018, the MPS was 42.23 with an average of 8.45 and a standard deviation of 4.73; Basic Education Exit Assessment (BEEA) S.Y. 2018-2019, the MPS was 28.84 with an average of 17.30 and a standard deviation of 5.24 (Duno, 2019). This indicates that the student's mathematical proficiency levels fell in the Low Proficient and Not Proficient range, respectively. Overall, CAR did not achieve a proficiency and accuracy level of 75% in numeracy for Grade 3 as exhibited in the results of ELLNA for S.Y. 2016-2017, 2017-2018 and BEEA for S.Y. 2018-2019 (DepEd, 2017; DepEd, 2018; & DepEd, 2019).

In the DepEd - National Report of the Philippines (2019), students showed poor performance in terms of competency and accuracy in some learning areas for Grades 6, 10, and 12, as presented by the findings of 21st Century Skills and learning areas examined in local assessments, established on the results of the National Achievement Test (NAT) 2018.

NAT 2018 results in Region II in Mathematics are as follows: the Mean Percentage Score (MPS) for Grade 6 was 36.66, 34.82 in Problem Solving (PS), 43.22 in Information Literacy (IL), and 31.93 in Critical Thinking (CT). This indicates that the Grade 6 learners' Mastery Level Index (MLI) is within Average Mastery; the MPS for Grade 10 was 35.34, 39.95 in PS, 33.66 in IL, and 32.42 in CT. This implies that the MLI of Grade 10 students falls within the range of Average Mastery. This also demonstrates that learners performed way below the acceptable MPS, with the MPS for Grade 12 being 31.02, 28.15 in PS, 34.98 IL, and 29.94 in CT. This demonstrates that the MLI falls within Average Mastery and that learners performed way below the acceptable MPS. Results for Grade 6 reveal the urgent need for more intervention programs and activities to increase learners' performance. The results of Grade 10 indicated a deficient performance of students and a need to focus on CT skills. Lastly, Grade 12 indicates a deficient performance of senior high school students and needs to focus on enhancing CT skills. Overall, Region II could not surpass a proficiency and accuracy level of 75% in all

subject areas for Grades 6, 10, and 12, as presented by the findings of 21st Century Skills and mathematics as one of the learning areas (DepEd, 2018).

In Region III, the NAT results in Mathematics are as follows: for S.Y. 2016-2017 the MPS for Grade 6 was 34.14, 35.20 in Problem Solving (PS), 31.02 in Information Literacy (IL), and 36.19 in Critical Thinking (CT). This indicates that the Grade 6 learners' Mastery Level Index (MLI) was within Low Mastery; the MPS for Grade 10 was 35.64, 36.04 in PS, 35.54 in IL, and 35.52 in CT. This implies that the MLI of Grade 10 students fell within the range of Average Mastery; for S.Y. 2017-2018 the MPS for Grade 6 was 37.35, 34.00 in Problem Solving (PS), 42.54 in Information Literacy (IL), and 35.52 in Critical Thinking (CT). This indicates that the Grade 6 learners' Mastery Level Index (MLI) was within Average Mastery; the MPS for Grade 10 was 33.87, 38.09 in PS, 31.88 in IL, and 31.65 in CT. This implies that the MLI of Grade 10 students fell within the range of Low Mastery. This also demonstrates that learners performed way below the acceptable MPS, with the MPS for Grade 12 being 29.21, 27.29 in PS, 32.30 IL, and 28.04 in CT. This demonstrates that the MLI falls within Low Mastery and that learners performed way below the acceptable MPS. Results for Grade 6, 10, and 12 reveal the urgent need for more intervention programs and activities to increase learners' performance. Overall, Region III could not surpass a proficiency and accuracy level of 75% in all subject areas for Grades 6, 10, and 12, as presented by the findings of 21st Century Skills and mathematics as one of the learning areas (DepEd, 2017; & DepEd, 2018.)

To provide more detailed analysis of the data, the results in the NAT in Mathematics for the Schools Division Office of Angeles City in Region III are as follows: for S.Y. 2016-2017, the MPS for Grade 6 was 36.96, Average Mastery, with 38.30, 33.31, and 39.26 in PS, IL, and CT, respectively. The MPS for Grade 10 was 38.28, Average Mastery with 38.27, 37.94, and 38.62 in PS, IL, and CT, respectively; for S.Y. 2017-2018, the MPS for Grade 6 was 40.66, Average Mastery, with 39.03, 45.22, and 37.74 in PS, IL, and CT, respectively. The MPS for Grade 10 was 36.47, Average Mastery with 41.05, 34.23, 34.13 in PS, IL, and CT, respectively. Lastly, the MPS for Grade 12 was 29.58, Low Mastery with 28.58, 32.27, 27.90 in PS, IL, and CT, respectively (Schools Division Office of Angeles City [SDO], 2017; & SDO, 2018). Similar to the recommendations for Region III, results for Grade 6, 10, and 12 reveal the urgent need for more intervention programs and activities to increase learners' performance.

Problem-solving skills are activities that an individual performs using previously taught knowledge and skills acquired in dealing with new and unfamiliar problems. It is a process of using existing knowledge and generating new knowledge (Al-Ayasrah, 2015; Nadila, 2021). According to Abdellatif and Zaki (2020), problem-solving is an important requirement in an individual's life since numerous challenges they experience daily require solutions. However, according to Callaman and Itaas, as reported by Auxtero and Callaman (2021), one of the main reasons students dislike math is that they do not see its importance in their daily lives. This can be a significant barrier to accomplishing the goals of achieving the needed skills.

Based on current studies on the mathematics performance of Filipino learners for both international and local assessments, it is imperative to provide an intervention of improving students' mathematical proficiency through the development of problem-solving skills. This approach follows the DepEd's K-12 Curriculum System Framework, which enhances the critical thinking and problem-solving skills of Filipino learners.

Teachers play a vital role in guiding students to accomplish these twin goals. One method for tracking their progress is providing specific instructions and a scoring rubric. Furthermore, learners are directed

to the crucial criteria that weigh more heavily than others. As stated in the study of Chowdhury (2018), a well-designed rubric can be applied as an educational tool to facilitate student learning. These aid students in determining the degree to which their current performance meets each significant criterion and what efforts can be made to improve the quality of their work. Rubrics, according to Kinne et al. (2014), support and increase teaching efficacy. Teachers increase the unbiased nature of grading by using rubrics for summative assessments.

A rubric, defined by Kocakülah (2022), is a learning tool that evaluates and guides students' work according to the criteria specified by a predefined proficiency level. Also, this provides immediate feedback on a specific criterion, objectively evaluates the work, and reduces conflict in scoring (Balch et al., 2016). This serves as a scoring guide to the students' students' outputs, projects, and other performance-based activities. Additionally, as mentioned by Tenam-Zemach and Flynn (2015), rubrics serve as a crucial and accountable tool for enhancing the quality of education, and their usage in education has been widespread. Moreover, Schoepp and Kranov (2018) reported that their most recent Google Scholar search yielded 54 papers and 347,000 hits for the keyword "rubric" and its associated terms, such as "practical assessment" and "research evaluation". It demonstrates how rubrics have grown in popularity due to their significance and applicability to modern classroom assessments and evaluations.

The holistic and the analytic rubrics are the two-widely used types of rubrics. A holistic rubric evaluates performance across various criteria (Chan, 2015). This allows the evaluator to assign a single score based on the judgment of the overall work. On the other hand, an Analytic rubric is a type of rubric that focuses on the most important characteristics related to performance criteria. (Noh et al., 2021) This provides distinct levels of achievement for each criterion, allowing evaluators to assess student's performance individually (Battershill & Ross, 2017). This type of rubric is a scoring instrument that displays the desired skill and score based on the descriptors assigned to each score in each criterion. These rubrics create a standard framework and language for assessment, are criterion-referenced, and make complex output to be evaluated objectively (Assessment and Curriculum Support Center, 2024).

Rubrics are often used in many areas of learning in educational systems. Aside from classroom-based activities or projects, these are also used to analyze and evaluate various tasks and assessments. Based on the findings of Carson and Kavish (2018), the use of rubrics for scaffolding enhances writing and benefits both accountability and assessment goals. Scaffolding can help students progress through the stages of Bloom's cognitive taxonomy to achieve mastery of certain abilities. It was shown in their study that scaffolding rubrics were used to target both student learning and technical writing abilities.

Additionally, results after the intervention of the utilization of rubrics in the studies of Shadle et al. (2012), Panadero and Jonsson (2013), Kasimatis and Papageorgiou (2019); Mustafa and Raisha (2021); and Noh et al. (2021) concluded that majority of the students achieved all the performance criteria at an acceptable level. Even during the latest pandemic, the value of rubrics and standardized assessment procedures in providing fair scores to learners was recognized and implemented (Al-Bargi, 2022). Furthermore, Brookhart and Chen (2015) synthesized the findings of the utilization of rubrics in the education setting published from 2005 to 2013. Based on the findings of their study, the overall effect of utilizing rubrics on student's performance is positive. However, there were pieces of evidence that respondents' insights on self-regulation are varied, while connections to motivation to learn is on the positive side. As stated by Johnsson (2014), it is possible to express expectations to students using

rubrics. They not only appreciate the efforts to create rubrics clear but also utilize these rubrics to guide them to assess their performances.

Auxtero and Callaman (2021) recently stated in their study that employing a rubric as a learning aid in teaching Basic Calculus enhances students' performance. Rubrics educate students on how to apply procedural knowledge to solve real-world problems involving the use of derivatives.

Recent studies have found the efficacy of using rubrics in some other fields. Güneş et al. (2017) designed and validated a reliable measuring method with rubrics to assess teachers' self-efficacy. A 28-item measurement tool with a four-factor structure was obtained from validity and reliability analyses. Researchers can use the constructed measure to investigate correlations between teachers' self-efficacy and various educational variables. Menéndez-Varela and Gregori-Giralt (2018) identified the effectiveness of rubrics in supporting the incorporation of undergraduate students into assessor teams to improve their professional judgment. It has been established that incorporating students into assessment teams results in educational gains. Rubrics can aid in the incorporation of students into an assessment culture.

Furthermore, using a rubric as a learning resource helps students improve their professional judgment. The rubric can also be used as an essential tool to identify relevant competencies for employability. Sánchez et al. (2022) created and validated an assessment rubric for important employability qualities. The following competencies were chosen: (1) problem-solving, (2) teamwork, (3) adaptive capacity, (4) communication, (5) creativity, (6) leadership, and (7) decision-making.

As stated in Popham's article, reiterated by "What's Wrong--and What's Right--with Rubrics – ProQuest" (2025), in creating effective rubrics, there should exist three essential features: Evaluative Criteria, quality definitions, and scoring strategy. Evaluative criteria are the specific dimensions that needs to be addressed and evaluated. Quality definitions are the descriptors with varying degrees of quality in work for each evaluative criterion. Scoring strategy is the method to assign scores based on the quality definitions that enables to determine how the levels of performance are quantified. Furthermore, adding overall impact in the essential features balances subjectivity with structure of the rubrics. It summarizes how well various components of the work come together to achieve the purpose (McTighe & Frontier, 2022). These essential features ensure consistency and objectivity in evaluating one's work.

The study by Chan and Ho (2019) was conducted to discover various perspectives of students and educators on the pros and cons of rubric practices. The best practices were divided into four categories: (1) generalized evaluation methods, (2) objectivity of evaluation, (3) recommendations for student work, and (4) clarity in the review process. On the other hand, the bad practices in using rubrics were (5) vague explanations in marking rubrics and (6) failure to offer the ranges of marks for each grade. Furthermore, it was concluded that good rubrics can provide fair and consistent marking and more objective assessments of students' accomplishments, promoting academic standards.

Some studies need to be more consistent with the effectiveness of utilizing rubrics for assessing students' performances. According to Ari's findings (2021), the researchers should have placed a higher value on the validity of rubrics—some of the studies given needed to be more consistent and provide more information about reliability. Gottlieb and Moroye (2016) argued that, while rubrics can be used beneficially, they are still not enough to achieve any solid sense of objectivity and that carrying out accurate and complex judgment for case-to-case studies of student work remains an unavoidable, time-consuming, yet necessary responsibility for teachers. Additionally, teacher educators and preservice teachers may be a factor when they have limited assessment literacy knowledge (Hodges et al., 2019).

The assessment rubric often needs more flexibility and details and needs to be more utilized (Bukhari et al., 2021). The findings of their study indicate that the student's writing improved significantly between the three revisions. Following implementing the departmental rubric, each pair of students and teacher who supervises noted enhancements in the students' skills in research writing. They highlighted additional and specific improvements with the newly modified rubric, particularly in the extent of the review of related literatures, statement of the problem, operational definitions of terms.

Another component affecting students' performance is the rubric itself. Mustafa and Raisha (2021) validated a proposed rubric from Mustafa et al. (2019) concerning the significance of vocabulary e-learning: A comparison on the effects of training in reading skills with and without vocabulary homework. The results suggest that the grades for seven of the twenty criteria in the rubric needed to be revised since they differed significantly from the grades proposed by the students.

Wind (2020) investigated techniques for assessing how consistently raters employ a common rating scale. Although using analytic rubrics for writing assessments provides initial information about students' strengths and weaknesses in various areas, such as the meaning and mechanics of their composition, the results in both examples showed inconsistency in the functionality of rating scale categories across domains for several evaluators.

Reddy and Andrade (2010) examined empirical studies on the usage of rubrics at the post-secondary level. They concluded that the focus should be on reliability and validity when constructing rubrics for use in various educational situations. The study conducted by Gallardo (2020) identified the creation and application of performance-based assessment rubrics from 2009 to 2019. The findings indicated that certain facts and reflections on the complexity of rubric design are explored to address the problems in education associated with competency-based assessment (CBA) contemporary demands. These facts and reflections include the incorporation of learning domains that go beyond cognition, authenticity, and interdisciplinarity in learning designs following students' progress, improving educators' assessment literacy to meet the role of CBA demands, and ineffectiveness of CBA as a method of evaluation.

Applying rubrics in writing evaluation remains a source of thoughtful and innovative research (Crusan, 2015). Hodges et al. (2019) developed the Writing Rubric to Inform Teacher Educators (WRITE) to complete the missing factors and gaps and recommend valuable insights to current research. Based on the findings, one potential reason for the need for more research on writing evaluation in teacher training is that writing achievement is multi-faceted and complex to evaluate. The contents and wording of the rubrics should be modified to provide more precise instructions to the evaluators. Moreover, Saito et al. (2021) introduced a statistical method for analyzing rubric qualities using the goal question metric (GQM) method. According to this study, the GQM method, a goal-oriented thinking framework, was used to determine statistical methods for quantitatively assessing the characteristics of rubrics. It identifies statistical methods without missing the goal of evaluating the required rubric characteristics.

Geometry, one of the important branches of mathematics, studies measurements, properties, shapes, higher dimensional analogues, and relationships of points, lines, angles, surfaces, and solids. This field enables an individual to solve real-world problems in the real world. Moreover, to fully understand all the concepts and theories in this field, one should visualize them perfectly. Geometry will be more understood if modelled and illustrated flawlessly. It was concluded by Crompton and Ferguson (2024) that geometry and spatial reasoning play an important role by providing students a medium to analyze, understand, and reflect with their physical environment. The study summarizes the four essential understandings: (1) characteristics of shapes and geometric properties, (2) spatial orientation, (3)

construction and breakdowns of geometric forms, and (4) geometric changes and symmetry adjustments. Furthermore, it highlighted the leading proponents and a list of other smaller building blocks to understand each concept.

Two of the domains in Geometry included in this study are Logic and Proofs and Transformation (Congruence and similarity) for Triangles. These domains are the subject of the activities of this research. According to Casanova et al. (2021) in their recent study about geometric thinking on triangles, students had imprecise use of some terminologies when considering isosceles and obtuse triangles, which led to only few could recognize the concepts of the Pythagorean Theorem. The study of Stevens (2023) aimed to support math teachers in understanding and applying the current math content and teaching-learning practices. The study states that the content supports strategies to develop students' fundamental knowledge and skills in answering problems by applying techniques and approaches in mathematics. Particularly, their fluency in dealing with procedures in proving mathematics concepts, definitions, postulates, theorems, and corollaries in Logic and Proofs. Examples of the strategies includes real-world scenarios, error analysis, formal debate, formal proof planning, and routinary formative assessments. Moreover, to provide an idea in error analysis that could be applied to Logic and Proof standards include, examples include (1) inappropriate counterexamples in an argument; (2) not using the existing facts in the given, (3) not justifying the statements and steps, (4) incorrect usage of key definitions, (5) incorrect construction and application of conditional statements, namely: converse, inverse and contrapositive; (6) or faulty judgment of logical statements. Error analysis generates an interactive student discussion that enables students to work on their own as they explain and correct their mistakes without any guidance from a teacher. Additionally, for transformation, the content supports strategies, techniques and approaches that allow students to build students' understanding to mathematical concepts and procedural fluency. It includes real-world scenarios, triangle congruency and similarity, and routinary formative assessments. Examples of congruence and similarity include rigid motions, namely reflections, rotations, and translations. This study guide helps geometry teachers identify which strategy to use for struggling students.

Recent studies prove that students have difficulties in understanding concepts of proving similar triangles. Musfiratul et al. (2023) showed that the majority of the students had conceptual difficulties in understanding triangle materials. The causes of these difficulties include: Lack of focus, lack of understanding from the previous concepts; lack of practice; teacher's explanation regarding the materials; and lack of accuracy in understanding and comprehension of the problems. Additionally, in the study conducted by Biber (2020), it showed that students are struggling with triangles that are overlapping and Angle-Angle (AA) Theorem type of questions. Also, Haj-Yahya (2021) found out that many students did not accept the congruent and similar triangles theorems as formal definitions of congruency and similarity; as a result, students' understanding of geometric definitions are affected by the drawback in understanding the characteristics and roles of mathematical definitions.

Given these challenges in understanding, proving, and solving problems involving similarity of triangles, a need for interventions can effectively address students' gaps and enhance their abilities in solving them. Once promising approach is the application of a self-assessment tool, such as rubrics, into geometry lessons. Rubrics provide clear guidelines as for evaluating students' understanding. Furthermore, these rubrics identify what particular strengths and weaknesses students have. This offers a means for focusing to the weaknesses and allowing teachers to address misconception and miscalculations early in the solving process. Integrating rubrics into the teaching-learning process

provides opportunities to bridge the gaps in students' difficulties and their ability to solve problems in mathematics. This reinforces their problem-solving abilities in real-world applications.

A limited amount of literature focuses on integrating rubrics into lessons related to the similarity of triangles. Moreover, introducing assessment tasks and rubrics during the learning process of the students identifies the weaknesses of the students in proving theorems and solving problems involving real-world problems. This includes understanding the concepts, proving theorems through two-column proofs and flowcharts, overlapping triangles, and problem-solving questions. Furthermore, this opens up an opportunity to address the gaps. This study is anchored on Jerome Bruner's constructivist theory. According to this view, the process of cognitive framework starts with picking and modifying information, generating hypotheses based on the initial modification of the pieces of information, before coming up into conclusions. This structure gives meaning to experiences and helps learners to explore beyond any given information (Jiang & Perkins, 2013). According to this study, problem-solving ability permits an individual to relate what he already knows to what he is dealing with, which are new and unfamiliar problems. Moreover, using the assessment tasks and rubrics would be beneficial for improving solution construction and getting the correct answer.

Based on current international and local research on mathematics education, there is a need to provide interventions to strengthen students' mathematical proficiency through problem-solving skills. This was done using a valid and reliable method of developing assessment tasks and rubrics. Also, it adhered to the proper construction procedure. This study was conducted to determine the effectiveness of assessment tasks and rubrics in assessing Filipino students' mathematical proficiency when dealing with real-world problems that involve the Similarity of Triangles. The primary purpose of this research is to develop and validate assessment tasks and rubrics and to seek the difference between students who are using assessment tasks and rubrics and students who are not to enhance their mathematical proficiency in solving real-world problems involving the similarity of triangles.

**Conceptual Framework**

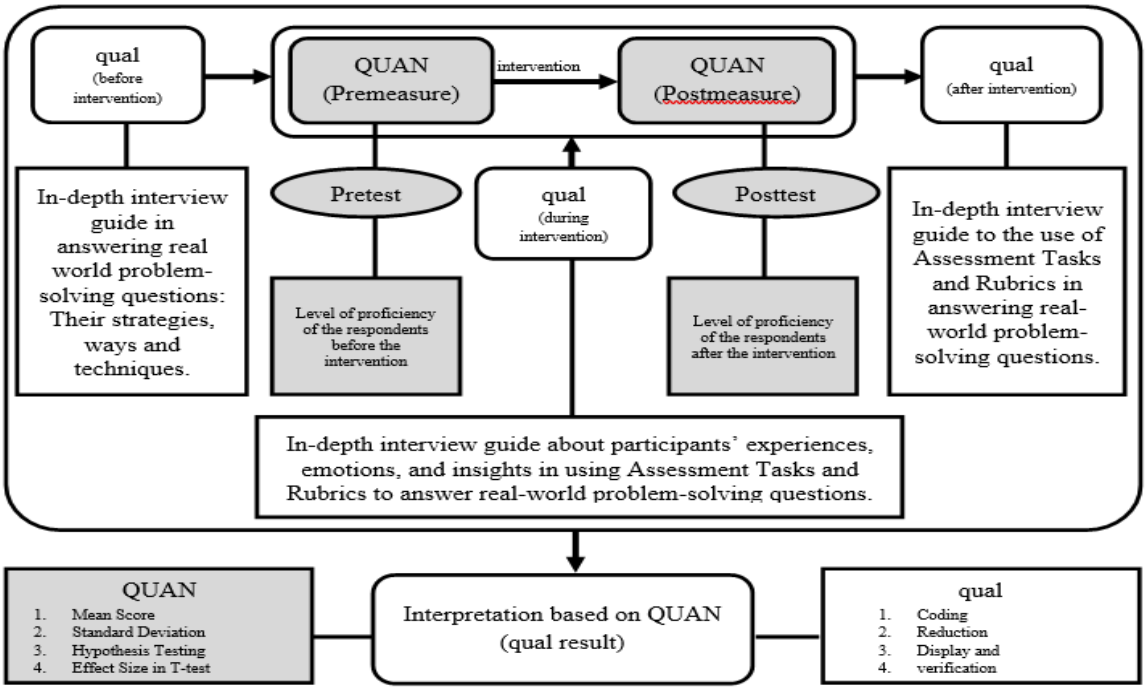


**Figure 1. Schematic diagram of the study**

This study used an Embedded Experimental Design Model. It consists of a primary phase and a supplementary phase. The primary phase is the quantitative data collection, while the supplementary phase is the qualitative data collection.

In the quantitative phase, this study used a one-group pretest-posttest and quasi-experimental research designs. A single group of research respondents' or subjects' level of mathematical proficiency was observed prior to the experiment; the treatment, the usage of assessment tasks and rubrics, was administered to all respondents in four weeks with twelve (12) sessions; and finally, the researcher evaluated the level of mathematical proficiency of the respondents after the treatment.

On the other hand, in the qualitative phase, in-depth interview guides were provided before, during, and after the treatment. Before the intervention, an in-depth interview guide was given to the participants to identify their pre-existing techniques, ways, and strategies for solving real-world problems in mathematics. During the intervention, a separate interview guide was given to learn from their experiences, emotions, and insights while using the assessment tasks and rubrics to answer real-world problem-solving questions. Lastly, the final in-depth interview guide was given to understand if the tool helped them in solving problems involving the lessons in Similarity of Triangles if they could apply it in other lessons in mathematics, and if they could recommend using them to other students as a new way of solving real-world problems.

This study determined if using assessment tasks and rubrics affects students' problem-solving skills in mathematics, specifically in the Similarity of Triangles lessons.

**Statement of the Problem**

This study aimed to develop and validate assessment tasks and rubrics to solve problems involving the Similarity of Triangles among Grade 9 students in one of the schools in Angeles City during the academic year 2023-2024. The study findings were the basis for using rubrics for the third-quarter lessons in Math 9.

Specifically, the study aimed to provide answers to the following questions:

1. How may the experts validate the assessment tasks and rubrics in terms of:
    1.1 evaluative criteria;
    1.2 quality definitions;
    1.3 scoring strategy; and
    1.4 overall impact?
2. How may the students' mathematical proficiency level be described before and after their exposure to the assessment tasks and rubrics?
3. Is there a significant difference between the respondents' mathematical proficiency in pretest and posttest results?
4. What are the students' mathematical proficiency changes after utilizing the assessment tasks and rubrics?
5. What are the students' methods, ways, and techniques for answering real-world problem-solving questions?
6. What experiences, emotions, and insights do the students have while using the assessment tasks and rubrics?
7. How do the assessment tasks and rubrics help the students answer real-world problem-solving questions involving the similarity of triangles?

## Chapter 2
## METHOD

This chapter includes the research design, respondents, participants, sampling technique, research instruments, construction and validation of the research instruments, ethical considerations in conducting the interview, data collection, and statistical treatment.

### Research Design

This study used an embedded experimental mixed-methods research design with primary and supplementary phases. The primary phase collected quantitative data, while the supplementary phase collected qualitative data. In the book reviews on "Creswell's and Plano Clark's Designing and Conducting Mixed Methods Research in 2006" conducted by Cohen (2008) and Ishtiaq (2021), Embedded Experimental Design is a two-phase approach in which the qualitative phase acts as a supporting data collection procedure for the quantitative phase (Cohen, 2008). The embedded qualitative data is within the experimental design.

The reason for choosing an embedded experimental design was to strengthen the conclusion of the collected data during the quantitative phase. Additionally, the researcher's goal was to find if there is a significant difference between the students' mathematical proficiency levels before and after their exposure to the tools as their guide in answering real-life application problems in similarity of triangles. This was also supplemented and enriched by conducting an in-depth interview before, during and after the quantitative phases.

In the quantitative phase, this study used a one-group pretest-posttest and quasi-experimental research designs. A single group of research respondents' or subjects' level of mathematical proficiency was observed prior to the experiment; the treatment, the usage of assessment tasks and rubrics, was administered to all respondents in four weeks with twelve (12) sessions; and finally, the researcher evaluated the level of mathematical proficiency of the respondents after the treatment. On the other hand, in the qualitative phase, in-depth interview guides were provided to selected students before, during, and after the treatment.

### Respondents/Participants

This study involved one-intact Grade 9 class with seventeen (17) students enrolled at ALLS in Angeles City, Pampanga, Philippines, during the Third Quarter of the Academic Year 2023-2024. The age of the students who qualified to be one of the respondents ranged from 14 to 15 years old, and they were regular students taking geometry lessons. The study utilized purposive sampling to get the target respondents because it is simple and direct. The researcher also wanted to make the collected data to be more reliable by getting all the possible respondents for the study.

To select the participants, the researcher used purposive sampling by asking for seven (7) participants from the class who met the established criteria. These criteria included being officially enrolled in the class, providing informed consent for the interviews, being available for all scheduled interviews, and demonstrating the ability to articulate their thoughts effectively. These participants were willing to be interviewed before, during, and after the intervention phases. However, one of the seven volunteers backed out due to some circumstances. The participants answered the in-depth interviews via questionnaires and face-to-face interviews.

**Instruments**

The research instruments included in this study were (1) the assessment tasks and rubrics for all lessons involving the Similarity of Triangles; (2) the test questionnaires for the pretest and post-test examinations; (3) and the in-depth interview guide for before, during and after the intervention phases. All instruments underwent separate tests of validity and reliability.

For the quantitative phase, the rubrics of this study (see Appendix F) were adapted and improved from the tool by Auxtero and Callaman (2020) in their study titled "Rubric as a Learning Tool in Teaching Applications of Derivatives in Calculus". The developed rubric in their study was adapted and improved from the studies conducted by Gleason in 2013 about "Assessment of Students' Critical Thinking and Problem-Solving Abilities" and by Malang in 2016 on "Effectiveness of a Rubric as a Learning Tool in Teaching Mathematics of Investment." The tool was validated by experts and got a good overall descriptive result. It had a Cronbach's value of .857 for the reliability test.

The tool by Auxtero and Callaman (2020) for students who undertake Calculus lessons has a strong applicability in the developed tool for Geometry. Based on the successful implementation of the rubrics in answering complex real-world problems in Calculus, this also helped in constructing geometrical representations, proving theorems, and spatial relationships. The adapted tool was modified based on the levels of students, context, and geometric concepts and theorems.

Moreover, the steps for solving problems were outlined in the rubrics, along with the competencies that students should have to solve problems that arise in practical application: (1) visualization; (2) formula/concept to apply; (3) Equation given the formula; (4) Solving Equations; (5) Simplification; and (6) Look Back. The three validators of the assessment tasks and rubrics are experts in mathematics education and assessments. Furthermore, to ensure the validity and reliability of the rubric, (a) evaluative criteria, (b) quality definition, (c) scoring strategy, and (d) overall impact were evaluated using a Likert scale. An evaluation sheet, sample assessment tasks, and rubrics were attached and used by the experts to provide comments and recommendations to improve the instrument. The assessment tasks and rubrics got outstanding and excellent grades from the validators, with a content validity index of 1.00 and grand mean of 4.93. Furthermore, looking for an English critique was suggested to simplify and enhance some complex terminologies present in the tool.

The pretest and post-test examinations were administered to assess students' mathematical proficiency in the lessons before and after the intervention. The pretest and post-test examinations (see Appendix G) that contained the real-life application questions were patterned with the mathematics curriculum guide by DepEd. These consist of forty-point (40) tests, twenty-five (25) items that are multiple-choice test type and three (3) problem-solving questions worth five (5) points each, which are composed of the lessons in Similarity of Triangles and to prove the conditions for similarity of triangles, namely: (a) SAS similarity theorem; (b) SSS similarity theorem; (c) AA similarity theorem; (d) right triangle similarity theorem; (e) and special right triangle theorems. It conformed to the table of specifications (TOS, see Appendix H) to provide a balance of items testing thinking skills in lower to higher order of Bloom's Taxonomy. It consists of three (3) Remembering, four (4) Understanding, four (4) Applying, five (5) Analysis, six (6) Evaluating, and three (3) Creating test questions. These tests were administered during the pretest and post-test based on the conceptual delivery of the study process. Validity and reliability testing of the pretest and post-test examinations were done before the official publication of the questionnaires. The result indicated that all expert validators rated all the items of the instrument to be highly relevant. This indicates that the instrument passed the validity test having a content validity index

of 1.00. Furthermore, the instrument also passed the reliability test having KR-20 Coefficients of 0.95, which greater than the threshold of 0.70. This only implies that the self-made questionnaire is both valid and reliable.

Three experts validated the content of the examinations using a content validity checklist to evaluate their degree of relevance and clarity. Most items in the pretest and post-test examination tools were highly relevant and very clear in the degree of clarity. Meanwhile, items that failed to meet the criteria were rejected or reconstructed depending on the decision of the validators. The sample pretest and post-test examinations and TOS were attached and used by the experts to give their comments, revisions for items, and suggestions. It was suggested that figures and illustrations be included for items that need directions and points of reference. An English critique was also requested to enhance the art of questioning the items. Overall, the pretest and post-test examination tools were constructed well and revised based on the comments and suggestions of the validators.

For the qualitative structure of the study, the in-depth interview protocol consists of (a) preliminaries (i.e. title of the study, date, time, place, interviewer, and optional information of the interviewee), (b) introduction (i.e. study, organization, researchers, ethical consideration, consent to participate, and consent for video recording), (c) interview questions (i.e. structured questions, probing questions, in-depth questions to uncover details of the interviewee's experiences and perspectives on a subject, and clarification, and (d) closing statements (i.e. concluding statement, collect demographic information, thank-you message, and contact information if the respondents need to contact the researchers) were facilitated (see Appendix I). An in-depth interview was selected among the classifications since, according to the study of Showkat and Parveen (2017), there is no set order to follow in this type of interview. The questions were directed towards a particular topic, and as the dialogue progresses, more questions emerge. These interview protocols also underwent a series of modifications based on the recommendations of the experts and pilot testing ensuring that the questions were clear, relevant, and aligned with the objectives of the study.

**Data Collection**

In conducting this study, the researcher sent formal letters to the: a) institutional review boards of Don Honorio Ventura State University (DHVSU) and secured a research ethics clearance, where the researcher is currently enrolled (See Appendix B); b) validators for the research instruments: the assessment tasks and rubrics; and the multiple-choice questionnaires about the Similarity of Triangles that the researcher used in the pretest and the post-test, and the in-depth interview protocols; c) Principal and Chairman of the Board of Trustees of ALLS (See Appendix C), where the respondents were enrolled, and d) participants or parents of the study (See Appendix D).

The letter for the validators of both the assessment tasks and rubrics, as well as the questionnaire (See Appendix A) about the Similarity of Triangles, were approved first by the thesis adviser of the researcher. The validators were given two weeks to validate the said instruments. After the validation process, the comments, suggestions, and recommendations of the validators were considered when revising the instruments. The validators checked the edited instruments again before they were printed and used by the respondents. Additionally, a series pilot testing was done in a different school to guarantee the predictive validity and reliability of the pretest and post-test questionnaires. This was to check how much time the respondents needed to take the assessment. Also, this supplied an additional data point for the study and identified the prospective problems that may arise during the actual tests.

Before starting the data collection, the researcher informed the class about the purpose of the study, the methodology, and the ethical considerations. The researcher then asked seven participants for the in-depth interviews and gave their interview schedules.

When all the preliminaries were cleared, the respondents answered the pretest questionnaires about real-world mathematics problems involving the Similarity of Triangles. After the day of the pretest examination, the researcher checked the questionnaires to identify their levels of mathematical proficiency. Since all the respondents were at the Beginner level, the same instructional materials and procedures were used. For the first session, the researcher presented the rubrics and instructed how the pointing system determines their performance. In the second session, the researcher prepared a lesson about the AA Similarity Theorem and answered problems using the two-column proof and the flowchart. In the third session, the respondents were regrouped to answer a real-world problem that involved the concepts of similarity of triangles. The groups submitted their work to the researcher afterward. In the fourth session, the researcher gave their rubrics back with some feedback to improve their work. The respondents were given time to evaluate their work as a group and to improve their way of dealing with the problem using the rubrics. In the succeeding sessions, the cycle was repeated but the respondents were no longer grouped. They had a lesson about the similarity of triangles lesson before having the assessment tasks with the rubrics to guide their work. After four weeks with twelve sessions, the respondents were given one hour to take the 40-point examination. All respondents took the same validated test but without the use of rubrics during the assessment, which served as the post-test exam for this study.

**Ethical Considerations**

The study strictly adhered to the standards set by Don Honorio Ventura State University (DHVSU) when conducting and writing the research manuscript. The researcher had secured an Ethics Clearance from the Graduate School Research Laboratory before gathering respondents' data. Moreover, for the academic integrity of this study, proper attribution was given to the rightful owners through accurate citations. This is done using the DHVSU and APA 7 formatting.

A letter of intent (see Appendix E) was provided for the administrator and review board approval of the institution to conduct the research study legitimately. The principal's office requested the same letter of intent to ensure the students' safety and confidentiality. Informed consent (see Appendix G) was obtained from every study participant before data collection began. If it turns out that the selected respondents were considered minors, parental consent was provided to their parents or guardians (see Appendix H). These letters were signed entirely first before the study was conducted.

Respect for the privacy of the respondents was imposed. These respondents were not forced to participate in this study and were given the chance to withdraw if they decided to discontinue the process. Their names remained anonymous by giving codenames to secure confidentiality and privacy. This study was conducted during the vacant periods and free time of the student-respondents. All collected information was kept private. Additionally, the data gathered was used solely for research purposes and was not shared with any unauthorized individuals. Proper ethical considerations were observed to ensure that the respondents felt safe and comfortable throughout the study.

The researcher strictly adhered to the privacy of the data obtained using the different instruments to ensure proper dissemination of information and conform to the ethical standards of all respondents in the selected school. Respondents' profiles were treated with the utmost confidentiality, and the researcher

assured that the information gathered and collected would be used only to ensure the success of this study.

**Statistical Treatment of Data/Data Analysis**

The pretest and post-test scores were tabulated for statistical treatment. The following statistical tools were used for the computation and analysis of data: mean score, standard deviation, t-test for paired two samples for means, and effect size.

The mean score was used to determine the mean value of the evaluation tool for assessment tasks and rubrics and the respondents' pretest and post-test scores. The standard deviation was also used to determine how dispersed the respondents' scores were. A t-test for paired two samples for means tool was used to measure the significant difference between the group's pretest and post-test scores, and hypothesis testing was used based on an alpha 0.05 level of significance. Lastly, the effect size of a t-test used in this study is by Cohen's d, which quantifies the difference between two group means in terms of standard deviation. This was used to determine the degree of effectiveness of the treatment.

In classifying the level of mathematical proficiency of the respondents, the following stages were used:

Level of Proficiency Based on the Assessment Scores

| **Level of Proficiency** | **Scores** |
|---|---|
| **Beginning** | 1-24 |
| **Developing** | 25-28 |
| **Approaching Proficiency** | 29-31 |
| **Proficient** | 31-34 |
| **Advanced** | 35-40 |

The aforementioned data show the basis for classifying the respondents' proficiency level in this research. The scores and the level of proficiency corresponding to each score were taken from the Department of Education (DepEd) Order no. 73, s. 2012, which entails the guidelines on the assessment rating of learning outcomes under the K to 12 Basic Education Curriculum. DepEd Order no. 8, s. 2015 contains the Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program in Appendix B (Transmutation Table). To ensure consistency and fairness in the evaluation process, the research employed a rigorous data verification method. To identify the levels of proficiency of each respondent, their score in the pretest and posttest was divided to the total score of 40. This was multiplied to 100, to convert it to a 100-scale. Finally, the score in the 100-scale was converted based on the transmutation table. To make it standardized, the researcher converted the percentage scores into the actual scores of the respondents. The following are the percentage weights and their corresponding conversion to a score of 40 without the transmuted grade:

**1. Conversion of Scores to Determine the Proficiency Level**

| **Initial Grade** | **Transmuted Grade** | **Score** | **Proficiency Level** |
|---|---|---|---|
| < 60 | < 75 | 1 – 24 | Beginning Level |
| 60 – 68 | 75 – 79 | 25 – 28 | Developing |
| 68 - 76 | 80 – 84 | 29 – 31 | Approaching Proficiency |

| | | | |
|---|---|---|---|
| 76 - 84 | 85 – 89 | 31 – 34 | Proficient |
| > 84 | > 90 | 35 – 40 | Advanced |

The description of indicators for each level of proficiency is discussed in the next data.

Levels of Proficiency and Their Meanings and Indicators

| **Level of Proficiency** | **Meaning** | **Indicators** |
|---|---|---|
| 1 | Beginning | The student struggles with his/her understanding due to a lack of essential knowledge and skills. |
| 2 | Developing | Students possess the minimum knowledge and skills but need help throughout the performance of authentic tasks. |
| 3 | Approaching Proficiency | The student develops fundamental knowledge, skills, and core understanding; with little guidance, they can transfer understanding through authentic performance tasks. |
| 4 | Proficient | The student develops fundamental knowledge, skills and core understanding and can transfer them independently through authentic performance tasks. |
| 5 | Advanced | The student exceeds core requirements in terms of knowledge, skills and core understanding and can transfer them automatically and flexibly through authentic performance tasks. |

For the assessment tasks and rubrics, the Likert scale used by the experts was provided and employed as a scoring tool to quantify and standardize the evaluation of their specific aspects. The scale consisted of the scores 1 (Poor), 2 (Fair), 3 (Satisfactory), 4 (Very Satisfactory) and 5 (Outstanding), enabling a nuance analysis of each item under evaluation. This scale indicated the extent of the experts' evaluation on the (1) evaluative criteria, (2) quality definitions, (3) scoring strategy, and (4) overall impact. For the evaluative criteria, the Likert scale was used to determine whether the dimensions assessment tasks and rubrics tools were comprehensive, written in a logical manner, show quality and craftsmanship, provide a reasonable allocation of points, and represent the skills that students must display. For the quality definitions, the Likert scale was applied to identify whether the quality definitions present in the assessment tasks and rubrics are comprehensive, written in a logical manner (from highest to lowest), and distinguishable with the scale descriptors. Moreover, for the scoring strategy, the Likert scaled helped to discover whether the descriptors are comprehensive, observable, measurable, consistent within each criterion, and represent meaningful differences in performance across all scales. Finally, for the overall impact, the Likert scale was used to determine if the assessment tasks and rubrics help the students understand the instructor's expectations for the tasks, help the students evaluate their own

works, help the students improve their performance, ensure consistency and objectivity in grading, and help to get the answers accurately.

Meanwhile, the Likert scale used by the experts for the pretest and posttest examinations was provided separately to check the content validity of each item. There are two scales provided to check the examinations, namely: Degree of relevance and degree of clarity. For the degree of relevance, the scale consisted of the scores 1 (Highly Irrelevant), 2 (Relevant), 3 (Relevant), and 4 (Highly Relevant). On the other hand, for the degree of clarity, the scale consisted of 1 (Nor Clear), 2 (Needs Revision), 3 (Clear), and 4 (Very Clear).

For the qualitative phase, this study used Braun and Clarke's (2006) reflexive thematic analysis framework for the data analysis. This approach has specific methods that are easy to follow. Moreover, this framework provides a flexible and systematic procedure that enables researchers to get data and to be guided accordingly. Furthermore, this framework has six key phases: (1) Familiarization of the data; (2) initial coding; (3) generating initial themes; (4) reviewing themes; (5) defining and naming themes; and (6) producing the report.

The method for coding the data is through manual coding. Manual coding is used for qualitative and mixed-methods research. This method analyses unclear texts, audio, video, and image data. Moreover, data from interviews, focus groups, surveys, social media, and journal articles are analyzed and processed by labelling and organizing them to identify themes and their relations. The researcher also secured audio and video recordings so that interviews could quickly be transcribed.

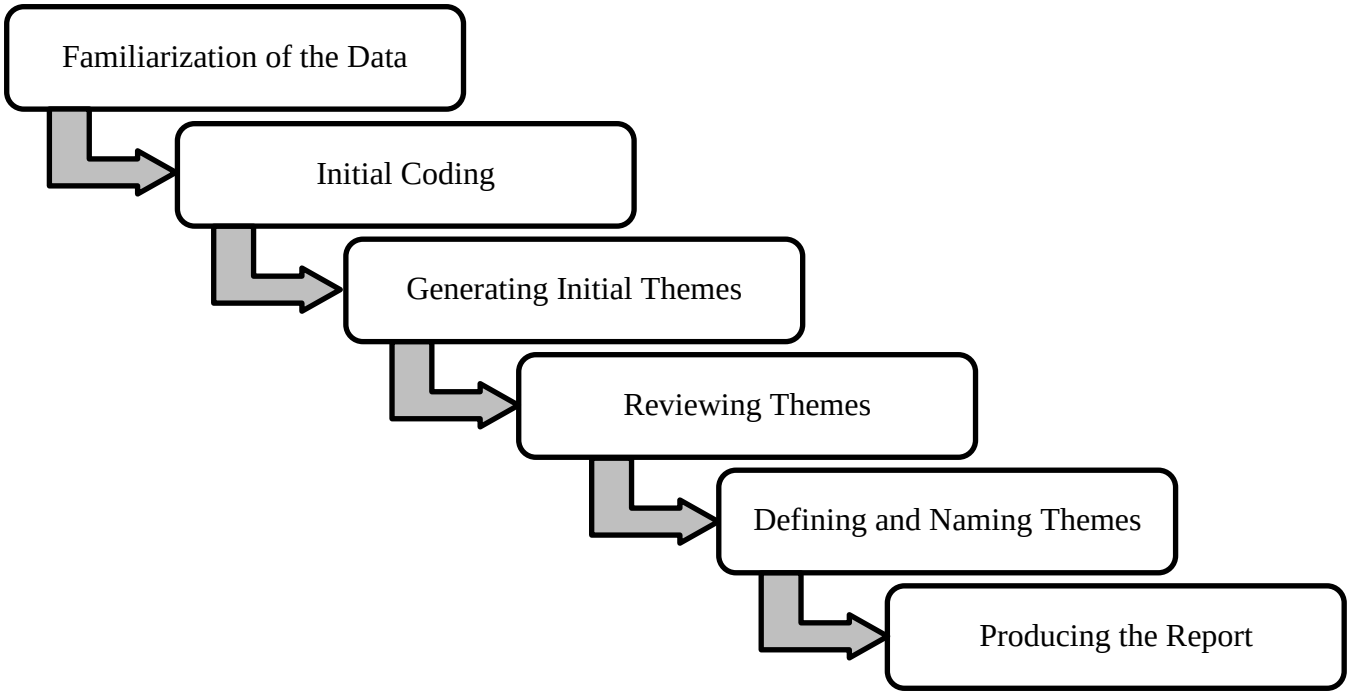


**Figure 2. Reflexive thematic analysis framework by Braun and Clarke**

Figure 2 shows the reflexive thematic analysis framework of the study. In step 1, the researcher read thoroughly all the responses provided by the participants. Additional pieces of information were included after the transcription of the data. A video recording served as a backup plan in case the data was unclear and needed clarification. The researcher gained a general sense of information when the data were transcribed. In step 2, the researcher then manually coded critical and essential segments and

assigned codes and labels. When codes were organized through manual coding, the researcher repeated the cycle by moving again to read the data, for the process of coding is iterative. The researcher then wrote up to describe the codes. After identifying the codes, the researcher identified whether the codes were connected and engaging. Codes that needed to be answered in the research questions have been disregarded. Then, in step 3, the researcher constructively tried to find a connection with the codes to develop categories. Categories that were connected formed themes. Step 4 shows that the themes were also compared with some existing theories. The researcher reduced the themes in cases where data could be combined if they had the same thought or removed if redundancy existed. In step 5, the researcher finally collapsed the codes into seven themes, and in step 6, the researcher wrote a conclusion to answer the research questions.

## Chapter 3
## RESULTS, FINDINGS AND DISCUSSION

This chapter presents, analyzes and interprets the data gathered in the study by the problems presented in the first chapter. It discusses the effects of the Assessment Task and Rubrics quantitatively and qualitatively. Furthermore, one-on-one, in-depth, semi-structured interview protocols are also presented in this chapter to support the results and discussion.

### 1. Evaluation for Assessment Tasks and Rubrics

Assessment tasks and rubrics help students evaluate their work while answering a problem or performing a task. They also help students understand what is expected in a specific question, leading to better problem-solving strategies. Moreover, using rubrics when dealing with real-world problems in mathematics encourages students to reflect on where they need to improve and identify their strengths and weaknesses.

To evaluate the use of the created assessment tasks and rubrics, the researcher made an evaluation tool that includes the following parts: (1) Evaluative criteria, (2) quality definitions, (3) scoring strategy, and (4) overall impact. The following tables include the indicators, mean, standard deviation, and verbal description for each part of the assessment tasks and rubrics.

### 1.1. Evaluation in Terms of Evaluative Criteria

Table 1 on the next page shows the descriptive analysis of the experts' evaluation of assessment tasks and rubrics regarding their evaluative criteria. This part of the rubric defines successful work in solving a problem or doing a task. It guides the students with general ideas with specific dimensions about what they are expected to accomplish and helps them focus on developing specific skills.

**Table 1: Descriptive Analysis of Experts' Evaluation of Assessment Tasks and Rubrics in terms of Evaluative Criteria**

| Indicators | Evaluator 1 | Evaluator 2 | Evaluator 3 | Mean | SD | Verbal Description |
|---|---|---|---|---|---|---|
| **1. The dimensions (steps) are comprehensive.** | 5 | 5 | 4 | 4.67 | 0.58 | Outstanding |
| **2. The dimensions are written in a logical manner.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |

| | | | | | | |
|---|---|---|---|---|---|---|
| **3. The dimensions show work quality and craftsmanship.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **4. The allocation of points is reasonable.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **5. The dimensions represent the skills that the students must display.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **Grand Mean** | | | | **4.93** | **0.12** | **Outstanding** |

Table 1 displays the experts' evaluation of the use of the assessment tasks and rubrics in terms of their evaluative criteria. Indicator 1 has a mean of 4.67 and a standard deviation of 0.58. Indicators 2, 3, 4, and 5 got a mean of 5.00 and standard deviation of 0.00. Overall, all indicators got a verbal description of Outstanding with a grand mean of 4.93, a standard deviation of 0.12, and a final verbal description of Outstanding. This implies that the dimensions of the assessment tasks and rubrics are comprehensive, written in a logical manner, and the allocation of points is reasonable. Also, the dimensions show work quality and craftsmanship and represent the skills that the student must display. An English critic was asked to simplify and to correct some criteria used in the tool as recommended by the experts.

### 1.2. Evaluation in Terms of Quality Definitions

Table 2 presents the descriptive analysis of the experts' evaluation of assessment tasks and rubrics regarding their quality definitions. This part of the rubric describes a gradation of the level of mathematical proficiency or skills for each criterion, which makes expectations transparent and gives the evaluator and the students a consistent and objective score.

**Table 2: Descriptive Analysis of Experts' Evaluation of Assessment Tasks and Rubrics in terms of Quality Definitions**

| Indicators | Evaluator 1 | Evaluator 2 | Evaluator 3 | Mean | SD | Verbal Description |
|---|---|---|---|---|---|---|
| **1. The quality definitions (scales) are comprehensive.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **2. The quality definitions are written logically (from highest to lowest).** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **3. The scale descriptors are distinguishable from other quality definitions.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **Grand Mean** | | | | **5.00** | **0.00** | **Outstanding** |

Table 2 shows the experts' evaluation of the use of the assessment tasks and rubrics regarding their quality definitions. Indicators 1, 2, and 3 have a mean of 5.00 and a standard deviation of 0.00. In total, all indicators received a verbal description of Outstanding with a grand mean of 5.00, a standard deviation of 0.00, and a final verbal description of Outstanding. This implies that the scales of the rubrics are comprehensive, written in a logical manner, and distinguishable from other quality definitions. An English critic was asked to simplify complex terminologies used in the tool as recommended by the experts.

**1.3. Evaluation in Terms of Scoring Strategy**

Table 3 on the next page shows the descriptive analysis of the experts' evaluation of assessment tasks and rubrics regarding their scoring strategy. This part of the rubric explains how each criterion will be graded and translated into scores. It includes descriptors with their corresponding numerical translation. Also, this provides an objective way to calculate the total score.

Table 3 shows the experts' evaluation of the use of the assessment tasks and rubrics in terms of their scoring strategy. Indicators 1, 2, and 3 have a mean of 5.00 and a standard deviation of 0.00, while Indicators 4 and 5 have a mean of 4.67 and a standard deviation of 0.58. In totality, all indicators got a verbal description of Outstanding with a grand mean of 4.87, a standard deviation of 0.23, and a final verbal description of Outstanding. This implies that the descriptors are comprehensive, observable, measurable and consistent with each criterion. It also implies that these descriptors articulate the expectations for each quality definition and represent meaningful differences in performance across all scales for a given criterion.

**Table 3: Descriptive Analysis of Experts' Evaluation of Assessment Tasks and Rubrics in terms of Scoring Strategy**

| Indicators | Evaluator 1 | Evaluator 2 | Evaluator 3 | Mean | SD | Verbal Description |
|---|---|---|---|---|---|---|
| **1. The descriptors found in the intersected columns and rows are comprehensive.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **2. The descriptors are observable and measurable.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **3. The descriptors are consistent within each criterion.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **4. The descriptors articulate the expectations for each quality definition (scale).** | 5 | 5 | 4 | 4.67 | 0.58 | Outstanding |
| **5. The descriptors represent meaningful differences in performance across all scales for a** | 5 | 5 | 4 | 4.67 | 0.58 | Outstanding |

| | | | |
|---|---|---|---|
| **given criterion.** | | | |
| **Grand Mean** | **4.87** | **0.23** | **Outstanding** |

### 1.4. Evaluation in Terms of Overall Impact

Table 4 presents the descriptive analysis of the experts' evaluation of assessment tasks and rubrics regarding their overall impact. This part of the rubric reflects the holistic view of the assessment tasks and rubrics based on their effectiveness.

**Table 4: Descriptive Analysis of Experts' Evaluation of Assessment Tasks and Rubrics in terms of its Overall Impact**

| Indicators | Evaluator 1 | Evaluator 2 | Evaluator 3 | Mean | SD | Verbal Description |
|---|---|---|---|---|---|---|
| **1. The rubric helps the students understand the instructors' expectations for the tasks.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **2. The rubric helps the students evaluate their own work.** | 5 | 5 | 4 | 4.67 | 0.58 | Outstanding |
| **3. The rubric helps the students improve their mathematics proficiency in doing a task.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **4. The rubric ensures consistency and objectivity in grading.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **5. The rubric follows a step-by-step guide to help students get the answers correctly.** | 5 | 5 | 5 | 5.00 | 0.00 | Outstanding |
| **Grand Mean** | | | | **4.93** | **0.12** | **Outstanding** |

Table 4 shows the experts' evaluation of the use of the assessment tasks and rubrics in terms of their overall impact. Indicators 1, 3, 4, and 5 have a mean of 5.00 and a standard deviation of 0.00, while Indicator 2 has a mean of 4.67 and a standard deviation of 0.58. All indicators got a verbal description of Outstanding with a grand mean of 4.93, a standard deviation of 0.12, and a final verbal description of Outstanding. This implies that the rubrics help the students understand the instructors' expectations for the tasks, evaluate their own work, identify their strengths and weaknesses, and improve their mathematical proficiency in solving mathematics problems. It also implies that these rubrics ensure consistency and objectivity in grading. Finally, the assessment tasks and rubrics follow a step-by-step guide to help students get the answers correctly.

**2. Level of proficiency of Grade 9 students before and after their utilization of Assessment Task and Rubrics Intervention**

**2.1. Level of proficiency of Grade 9 students before their utilization of Assessment Task and Rubrics Intervention**

To assess the respondents' mathematical proficiency before their exposure to the intervention, the researcher used a self-made 40-item pretest questionnaire. Table 5 highlighted the respondents' proficiency level before their exposure to the Assessment Tasks and Rubrics intervention. The questionnaire covered various mathematical concepts about the similarity of triangles, ensuring a comprehensive evaluation of the respondents' initial skills. The test results provided a baseline measure of their mathematical proficiency, which was essential for comparing their progress after the intervention. This initial assessment helped identify specific areas where students needed improvement.

**Table 5: Level of Proficiency of the Students Before Their Utilization of the Intervention**

| Pretest | | N | % | Mean | SD | Verbal Description |
|---|---|---|---|---|---|---|
| **(1-24)** | **Beginning** | 17 | 100.00 | 9.88 | 3.95 | Beginning |
| **(25-28)** | **Developing** | 0 | 0 | | | |
| **(29-31)** | **Approaching Proficiency** | 0 | 0 | | | |
| **(32-34)** | **Proficient** | 0 | 0 | | | |
| **(35-40)** | **Advanced** | 0 | 0 | | | |
| | **Total** | **17** | **100.00** | | | |

Table 5 indicates that seventeen (17) out of seventeen (17) respondents, or 100% of the respondents, were under the Beginning level. On the other hand, no respondents were under the Developing, Approaching Proficiency, Proficient and Advanced levels in their pre-assessment. Overall, the level of proficiency of the respondents before their exposure to the intervention is "Beginning", with an average score of 9.88 and a standard deviation of 3.95. This indicates that the respondents need help with their understanding due to a lack of essential knowledge and skills.

In the study conducted by Biber (2020), it was concluded that students are struggling with triangles that are overlapping and Angle-Angle (AA) Theorem type of questions. Also, Haj-Yahya (2021) found out that many students did not accept the congruent and similar triangles theorems as formal definitions of congruency and similarity; as a result, students' understanding of geometric definitions are affected by the drawback in understanding the characteristics and roles of mathematical definitions. These studies support that the level of proficiency of the students falls under the beginning level. They need to gain essential knowledge and skills to answer problems involving the similarity of triangles.

According to the New York State Education Department (n.d.), to support the level of proficiency of students before any learning intervention, conducting a diagnostic test helps to identify the strengths and weaknesses in some mathematical concepts, allowing immediate intervention for the students. This assessment serves as a valuable tool for educators to tailor their instructional strategies based on students' specific needs. By identifying learning gaps in understanding early on, teachers can implement targeted interventions to enhance learning outcomes. Additionally, diagnostic tests provide a benchmark

for measuring student progress throughout the instructional process. Furhermore, incorporating interactive learning resources during class discussion, such as visual aids and gamified assessments bridges the gaps in understanding lessons and enhances motivation among learners. Moreover, collaborative learning strategies contribute to strengthening problem-solving skills. Lastly, providing regular feedback allows students to track their progress.

### 2.2. Level of proficiency of Grade 9 students after their utilization of Assessment Task and Rubrics Intervention

To assess the respondents' mathematical proficiency after utilizing the intervention, the researcher facilitated the same self-made 40-item post-test questionnaire. The post-test results were then compared with the pre-test scores to determine any improvements in the respondents' proficiency. This comparison helped evaluate the effectiveness of the Assessment Tasks and Rubrics intervention in enhancing students' mathematical skills. Table 6 highlights the respondents' proficiency level after exposure to the Assessment Tasks and Rubrics intervention.

**Table 6: Level of Proficiency of the Students After Their Utilization of the Intervention**

| Posttest | | N | % | Mean | SD | Verbal Description |
|---|---|---|---|---|---|---|
| **(1-24)** | **Beginning** | 7 | 41.18 | 26.24 | 6.44 | Developing |
| **(25-28)** | **Developing** | 4 | 23.53 | | | |
| **(29-31)** | **Approaching Proficiency** | 3 | 17.65 | | | |
| **(32-34)** | **Proficient** | 1 | 5.88 | | | |
| **(35-40)** | **Advanced** | 2 | 11.76 | | | |
| | **Total** | **17** | **100** | | | |

Table 6 shows the level of proficiency of the respondents after they utilized the intervention. Also, it illustrates that seven (7) out of seventeen (17) respondents or 41.18% of the respondents, are still under the Beginning level. Four (4) out of seventeen (17) or 23.53% of the respondents are now in the Developing level. Meanwhile, 17.65% or three (3) out of seventeen (17) improved to Approaching Proficiency. One (1) out of seventeen (17) respondents climbed to Proficient level. Lastly, two (2) out of seventeen (17) respondents made it to the Advanced level of proficiency. In totality, the level of mathematical proficiency of the respondents after their exposure to the intervention is "DEVELOPING", with an average score of 26.24 and a standard deviation of 6.44. This suggests that while all respondents have minimal knowledge and abilities in the lessons, they require assistance carrying out authentic tasks. Recent studies prove that devising instructional strategies, techniques, and methodologies has been helpful for the development of students' mathematical proficiency, especially for geometry lessons. Maweya and Pule (2024) investigated the effectiveness of specific classroom intervention strategies to improve student proficiency in similar triangles. It revealed that 50% of the total number of respondents demonstrated improvement, and the intervention is an effective strategy for enhancing students' engagement. Additionally, Adonis (2020) developed ten Contextualized Strategic Intervention Materials (CSIMs) as an intervention on the generalized least mastered skills of High School for the school year

2015 to the school year 2018. The study unveiled that there were significant learning experiences in using the CSIMs.

Using assessment tasks and rubrics also shows improvement in the learning process of students. Nkhoma et al. (2020) stated that a rubric is not only an assessment tool that is useful for students, but it also supports learners in selecting appropriate learning strategies. Moreover, the analytical rubrics in solving physical and mathematical problems allow us to assess complex aspects that contribute to an understandable and transparent evaluation (Salazar-Torres et al., 2021). The utilization of rubrics not only guides students to answer problems but also gives them a significant opportunity to improve.

**3. Test for Significant Differences between the level of proficiency of the respondents before and after their exposure to the Assessment Tasks and Rubrics Intervention**

After a month-long discussion of the lessons on similarity of triangles and with the use of assessment tasks and rubrics, the respondents underwent a post-test examination using the same instrument during the pre-assessment.

Table 7 displays the test for a significant difference between the respondents' mathematical proficiency before and after their exposure to the intervention. To test for a significant difference between their pretest and post-test results, a one-tailed t-test for paired two-sample means was used.

**Table 7: Test for Significant Differences between the Mathematical Proficiency of the Respondents before and after their utilization of the intervention**

| Test | Mean | SD | Cohen's d | df | t-value | Sig. | Decision |
|---|---|---|---|---|---|---|---|
| **PRETEST** | 9.88 | 3.95 | 0.423 | 16 | -7.052** | .000 | Reject Ho |
| **POST-TEST** | 26.24 | 6.44 | | | | | |

Table 7 reveals that the computed t-value of 7.052 is greater than the critical t-value of 1.746 with a p-value of 0.0000013. This implies that the null hypothesis is rejected at a 0.05 level of significance. This leads to the conclusion that the mathematical proficiency of the respondents after their exposure to assessment tasks and rubrics as the intervention played a significant role. This implies that their mathematical proficiency with the use of assessment tasks and rubrics is significantly higher than that of not having it.

Additionally, the calculated Cohen's d of 0.423 suggests that the intervention had a moderate impact on the measured outcome, but the effect is not very strong. Given the sample size of seventeen (17) is relatively small, the effect might need further validation with a larger sample size to confirm its practical significance.

As Francis (2018) states, students are engaged in class discussions if they are provided with the rubric and are given additional resources. Another factor to consider to effectively use rubrics is teaching students to use them. Additionally, the study conducted by Auxtero and Callaman (2021) revealed that using rubrics as a learning tool for the application of derivatives lessons is effective in improving students' mathematics mathematical proficiency. The utilization of assessment tasks and rubrics helps and guides students to develop their understanding of solving real-world problems.

Assessment is an act of evaluating one's work in which teachers rate students' achievement by the process of collecting, measuring, analyzing, synthesizing, and interpreting the data provided. The pieces

of information are created and monitored to check whether the competencies set about by the curricula for their level are achieved and follow systematic and substantively grounded procedures (Ghaicha, 2016). In a classroom setting, assessment is obtaining evidence of what the learner knows, understands, and can do (DepEd, 2015). It is also a method of determining if the competencies that learners should acquire are learned during and after the learning process.

To effectively defend an intervention's impact, we need to include assessment for learning, assessment of learning, and assessment as learning. Assessment for learning is any assessment for which the priority is to serve the promote students' learning (Flórez & Sammons, 2013). This includes classroom interaction, questioning, structured classroom activities, and feedback geared at helping students bridge learning gaps (Schellekens et al., 2021). Assessment for learning is to give continuous feedback to maximize student learning and teaching practice. It is a continuous process allowing teachers to know students' needs and change or adapt interventions accordingly. This type of assessment allows teachers to identify the strengths and weaknesses of the learners. Also, this provides explicit guidance and scaffolding. Moreover, this adjusts the teaching approaches to maximize learning outcomes. The assessment tasks and rubrics were used to diagnose students' strengths and weaknesses in the process of problem-solving, allowing the teacher-facilitator to focus on improving the parts where the students were weak. On the other hand, the assessment of learning indicates the student's level of achievement in learning outcomes (Schellekens et al., 2021). This takes place at the end of the cycle of learning to measure students' overall accomplishments. This works best to decide whether the intervention has led to significant improvements, impacted teaching practices, and supplied pieces of information to teachers, administrators, and even curriculum developers. The assessment tasks and rubrics have presented that the respondents' mathematical proficiency significantly improved. This can also be seen in Table 8 about the changes in respondents' level of mathematical proficiency. Finally, assessment as learning is the concept of assessment where students learn, self-correct, self-assess, and collaborate during the assessment (Schellekens et al., 2021). This assessment allows learners to be engaged in the process of learning as they reflect on their progress. This encourages and supports self-assessment that allows students to become independent learners. This involves self-assessment in which students track their progress and development, peer evaluation in the form of constructive criticisms, and even journals that enable students to identify their strengths and areas for development. The assessment tasks and rubrics enabled the respondents to self-assess, self-reflect, work in pairs, and work in groups. These reflections made the respondents responsible on their own or without any assistance from anyone. In conclusion, the essential balance between the assessment for, of, and as learning is needed in the assessment tasks and rubrics. The formative assessment provided consistent guidance for learning, summative assessments assigned a significant effect on student's progress, and the self-assessment promoted students' ownership of learning. Through these vital advantages of using the assessment tasks and rubrics, the respondents performed better and met the needs for students' progress.

**4. Significant Changes in Respondents` Mathematical Proficiency After their Utilization of Assessment Tasks and Rubrics**

**Table 8: Analysis of Changes in Respondents` Level of Mathematical Proficiency Before and After Their Exposure to Assessment Tasks and Rubrics**

| Changes in the Level of Math Proficiency | N | % |
|---|---|---|
| **Beginning to Developing** | 4 | 23.53 |
| **Beginning to Approaching Proficiency** | 3 | 17.65 |
| **Beginning to Proficient** | 1 | 5.88 |
| **Beginning to Advanced** | 2 | 11.76 |
| **Retained on the same level of math proficiency (Beginning)** | 7 | 41.18 |

Table 8 shows the analysis of changes in respondents' level of mathematical proficiency before and after their utilization of assessment tasks and rubrics to enhance students' mathematical proficiency in solving problems involving the similarity of triangles. It reveals that four (4) out of the original seventeen (17) or 23.53% of the respondents are now in the Developing level from the Beginning level. Meanwhile, 17.65% or three (3) out of the original seventeen (17) improved to Approaching Proficiency from the Beginning level. One (1) out of seventeen (17) respondents climbed to the Proficient level from the Beginning level. Two (2) out of the original seventeen (17) respondents made it to the Advanced level of mathematical proficiency from the Beginning level. Furthermore, seven (7) out of the original seventeen or 41.18%, although their scores became higher, (17) retained in the Beginning level. This implies that there may be other external factors at play, such as limited exposure in prior learning, individual learning differences, and varying levels of access to resources.

This implies that 58.82% improved from their pretest to their post-test assessment after the intervention of using assessment tasks and rubrics.

The following studies show that using rubrics as an intervention tool enhances the level of mathematical proficiency of students. Tashtoush et al. (2024) focused on the importance of making rubrics for students' achievement. Using rubric-based assessments enhances student learning outcomes. This also promotes engagement and motivation. Additionally, it also supports differentiated instructions, facilitates immediate and meaningful feedback and self-assessment, and promotes effective communication between teachers and students. Gallego-Arrufat and Dandis (2016) incorporated the use of rubrics as an assessment tool in a secondary mathematics classroom in Spain. Using rubrics played an active part during the teaching-learning process for it gives an overview of what is expected from them and motivates them to achieve it. The study concluded that rubrics have the potential to enhance students' learning. Another study conducted by Brinkmann (2014) investigated the impact of using analytic rubrics on students' mastery of rational numbers in an eighth-grade class. It was found that students improve their mastery of concepts when teachers provide them with timely and corrective feedback.

## 5. Participants' Methods, Ways, and Techniques in Answering Real-world Problem-Solving Questions

### Theme 1: Conventional Problem-Solving Methods

This theme captures the conventional methods and techniques that students use: trial-and-error, answering by logical thinking, and applying formulas and strategies that can be applied to answer the problems.

Participants frequently highlighted the methods they used in answering the math problems. Two participants remarked,

> *What I usually do is to streamline the formulae and processes I already know. I strategize afterwards on what is best to solve the problem.* (Participant 1)
>
> *When I try to solve real-world problem-solving questions in my math assignments, I try to answer them with the knowledge I have been taught (standard way). On the other hand, if I do not understand the questions, I would try to guess or use logical thinking or even go through my notes.* (Participant 2)

This reveals that the traditional method of solving mathematics problems is one of the prevailing methods that students use nowadays. They would opt to use a shorter way if they think a question is easy. On the other hand, using another method or an improved way of answering problems than the traditional method is an upgrade for them. Participant 2 stated:

> *"If the method I will be taught is much easier, then I am willing to learn it. I have been struggling when it comes to math and I could not even process complex calculations. All in all, if the new procedure would be easier and better, I am willing to learn it."*

In the study conducted by Vidad and Quimbo (2021), the majority of the problems that students are experiencing are their inability to distinguish known from unknown information, their incapacity to translate problems into mathematical equations, and their incapability to identify the correctness of solutions. This calls for an intervention that uses different methods and techniques in solving math problems.

### Theme 2: Reflections on Method Comparison

This theme explores the participants' reflections on the differences between their previous methods, techniques, and approaches to answering real-world math problems and the assessment tasks and rubrics. It also highlights the strengths of using the tool over their traditional methods and their willingness to learn a different method of solving a math problem.

Some participants preferred using the previously used method in solving math problems. One participant said,

> *I would rather use my old method. I am more familiar with the standard way of answering math problems. It might be useful to other students.* (Participant 3)

Three participants preferred using the new method, using the assessment tasks and rubrics, for it gives clarity, guidance, and accuracy. Also, confidence can be boosted since there is a higher chance of getting the answer. The participants remarked,

> *I think I prefer it this way because I feel like I am more guided. Also, I tend to panic less. It is better than my standard way of answering math problems, but it did not make a huge difference… I would rather use this method over my standard way of answering real-world math problems… The assessment tool helped me to answer real-world problem-solving questions. It made me guided to answer the problem.* (Participant 2)
> *I would rather use the new one. It is much easier for me to use than my usual way of answering real-world math problems.* (Participant 4)
> *I would use this new method. By using the new method, it will be more efficient compared to the old methods. Also, this makes the solution of the students clearer to present.* (Participant 5)

Furthermore, two participants stated that using the new tool is better with more complex problems, using it for easier problems would result in consuming more time. They preferred using their old methods to easier problems. They stated,

> *I will use this method if the questions are hard for me to answer. In simple questions that do not require much time and understanding, I will use my standard way – trial-and-error method… Use the tool when you want to be more accurate in getting the answer. If there are time restrictions, use the way it would be answered the fastest.* (Participant 1)
> *If I were a beginner, I would prefer this new method. To those who already mastered solving problems, they might use the faster way possible… I might use it if I forget about the solution/steps. For items that I can mentally solve or easier to solve, I might prefer to use a short method.* (Participant 6)

In summary, the participants expressed mixed preferences about their method, ways, techniques and approaches to solving math problems: Some favored their traditional way, especially if the problems are easier to answer and can be answered without showing the solutions; the majority preferred the new method, by using an improved way of showing the solution, assessment tasks and rubrics. Several studies show that using an intervention supports problem-solving methods. Dumigsi and Cabrella (2019) concluded that the Strategic Intervention Material is effective as an intervention tool in solving problems involving quadratic functions. Additionally, models are helpful to address the difficulties in problem-solving questions through their coping strategies (Rojo et al., 2024); Vidad & Quimbo, 2021).

This implies that using assessment tasks and rubrics benefits in getting the correct answers in solving real-world problems involving the similarity of triangles. They appreciated the tool for its guidance, clarity and accuracy, especially for complex problems. Lastly, they noted that it also boosted their confidence and reduced anxiety, with a participant expressing its efficacy and better way of presenting solutions.

## 6. Participants' Experiences, Emotions, and Insights while Using the Assessment Tasks and Rubrics

### Theme 3: Emotional Impact of the Tool

This theme reflects the participants' emotional reactions and feelings while using the assessment tasks and rubrics tool to solve problems involving the similarity of triangles. Students' feelings include relaxed

relaxed, confident, overwhelmed, nervous, stressed, panicked, and normal.

The participants expressed different emotions and feelings during the intervention phase. Participants shared during the second interview (During the Intervention phase).

> *To be honest, initially, I felt overwhelmed… It was a bit challenging since this was a new way for me to solve math problems. After some time, the assessment tasks and rubrics were fun and challenging, which I liked and enjoyed.* (Participant 4)
>
> *It saves a lot of time. I feel more confident, for it makes me answer the problems much faster.* (Participant 5)

This implies that using a different method in solving math problems takes work at first. Petronzi et al. (2021) defined mathematics anxiety as a negative cognitive-emotional response to mathematics. This response among students is triggered by the following factors: cognitive and emotional processes, self-regulation, metacognition, negative appraisal, and low math proficiency. Though the process of overcoming this is difficult, once they get used to the assessment tasks and rubrics, a guide in solving problems in math saves time and gives more confidence, for it gives a higher accuracy to get the answer. A recent study conducted by Enos L. et al. (2023) identified the students' self-confidence after using a problem-solving strategy. It was concluded that using a problem-solving approach boosts students' self-confidence in learning mathematics. In addition, the students need time to get along with some strategies and techniques to solve problems in math. Furthermore, consistent practice and continuous exposure to a variety of problem-solving techniques and methods can significantly enhance students' adaptability, critical thinking skills, and overall mathematical proficiency.

**Theme 4: Adaptation and Learning Curve**

This theme captures the learning process and adjustment period that the participants experience as they become familiar with the assessment tasks and rubrics. This is when they face a complex problem.

Initially, the participants may feel overwhelmed and need clarification as they learn to navigate and apply the assessment tasks and rubrics effectively. The adaptation period often involves understanding specific criteria and adapting their previous approaches in solving problems to the requirements in the rubrics. For some, this may involve trial and error and minor to major mistakes as they experiment with the different ways of structuring their answers and incorporating feedback to identify the factors that can be improved.

Participants shared that they needed more time to reflect and adjust, for they were still adjusting to the new approach. One participant said,

> *It was so interesting to learn new ways. It was comprehensive for it guided me to answer the problem step by step. At first, it was a bit hard but I was able to adjust and understand how to use it properly eventually.* (Participant 6)

The adjustment may include the parts and content of the rubrics: recognizing the criteria that hold higher weights, constructing the solution to be put, and persisting in repeating and practising solving problems. This requires hard work to learn as participants change and adapt their previously used approach to the assessment tasks and rubrics to answer real-world problems in math.

In summary, this theme highlights that while the adjustment period for using assessment tasks and rubrics may be difficult, it promotes growth and development. By complying with the criteria in the assessment tasks and rubrics, students build a strong foundation of skills that enable them to answer com

plex problems more effectively, enhancing their problem-solving skills.

**7. Effectiveness of the Assessment Tasks and Rubrics**

**Theme 5: Tool Effectiveness and Clarity**

This theme addresses students' perceptions of the assessment tasks and rubrics. This includes participants' views on how the assessment tasks and rubrics guide and contribute to more accurate answers in solving real-world problems. The insights indicate that the tool is an effective guide that enhances their ability to answer math problems with precision. Moreover, the participants shared that the tool not only guides them to get the answer but also gives them more confidence.

Participants reported that the structured assessment tasks and rubrics help them understand what are expected, enabling them to construct their solutions in a more organized manner. This minimizes errors and makes the process of solving problems more straightforward. The use of the tool acts as a guide that identifies their strengths and weaknesses in solving a math problem.

Participants shared how the assessment tasks and rubrics help them solve real-world problems involving the similarity of triangles. Two participants stated that,

> *It really helps me get the answers as accurate as possible. It was just a little time-consuming if ever I am required to use it. Some items are easy to answer without the use of the tool.* (Participant 1)
>
> *It was indeed useful in solving problems. It was just a bit time-consuming but you will get the answer exactly.* (Participant 6)

Additionally, the tool was noted for its supplementary function in improving efficacy. The participants found that this structured tool allowed them to complete the tasks more accurately, but a bit of time might be compensated, especially for the easy items since they were required to show the step-by-step solution to the problems. The clear guidance provided in the rubrics simplified the complexity of the problem, allowing the participants to focus on essential parts of it.

In summary, participants' perceptions revealed that the assessment tasks and rubrics were not only helpful in getting the answer accurately but were also valued for their role in making problem-solving more manageable but might sacrifice time. This combination of clarity, accuracy, and efficiency underscores the perceived effectiveness of the assessment tasks and rubrics in solving problems in mathematics.

**Theme 6: Guided Problem-Solving Approach**

This theme highlights the role of the assessment tasks and rubrics in offering students a structured guide to solving world problems involving the similarity of triangles. This tool guides and helps students to break down problems, especially more complex ones, into manageable steps. With these manageable steps, students may reduce their uncertainty and enhance their confidence. The rubrics act as a roadmap that highlights the expectations and provides clear criteria, which support students with a more organized way of showing their solutions and answers. This tool not only guides students in developing an organized sequence of steps but also encourages learning through self-evaluation. Consistency in using this tool by repetition is beneficial to be familiarized with it. Also, this tool helps students become more proficient over time. Moreover, this tool is useful in identifying the strengths and weaknesses of students. It distinguishes which criterion creates the series of mistakes.

Participants shared their insights about the assessment tasks and rubrics as their guide in solving problems involving similarity of triangles,

> *This makes someone answer the questions accurately. It also identifies your strengths and weaknesses that you can improve in the future.* (Participant 1)
> *Yes. I am willing [to recommend] as it guides the students to learn more because they are more guided. This is nice to use because it is user-friendly for the students to understand the lessons fully.* (Participant 2)
> *This is really helpful for those who struggle with some lessons. It takes time but it clearly shows the steps. This can identify where you are already good at and what else you need to improve.* (Participant 6)

In summary, this theme suggests that the use of assessment tasks and rubrics can significantly improve students' ability to solve real-world problems with greater ease and effectiveness. This creates a guide that helps students deal with math problems, especially complex ones.

**Theme 7: Improved Accuracy and Clarity**

This theme reflects how assessment tasks and rubrics support students in achieving more accurate results, reducing mistakes, and boosting their confidence in solving problems involving the similarity of triangles. In using the tool, students received a step-by-step guide that provided the outline of expectations for each criterion of the problem-solving process. The step-by-step procedure present in the rubrics gives a clear outline of the solution to a problem that helps minimize the common errors. As a result, the participants made fewer mistakes and got more accurate answers. Additionally, the tool encourages self-assessment to track their strengths and weaknesses for improvement. This self-assessment purpose of the rubrics does not only support better learning outcomes but also instils confidence. Students feel more assured to answer real-world problems solving on their own.

Three participants shared that the assessment tasks and rubrics helped them answer the problems accurately, provided clear and reasonable answers, reduced errors in calculations, and made them answer the problems more confidently. Participants mentioned,

> *It really helps me get the answers as accurate as possible.* (Participant 1)
> *You get the guidance and baseline on how to answer different types of questions.* (Participant 2)
> *I feel like the questions are easier to understand and it makes me answer the problems accurately.* (Participant 5)

In summary, this implies that assessment tasks and rubrics enhance both the accuracy and clarity of getting the correct answer in solving math problems and their confidence while solving them.

**Theme 8: Time Efficiency and Speed**

This theme emphasizes the benefits of assessment tasks and rubrics in terms of time efficiency and speed. The tool provides a structured procedure to follow to help students streamline their solutions to solve math problems, to reduce the time spent on deciding for the next steps, and to be familiar with the necessary steps in solving real-world problems in math stated in Polya's Four Steps in Problem Solving. With clear guidelines, students can bypass the use of the trial-and-error method, which often results in spending more time. This tool allows students to answer with a more direct and organized strategy of solving.

Participants had different insights regarding how they used the assessment tasks and rubrics with time as a factor. The following are the responses of the participants with regard to time:

> *It was just a little time-consuming if ever I am required to use it. Some items were easy to answer without the use of the tool… Personally, this makes me slowdown in answering problems.* (Participant 1)
> *It was just a bit time-consuming, but you will get the answer exactly… I might prefer to use a short method… It takes time but it clearly shows the steps. This can identify where you are already good at and what else you need to improve…* (Participant 6)
> *It saves a lot of time. I feel more confident, for it makes me answer the problems much faster.* (Participant 5)

Some participants mentioned that using the tool for easy questions might consume more time. On the other hand, the tool manages to solve more complicated problems. The ability to solve problems quickly becomes a great skill in situations where time is a factor. This theme highlights how the assessment tasks and rubrics do not only dwell with accuracy but also with time.

Chapter 4

## CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusions and recommendations based on the analysis in the previous sections.

### Summary of Findings

The following is the summary of the findings of the study:

1. The developed assessment tasks and rubrics were approved and modified based on the results and recommendations of the three experts. Overall, the assessment tasks and rubrics got a verbal description of Outstanding.
2. The level of proficiency of the respondents in Similarity of Triangles lessons before their utilization of the intervention was “BEGINNING”. On the other hand, the level of proficiency of the respondents after their utilization falls under “DEVELOPING”.
3. There was a significant difference between the mathematical proficiency of the respondents before and after their exposure to the intervention.
4. There were changes in the mathematical proficiency of the respondents. The following are from Beginning to Developing, Beginning to Approaching Proficiency, Beginning to Proficient, and Beginning to Advanced.
5. The participants have been using their traditional method of solving real-world mathematics problems. Examples of these methods are trial-and-error method, by applying simple logic, systematic problem-solving techniques, and estimation.
6. The participants expressed different emotions and feelings during the intervention phase. This includes feelings such as being relaxed, confident, overwhelmed, nervous, stressed, panicked, and just a normal feeling. On the other hand, after the utilization of assessment tasks and rubrics, the participants felt more confident and relaxed.
7. Overall, the insights indicate that the tool is an effective guide that enhances their ability to answer math problems with precision. Moreover, the participants shared that the tool not only guides them to the answer but also gives them more confidence in solving it.

**Conclusions**

In the light of the findings of the study, the researcher concluded that:

1. The developed assessment tasks and rubrics may be used as an essential tool to guide and enhance students' mathematical ability in solving problems involving the Similarity of Triangles.
2. Before the intervention of using assessment tasks and rubrics, the students struggled with their understanding due to a lack of essential knowledge and skills; after the intervention, the students had minimal knowledge and abilities about the lessons and required assistance carrying out authentic tasks.
3. The mathematical proficiency of the respondents after utilizing assessment tasks and rubrics as the intervention played a significant role. This implies that their mathematical proficiency with the use of assessment tasks and rubrics is significantly higher than that without them.
4. The respondents' proficiency in the lessons about the Similarity of Triangles significantly changed after their exposure to the Assessment Tasks and Rubrics. This implies that the utilization of the Assessment Tasks and Rubrics has a positive effect on the respondents' proficiency in the lessons involving the Similarity of Triangles.
5. Students still use different methods and techniques for dealing with real-world problem-solving questions. The most common methods are trial-and-error and simple logic, which are time-efficient.
6. Utilizing the assessment tasks and rubrics has a positive effect on the student's confidence levels. Students feel more secure and confident with their answers.
7. The assessment tasks and rubrics play a significant role in solving real-world problems involving similar triangles. These enhance the accuracy of getting correct answers to the problems. Moreover, the tools also contribute to students' emotional aspects by boosting their confidence.

**Recommendations**

Based on the findings and conclusions obtained from the study, the following recommendations are offered for consideration:

1. The Grade 9 mathematics teachers and students may be trained to use the rubric as a guide in Similarity of Triangles or even in other fields that focus on real-world problem-solving.
2. The Grade 9 learners are encouraged to utilize the Assessment Tasks and Rubrics to enhance their skills in solving problems involving the Similarity of Triangles.
3. The Grade 9 teachers who teach Similarity of Triangles lessons may incorporate the use of assessment tasks and rubrics as a teaching guide and assessment tool to evaluate students' learning.
4. Professionals responsible for the Mathematics Teacher Education Program may consider incorporating the principles upon which the Assessment Tasks and Rubrics are based into courses dealing with instructional methods and curriculum design.
5. The students may integrate other problem-solving strategies into their current approaches to dealing with real-world problem-solving questions.
6. The school administrators may support students who have problems handling their feelings and emotions in dealing with mathematics problems that students cannot answer.
7. Curriculum developers, book authors and publishing houses may consider putting the assessment tasks and rubrics in all Similarity of Triangles lessons.
8. Future researchers may consider other lessons in mathematics or other fields that can utilize the purpose of using Assessment Tasks and Rubrics to contribute to the pieces of evidence related to the ef-

fectiveness of rubrics as learning tools. They may also replicate this study in other lessons in mathematics across all grade levels to either affirm or negate the findings of this study.

**Reference List**

1. Abdellatif, M. S., & Zaki, M. A. (2020). Problem-Solving Skills as a Mediator Variable in the Relationship between Habits of Mind and Psychological Hardiness of University Students. *International Journal of Higher Education*, *10*(3), 88. https://doi.org/10.5430/ijhe.v10n3p88
2. Acido, J. V., & Caballes, D. G. (2024). Assessing educational progress: A comparative analysis of PISA results (2018 vs. 2022) and HDI correlation in the Philippines. *World Journal of Advanced Research and Reviews*, *21*(1), 462–474. https://doi.org/10.30574/wjarr.2024.21.1.0020
3. Al-Ayasrah, W. (2015). Teaching strategies and thinking skills; Amman: Osama House for Publishing and Distribution.
4. Al-Bargi, A. (2022). Exploring Online Writing Assessment Amid Covid-19: Challenges and Opportunities from Teachers' Perspectives. *Arab World English Journal*, *2*, 3–21. https://doi.org/10.24093/awej/covid2.1
5. Amin, I., Yousaf, A., Walia, S., & Bashir, M. (2022). *What Shapes E-Learning Effectiveness among Tourism Education Students? An Empirical Assessment during COVID19*. *30*, 100337–100337. https://doi.org/10.1016/j.jhlste.2021.100337
6. Arı, G. (2021). An Overview of Writing Rubrics in Doctoral Dissertations in Turkey. *International Journal of Progressive Education*, *17*, 2021. https://doi.org/10.29329/ijpe.2020.332.24
7. Assessment and Curriculum Support Center (2024). *Creating and Using Rubrics* - Assessment and Curriculum Support Center. https://manoa.hawaii.edu/assessment/resources/creating-and-using-rubrics/
8. Auxtero, L. C., & Callaman, Roar Abalos. (2021). Rubric as a Learning Tool in Teaching Application of Derivatives in Basic Calculus. *Journal of Research and Advances in Mathematics Education*, *6*(1), 46–58. https://eric.ed.gov/?q=rubrics+as+a+learning+tool&id=EJ1283933
9. Balch, D., Blanck, R., & Balch, D. H. (2016). Rubrics - Sharing the Rules of the Game. *Journal of Instructional Research*, *5*(1), 19–49. https://doi.org/10.9743/jir.2016.4
10. Battershill, C., & Ross, S. (2017). Using Digital Humanities in the Classroom: A Practical Introduction for Teachers, Lecturers, and Students. Bloomsbury Publishing https://www.bloomsbury.com/us/using-digital-humanities-in-the-classroom-9781350180895/
11. Biber, A. Ç. (2020). Students' difficulties in similar triangle questions. *Cypriot Journal of Educational Sciences*, *15*(5), 1146–1159. https://doi.org/10.18844/cjes.v15i5.5161
12. Bitir, T., & Duran, E. (2021). Development of a Rubric to Evaluate the Critical Writing Skills Levels of Fourth-Grade Primary School Students. *Educational Policy Analysis and Strategic Research*, *16*(4), 255–273. https://eric.ed.gov/?q=development+of+rubric&ff1=subScoring+Rubrics&ff2=dtySince_2014&id=EJ1328772
13. Brinkmann, N. C. (2014). *The impact of analytic rubric feedback in eigth grade mathematics (Order No. 3662764). Available from ProQuest Central; ProQuest Central; ProQuest Dissertations & Theses Global; ProQuest One Education. (1678077877).*
14. Brookhart, S. M., & Chen, F. (2015). The quality and effectiveness of descriptive rubrics. Educational Review, 67(3), 343-368. http://dx.doi.org/10.1080/00131911.2014.929565

15. Bukhari, N., Jamal, J., Ismail, A., & Shamsuddin, J. (2021). Assessment Rubric For Research Report Writing: A Tool For Supervision. *Malaysian Journal of Learning and Instruction*, *18*(No.2), 1–43. https://doi.org/10.32890/mjli2021.18.2.1
16. Carson, L. F., & Kavish, D. R. (2018). *Scaffolding Rubrics to Improve Student Writing: Preliminary Results of Using Rubrics in a Sociology Program to Enhance Learning and Mechanical Writing Skills*. *8*(2), 34–34. https://doi.org/10.3390/soc8020034
17. Casanova, J. R., Cantoria, C. C. C., & Lapinid, M. R. C. (2021). STUDENTS' GEOMETRIC THINKING ON TRIANGLES: MUCH IMPROVEMENT IS NEEDED. *Infinity Journal*, *10*(2), 217. https://doi.org/10.22460/infinity.v10i2.p217-234
18. Chan CKY (2015). Rubrics for Engineering Education, Engineering Education Enhancement and Research Asia (E3R Asia).
19. Chan, Z., & Ho, S. (2019). Good and bad practices in rubrics: The perspectives of students and educators. Assessment & Evaluation in Higher Education, 44(4), 533-545. https://doi.org/10.1080/02602938.2018.1522528
20. Chowdhury, F. (2018). Application of Rubrics in the Classroom: A Vital Tool for Improvement in Assessment, Feedback and Learning. *International Education Studies*, *12*(1), 61. https://doi.org/10.5539/ies.v12n1p61

21. Cohen, E. (2008). Book Review: Creswell, J. W., & Plano Clark, V. L. (2006). Designing and Conducting Mixed Methods Research. Thousand Oaks, CA: Sage. *Research on Social Work Practice*, *18*(5), 527–530. https://doi.org/10.1177/1049731508318695
22. Crompton, H., & Ferguson, S. (2024). An analysis of the essential understandings in elementary geometry and a comparison to the common core standards with teaching implications. *European Journal of Science and Mathematics Education*, *12*(2), 258–275. https://doi.org/10.30935/scimath/14361
23. Crusan, D. J. (2015). *Dance, ten; looks, three: Why rubrics matter*. *26*, 1–4. https://doi.org/10.1016/j.asw.2015.08.002
24. Darling-Hammond, L., Flook, L., Cook-Harvey, C. M., Barron, B., & Osher, D. (2019). *Implications for educational practice of the science of learning and development*. *24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791
25. Department of Education (2017). *Early Language, Literacy, and Numeracy Assessment for CAR, S.Y. 2016-2017*. https://www.deped.gov.ph.
26. Department of Education (2017). *National Achievement Test Results for Region III, S.Y. 2016-2017*. https://www.deped.gov.ph.
27. Department of Education (2018). *National Achievement Test Results for Region II, S.Y. 2017-2018*. https://www.deped.gov.ph.
28. Department of Education (2018). *National Achievement Test Results for Region III, S.Y. 2017-2018*. https://www.deped.gov.ph.
29. Department of Education (2018). *Early Language, Literacy, and Numeracy Assessment for CAR, S.Y. 2017-2018*. https://www.deped.gov.ph.
30. Department of Education (2019). *Early Language, Literacy, and Numeracy Assessment for CAR, S.Y. 2018-2019*. https://www.deped.gov.ph.

31. Department of Education. (2019). National Achievement Test 2018 National Report of the Philippines. Retrieved from 2018-NATIONAL-ACHIEVEMENT-TEST-NAT-610-12-RESULTS-AND-ANALYSIS-.pdf (deped.gov.ph)
32. Dumigsi, M., & Cabrella, J.B. (2019). Effectiveness of Strategic Intervention Material in Mathematics as Remediation for Grade 9 Students in Solving Problems Involving Quadratic Functions. *Asian Journal of Education and Social Studies*, 1–10. https://doi.org/10.9734/ajess/2019/v5i130137
33. Duno, J. (2019). *RM No. 366, s. 2019 - Result of the Early Language Literacy and Numeracy Assessment (ELLNA) for School Year 2016-2017; 2017-2018 and Basic Education Exit Assessment (BEEA) for School for School Year 2018-2019*. DepEd - Cordillera Administrative Region. https://m.depedcar.ph/regional-memoranda/rm-no-366-s-2019
34. Enos L., Lasarus, M., & Mentaruk, M. (2023). Improving students' self-confidence through problem-solving approach in mathematics teaching. *Nucleation and Atmospheric Aerosols*. https://doi.org/10.1063/5.0170715
35. Flórez, M., & Sammons, P. (2013). *Assessment for learning: Effects and Impact*. https://files.eric.ed.gov/fulltext/ED546817.pdf
36. Francis, J., Linking Rubrics and Academic Performance: An Engagement Theory Perspective, Journal of University Teaching & Learning Practice, 15(1), 2018. Available at: http://ro.uow.edu.au/jutlp/vol15/iss1/3
37. Gallardo, K. (2020). Competency-Based Assessment and the Use of Performance-Based Evaluation Rubrics in Higher Education: Challenges towards the Next Decade. *Problems of Education in the 21st Century*, *78*(1), 61–79. https://eric.ed.gov/?q=rubrics+as+a+learning+tool&ft=on&pg=2&id=EJ1265812
38. Ghaicha, A. (2016). Theoretical Framework for Educational Assessment: A Synoptic Review. *Journal of Education and Practice*, *7*(24). https://files.eric.ed.gov/fulltext/EJ1112912.pdf
39. Gottlieb, D., & Moroye, C. M. (2016). The perceptive imperative: Connoisseurship and the temptation of rubrics. Journal of Curriculum and Pedagogy, 13(2), 104-120. https://doi.org/10.1080/15505170.2016.1191389
40. Günes, P., Yildirim, O., & Yilmaz, M. (2018). Development of the Rubric Self-Efficacy Scale = Dereceli Puanlama Anahtarina Yönelik Öz-Yeterlilik Ölçeginin Gelistirilmesi. *Online Submission*, *5*(1), 176–189. https://eric.ed.gov/?q=rubrics+as+a+learning+tool&ft=on&pg=3&id=ED593373
41. Haj-Yahya, A. (2021). Students' conceptions of the definitions of congruent and similar triangles. *International Journal of Mathematical Education in Science and Technology*, *53*(10), 2703–2727. https://doi.org/10.1080/0020739X.2021.1902008
42. Helsa, Y., Juandi D., Turmudi, (2024), "Mathematics Proficiency– A Systematic Literature Review" in International Conference On Mathematics And Science Education, KnE Social Sciences, pages 613–623. DOI 10.18502/kss.v9i13.15965
43. Hodges, T. S., Wright, K., Wind, S. A., Matthews, S., Zimmer, W. K., & McTigue, E. M. (2019). *Developing and examining validity evidence for the Writing Rubric to Inform Teacher Educators (WRITE)*. *40*, 1–13. https://doi.org/10.1016/j.asw.2019.03.001
44. Ishtiaq, M. (2021). Book Review Creswell, J. W. (2014). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (4th ed.). Thousand Oaks, CA: Sage. *English Language Teaching*. https://doi.org/10/2935987/43613782/s200_muhammad

45. Jiang, X., & Perkins, K. (2013). A Conceptual Paper on the Application of the Picture Word Inductive Model Using Bruner's Constructivist View of Learning and the Cognitive Load Theory. *Interdisciplinary Journal of Teaching and Learning*, *3*(1). https://files.eric.ed.gov/fulltext/EJ1063072.pdf
46. Jonsson, A. (2014). Rubrics as a way of providing transparency in assessment. Assessment & Evaluation in Higher Education, 39(7), 840–852. https://doi:10.1080/02602938.2013.875117
47. Karali, Y., Palancioglu, Ömer Varol, & Aydemir, H. (2022). Examining the Factors Affecting Turkey's 4th Grade Mathematics Achievement According to TIMSS 2019 Final Report. *International Journal of Curriculum and Instruction*, *14*(1), 424–454. https://eric.ed.gov/?q=TIMSS+2019+results&ft=on&id=EJ1331582
48. Kasimatis, K., & Papageorgiou, T. (2019). Using Rubrics as Alternative Self-Assessment Technique of Project. *World Journal on Educational Technology: Current Issues*, *11*(3), 173–185. https://eric.ed.gov/?q=rubrics+as+a+learning+tool&ft=on&pg=2&id=EJ1224873
49. Kinne, L., Hasenbank, J., & Coffey, D. (2014.). Are We There Yet? Using Rubrics to Support Progress Toward Proficiency and Model Formative Assessment. *AILACTE Journal*, *109*. https://files.eric.ed.gov/fulltext/EJ1052581.pdf
50. Kocakulah, A. (2022). Development and Use of a Rubric to Assess Undergraduates' Problem Solutions in Physics. *Participatory Educational Research*, *9*(3), 362–382. https://eric.ed.gov/?q=development+and+validation+of+rubrics&ft=on&id=EJ1324992
51. Ma, S., Dawit Tibebu Tiruneh, & J. Michael Spector. (2023). *Critical thinking conceptualization in K-12: A case study of middle school teachers*. *8*(1), 100517–100517. https://doi.org/10.1016/j.ssaho.2023.100517
52. Maweya, G., & Pule, K. G. (2024). CLASSROOM DESIGN INTERVENTION STRATEGIES TO IMPROVE GRADE 10 LEARNERS' COMPREHENSION OF SIMILAR TRIANGLES. *Proceedings of the 29th National Congress of the Association for Mathematics Education of South Africa (AMESA)*. https://www.researchgate.net/publication/383415471_CLASSROOM_DESIGN_INTERVENTION_STRATEGIES_TO_IMPROVE_GRADE_10_LEARNERS
53. McTighe, J., and Frontier, T. (2022) *How to Provide Better Feedback Through Rubrics*. (2022). ASCD. https://ascd.org/el/articles/how-to-provide-better-feedback-through-rubrics
54. Menéndez-Varela, & Gregori-Giralt, E. (2018). *Rubrics for developing students' professional judgement: A study of sustainable assessment in arts education*. *58*, 70–79. https://doi.org/10.1016/j.stueduc.2018.06.001
55. Mullis, I. (2020). *TIMSS 2019 international results in mathematics and science*. Bc.edu; TIMSS & PIRLS International Study Center. https://dlib.bc.edu/islandora/object/bc-ir:109272
56. Musfiratul, M., Ikhsan, M., Anwar, A., & Arijuddin, A. (2023). Analysis of students' difficulties in understanding triangular material. *International Journal of Trends in Mathematics Education Research*, *6*(2), 138–144. https://doi.org/10.33122/ijtmer.v6i2.218
57. Mustafa, F., Assiry, S. N., Bustari, A., & Nuryasmin, R. A. (2019). The role of vocabulary e-learning: Comparing the effect of reading skill training with and without vocabulary homework.

Teaching English with Technology, 19(2), 21–43. https://www.tewtjournal.org/?wpdmact=process&did=NTc1LmhvdGxpbms

58. Mustafa, F., & Raisha, S. (2021). Rubric for Assessment of Learning Process in EFL Online Classrooms: Validation and Revision. *MEXTESOL Journal*, *45*(3). https://eric.ed.gov/?q=rubrics+as+a+learning+tool&ft=on&pg=2&id=EJ1310958
59. Nadila, P. (2021). Pentingnya Melatih Problem Solving Pada Anak Usia Dini Melalui Bermain. Pedagogi: Jurnal Ilmu Pendidikan, 21(1), 51–55. https://doi.org/10.24036/pedagogi.v21i1.965
60. New York State Education Department. (n.d.). *Diagnostic test compilation: Assessment tools*. Retrieved from https://depedclub.com/diagnostic-test-compilation-assessment-tools/
61. New York State Education Department. (n.d.). *Grade 4 math scaffolding guide*. Retrieved from https://www.nysed.gov/sites/default/files/programs/curriculum-instruction/grade4mathscaffoldingguide.pdf
62. New York State Education Department. (n.d.). *Turnkey guidance supporting all students*. Retrieved from https://www.nysed.gov/sites/default/files/programs/curriculum-instruction/turnkeyguidancesupportingallstudents.pdf
63. Nkhoma, C. A., Nkhoma, M. Z., Thomas, S., & Nha Quoc Le. (2020). *The Role of Rubrics in Learning and Implementation of Authentic Assessment: A Literature Review*. ResearchGate; unknown. https://www.researchgate.net/publication/343663513_The_Role_of_Rubrics_in_Learning_and_Implementation_of_Authentic_Assessment_A_Literature_Review
64. Noh, M., Zain, M., Hamid, Y. S., Abu, & Mohamad, M. (2021). Analytic Rubric in Evaluating the Continuous Assessment in Projects of Civil Engineering Undergraduate Students in Dynamics Subject. *Asian Journal of University Education*, *17*(4), 352–366. https://eric.ed.gov/?q=rubrics+as+a+learning+tool&ft=on&pg=9&id=EJ1328424
65. Panadero, E., & Jonsson, A. (2013). The use of scoring rubrics for formative assessment purposes revisited: A review. *Educational Research Review*, *9*, 129–144. https://doi.org/10.1016/j.edurev.2013.01.002
66. Pelaez, R. (2018). *K to 12 Curriculum Guide MATHEMATICS*. Academia.edu. https://www.academia.edu/35706592/K_to_12_Curriculum_Guide_MATHEMATICS
67. Pentang, J., Ibañez, E., Subia, G., Domingo, J., Gamit, A., & Pascual, L. (2021). *Problem-Solving Performance and Skills of Prospective Elementary Teachers in Northern Philippines*. *48*(1). https://files.eric.ed.gov/fulltext/ED618563.pdf
68. Petronzi, D., Hunt, T., & Sheffield, D. (2021). *Interventions to address mathematics anxiety: An overview and recommendations*. https://doi.org/10.31234/osf.io/a46eh
69. PISA 2022 Results (Volume I and II) - Country Notes: Philippines. (2022). OECD. https://www.oecd.org/en/publications/pisa-2022-results-volume-i-and-ii-country-notes_ed6fbcc5-en/philippines_a0882a2d-en.html
70. ProQuest. (2025) What's wrong--and what's right--with rubrics -. *Proquest.com*. https://doi.org/%22
71. Reddy, Y. M., & Andrade, H. (2010). A review of rubric use in higher education. Assessment & Evaluation in Higher Education, 35(4), 435–448. https://doi.org/10.1080/02602930902862859
72. Rojo, M., Gersib, J., Powell, S. R., Shen, Z., King, S. G., Akther, S. S., Arsenault, T. L., Bos, S. E., Lariviere, D. O., & Lin, X. (2024). A Meta-Analysis of Mathematics Interventions: Examining the Impacts of Intervention Characteristics. *Educational Psychology Review*, *36*(1). https://doi.org/10.1007/s10648-023-09843-0

73. Saito, D., Yajima, R., Washizaki, H., & Fukazawa, Y. (2021). Validation of Rubric Evaluation for Programming Education. *Education Sciences*, *11*. https://eric.ed.gov/?q=rubrics+as+a+learning+tool&ft=on&pg=4&id=EJ1317580
74. Salazar-Torres, J., Rincón Leal, O., & Vergel Ortega, M. (2021). The rubric as an assessment tool for solving problem situations in the physics and mathematics teaching context. *Journal of Physics: Conference Series*, *1981*(1), 012018. https://doi.org/10.1088/1742-6596/1981/1/012018
75. Sánchez Ramírez, J. M., Íñigo Mendoza, V., Marcano Lárez, B., & Romero-García, C. (2022). Design and validation of an assessment rubric of relevant competencies for employability. *Journal of Technology and Science Education*, *12*(2), 426. https://doi.org/10.3926/jotse.1397
76. Schellekens, L. H., Bok, H. G. J., Jong, van, Kremer, W. D. J., & van. (2021). A scoping review on the notions of Assessment as Learning (AaL), Assessment for Learning (AfL), and Assessment of Learning (AoL). *Studies in Educational Evaluation*, *71*, 101094–101094. https://doi.org/10.1016/j.stueduc.2021.101094
77. Schleicher, A. (2019). *PISA 2018: Insights and Interpretations.* OECD Publishing; OECD Publishing. 2, rue Andre Pascal, F-75775 Paris Cedex 16, France. Tel: +33-145-24-8200; Fax: +33-145-24-8500; Web site: http://www.oecd.org. https://eric.ed.gov/?id=ED601150
78. Schoepp, K., & Kranov, A. (2018). *An Effective Rubric Norming Process*. *23*(11). https://files.eric.ed.gov/fulltext/EJ1191402.pdf
79. Schools Division Office of Angeles City. (2017). *National Achievement Test results for Angeles City, S.Y. 2016-2017.* https://depedangelescity.com
80. Schools Division Office of Angeles City. (2018). *National Achievement Test results for Angeles City, S.Y. 2017-2018.* https://depedangelescity.com
81. Shadle, S. E., Brown, E. C., Towns, M. H., & Warner, D. L. (2012). A rubric for assessing students' experimental problem-solving ability. Journal of Chemical Education, 89, 319-325. https://doi.org/10.1021/ed2000704
82. Sproule, R., Drewery, D., & Pretti, J. (2019). Development of a Rubric to Assess Lifelong Learning in Work-Integrated Learning Reflection Assignments. *Collected Essays on Learning and Teaching*, *12*, 94–105. https://doi.org/10.22329/celt.v12i0.5376
83. Stevens, M. (2023). *Geometry Supports and Resources for Teachers*. https://files.eric.ed.gov/fulltext/ED631759.pdf
84. Sufyan, A., Hidayat, D., Lubis, A., Kultsum, U., Defianty, M., & Suralaga, F. (2020). *Implementation of E-Learning During a Pandemic: Potentials and Challenges*. https://doi.org/10.1109/citsm50537.2020.9268900
85. Tashtoush, M., Al Sheerawi, N., & Alrashid, N. (2024). Scoring Rubrics Method in Performance Assessment and its effect of Mathematical Achievement. Athens Journal of Education. 12. 1-22. 10.30958/aje.12-2-4. DOI: 10.30958/aje.12-2-4
86. Gallego-Arrufat, M. J., & Maha Dandis. (2016). Rubrics in a Secondary Mathematics Class. *International Electronic Journal of Mathematics Education*, *9*(1), 73–82. https://doi.org/10.29333/iejme/282
87. Tenam-Zemach, M., & Flynn, J. E. (2015, April). *Rubric Nation: Critical Inquiries on the Impact of Rubrics in Education*. Google.com. https://play.google.com/store/books/details/Rubric_Nation_Critical_Inquiries_on_the_Impact_of_?id=HAYoDwAAQBAJ&gl=US&pli=1

88. TIMSS - TIMSS. (2015). Ed.gov. https://nces.ed.gov/timss/
89. Vidad, D. C., & Quimbo, M. A. T. (2021). Students' Problem-solving Difficulties and Coping Strategies in Mathematics: A Model- Building Study. *International Journal of Learning, Teaching and Educational Research, 20*(9), 136–173. https://doi.org/10.26803/ijlter.20.9.9
90. Wind, S. A. (2020). *Do raters use rating scale categories consistently across analytic rubric domains in writing assessment? 43*, 100416–100416. https://doi.org/10.1016/j.asw.2019.100416