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Authentic Assessment Tools of the Most Essential Learning Competencies of Grade 9 Mathematics

Joey A. Mantes
Bicol University Graduate School, Legazpi City, Philippines
joeymantes256@gmail.com

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ABSTRACT

This descriptive-developmental study developed and evaluated ten authentic assessment tools aligned with the Most Essential Learning Competencies in Grade 9 Mathematics, specifically quadrilaterals. The tools consisted of performance tasks using the GRASPS format, project-based assessments, and problem-solving activities. Five jurors and six Grade 9 Mathematics teachers from Daraga National High School and Malabog National High School participated during school year 2022–2023. Jurors evaluated the validity of the tools, while teachers assessed their usability and acceptability. Findings showed that the tools were valid, obtaining a content validity index (CVI) of 1.00 and an excellent overall mean rating of 4.69 out of 5. Teachers rated the tools as highly usable, with a mean of 4.20, and highly acceptable, with a mean of 4.21. Suggested enhancements included localization and responsiveness to learners' needs, incorporation of cooperative approaches, more structured and specific formats, flexible and inclusive designs, and student self-assessment. The findings indicate that the developed tools can support teachers in assessing learners' attainment of intended competencies and learning objectives. The study recommends their use by Grade 9 Mathematics teachers, with further refinement based on student participation, feedback, and classroom experiences. It also recommends determining the tools' reliability and their acceptability among students. Future research may compare authentic and traditional assessments in terms of students' understanding, mastery, and attainment of learning competencies. These recommendations aim to strengthen the practical application and continued improvement of authentic assessment in mathematics instruction. Overall, the results highlight the potential value of carefully designed, competency-based tasks for classroom assessment.

Keywords: *Authentic Assessment Tools, Grade 9 Mathematics, Most Essential Learning Competencies, Quadrilaterals, GRASPS Model, Project-Based Assessment, Problem-Solving Assessment, Validity, Usability, Acceptability*

INTRODUCTION

Authentic assessment asks learners to demonstrate the application of knowledge through meaningful tasks rather than relying exclusively on recall-based tests. In mathematics education, performance tasks can make reasoning, problem solving, and the transfer of geometric properties to real-world situations observable to teachers. These goals are consistent with the emphasis on authentic performance and transparent criteria in assessment scholarship (Mueller, 2005; Palm, 2008; Wiggins, 1990).

In the Philippines, the Basic Education Learning Continuity Plan emphasized the Most Essential Learning Competencies (MELCs) during the COVID-19 disruption (Department of Education, 2020). These competencies supplied a curricular basis for aligning instruction and assessment. For Grade 9

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Mathematics, the quadrilaterals unit requires learners to identify and apply properties of parallelograms, rectangles, rhombi, squares, trapezoids, and kites, including the justification of geometric relationships and solutions to problems. Authentic performance tasks may provide opportunities to demonstrate these competencies in designed objects, everyday structures, and mathematical investigations.

Conventional short-response or selected-response assessments can be useful for measuring particular knowledge, but a single format may not capture the reasoning and production required by complex mathematical tasks. Authentic assessment therefore uses contextualized activities, student products, and scoring rubrics to make performance expectations explicit (Gulikers et al., 2004; Stevens & Levi, 2005). Studies of mathematics and related learning areas have examined performance-based designs and their potential for classroom assessment (Fauziah et al., 2018; Widana et al., 2021). These investigations inform the present developmental work without establishing the effectiveness of the specific tools produced here.

The development was informed by constructivist, experiential, and situated perspectives on learning. The shared premise is that prior knowledge and experience contribute to constructing meaning, while authentic contexts allow learners to apply concepts in purposeful activity. Figure 1 illustrates this theoretical relationship as presented in the thesis. Figure 2 presents the study's development-and-evaluation logic: juror validation and teachers' judgments inform the refinement of the assessment products. Both frameworks guide tool design; neither diagram is evidence of measured student learning outcomes.

The research gap addressed in the source thesis was the need for contextually relevant, competency-aligned authentic assessment materials for the Grade 9 Mathematics quadrilaterals unit. Rather than testing a teaching intervention or measuring student achievement, the present study concentrated on developing tasks and obtaining expert and teacher evaluations of their quality and potential classroom use.

Accordingly, the study sought to (1) develop authentic assessment tools for Grade 9 Mathematics quadrilaterals; (2) determine their content validity based on jurors' evaluations; (3) assess usability and acceptability as perceived by Grade 9 Mathematics teachers; and (4) identify revisions and enhancements suggested by the evaluators.

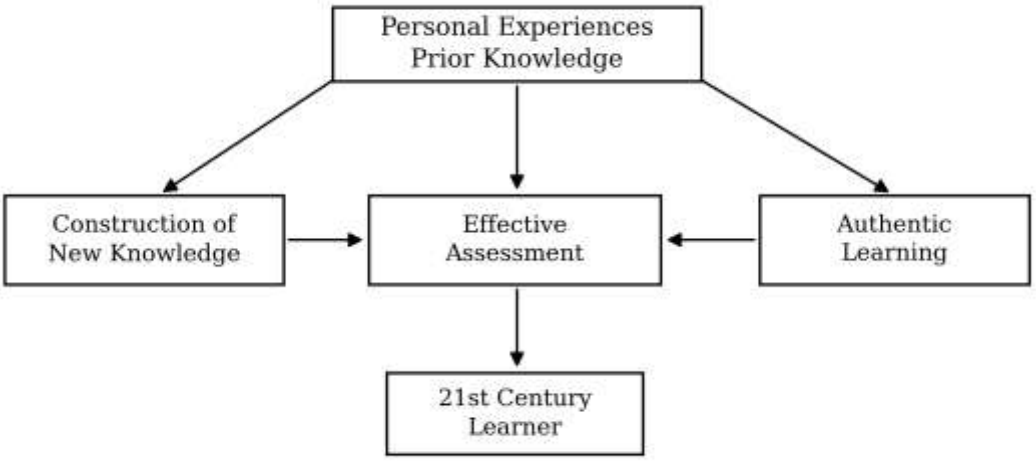


Figure 1. *Theoretical Paradigm*

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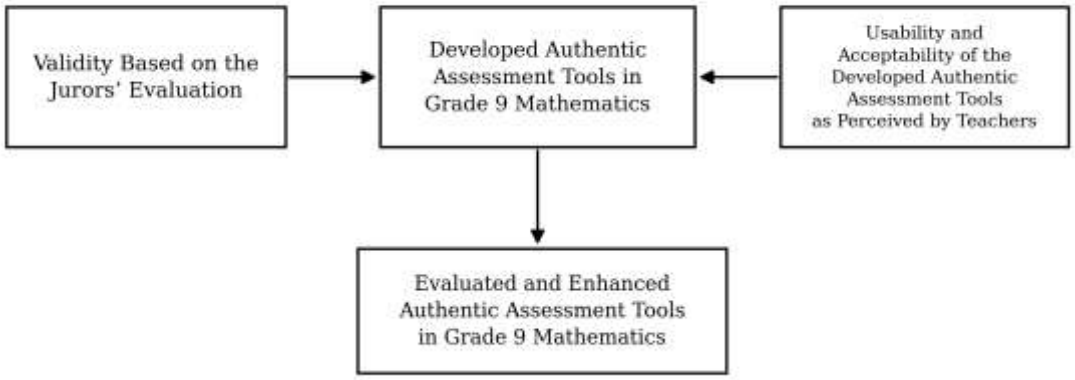


Figure 2. *Conceptual Paradigm*

METHODS

Research Design

This descriptive-developmental study combined the design of competency-aligned authentic assessment tasks with evaluator-based review. It used quantitative ratings from five jurors and six Grade 9 Mathematics teachers and qualitative comments to guide refinement. The work was organized into tool development and evaluation stages; it was not a classroom intervention or an experimental comparison. The source for curriculum alignment was the Department of Education Grade 9 Mathematics guide and its MELCs on quadrilaterals.

Quantitative ratings described perceived content quality, usability, and acceptability, whereas written feedback and focus-group suggestions guided revisions. The data were collected during school year 2022–2023.

The development stage included a focus-group discussion with teachers, design of ten tasks, and alignment with the relevant quadrilaterals competencies. The evaluation stage involved review by jurors, revisions, a repeat juror evaluation, and subsequent teacher ratings of usability and acceptability.

Sources of Data

The principal data sources were the Grade 9 Mathematics curriculum guide, the ten designed assessment tasks, the jurors' numerical evaluations and comments, and the six teacher-evaluators' ratings and recommendations. All competency codes and task labels in Table 1 follow the supplied manuscript.

Respondents

The respondents of the study are the following:

Five jurors evaluated the developed tools: four Master Teachers and one Teacher III. Their reported teaching experience ranged from 15 to 31 years, with postgraduate qualifications or coursework in mathematics education. They rated the content, learning-competency alignment, organization and mechanics, administrability, and rubrics, and provided revision suggestions.

Six Grade 9 Mathematics teachers from Daraga National High School and Malabog National High School evaluated the tools' usability and acceptability. Three were Teacher III and three were Teacher I, with teaching experience reported as approximately 4–32 years. Ratings reflected teacher perceptions of potential use and did not measure student outcomes.

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Instruments

The researcher used the following instruments to gather the needed data:

Evaluation Tools. There are three types of evaluation tools used in this study. The first tool was adapted from the study of Arciga (2018) wherein modifications were made in order to fit the necessary indicators for the authentic assessment tools. It was a validation checklist used to assess the presence of the indicators to the developed authentic assessment tools. The tool comprises the components: (a) content, (b) learning competency based, (c) organization and mechanics, (d) administrability and (e) rubrics. This evaluation tool became the basis to determine the validity of the authentic assessment tools wherein it has used a five-point Likert scale where jurors had selected a response scale to specify the level of observance of the indicators. Below is the five-point Likert scale of the evaluation tool.

Interval	Scale	Descriptive Interpretation
4.50 – 5.00	5	Excellent
3.50 – 4.49	4	Very Satisfactory
2.50 – 3.49	3	Satisfactory
1.50 – 2.49	2	Fair
1.00 – 1.49	1	Poor

The second evaluation tool was used to determine the acceptability of the developed authentic assessment tools. This evaluation tool was adapted from the study of Espinar and Ballado (2016) where Grade 9 teacher evaluators have looked into the presence of the following components: (a) clarity, (b) suitability, (c) usefulness, (d) adequacy, (e) timeliness, and (f) language, style and format. The indicators to these components were rated through a five point Likert scale where a rate of 5 means that the teacher evaluator strongly agrees with the presence of the indicator, 4 means agree, 3 means moderately agree, 2 means disagree and 1 means strongly disagree. The collated responses of the teachers were interpreted by the interval and corresponding level of acceptability below.

Interval	Level of Acceptability
4.50-5.00	Very Highly Acceptable
3.50-4.49	Highly Acceptable
2.50-3.49	Moderately Acceptable
1.50-2.49	Less Acceptable
1.00-1.49	Least Acceptable

Finally, the third evaluation tool which was modified from the study of Salavaria (2014) was used for the usability of the authentic assessment tools. The teacher-evaluators looked into the presence of indicators in the following components: (a) effectiveness, (b) efficiency, and (c) satisfaction in terms of use. These indicators were rated from the response scale of 1 to 5 where 5 means that the teacher evaluator strong agree with the presence of the indicator, 4 means agree, 3 means moderately agree, 2 means disagree and 1 means strongly disagree. The result was interpreted by the interval and corresponding level of usability below.

Interval	Level of Usability
4.50-5.00	Very Highly Usable
3.50-4.49	Highly Usable
2.50-3.49	Moderately Usable
1.50-2.49	Less Usable
1.00-1.49	Least Usable

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Focus Group Discussion Guide. These are questions and process guides of the researcher used to collect the suggested authentic assessment tools that may be developed on the most essential learning competencies for Grade 9 Mathematics.

Data Gathering Procedure

For the attainment of the goal of the study, the data gathering procedure was discussed.

Stage 1: Preliminaries. In this stage, the necessary documents needed for the conduct of the study were prepared by the researcher which includes the communication letters. After the permission to conduct the study was secured, a focus group discussion was conducted with the Grade 9 Mathematics Teachers in the chosen locale of the study which are Daraga National High School and Malabog National High School.

Stage 2: Development of the Authentic Assessment Tools. Suggestions during the focus group discussion were collated and considered by the researcher in the development of the authentic assessment tools. The researcher had developed ten (10) authentic assessment tools on the Most Essential Learning Competencies of Grade 9 Mathematics: Quadrilaterals which fell on the Third (3^{rd}) Quarter of the K to 12 curriculum guide.

Stage 3: Evaluation of the Jurors – Revision – Evaluation. In this phase, the developed authentic assessment tools were subjected to the evaluation of the selected Jurors of the study. After the evaluation, the Jurors comments, suggestions and recommendations were used in revising and enhancing the developed authentic assessment tools which were then subjected to another evaluation of the Jurors to ensure that the provided suggestions and recommendations were followed and included in the developed tools.

Stage 4. Analysis of the Jurors Evaluation. Five (5) Jurors were asked to evaluate the developed authentic assessment tools along with the components: content, learning competency based, organization and mechanics, administrability and rubrics. A weighted mean was used to determine the Jurors average views on the presence of the indicators of the evaluation tool to the developed authentic assessment tools.

The descriptive interpretation of the result was shown below.

Content validity was assessed using the content validity index (CVI), alongside the reported 1–5 expert ratings. Following the thesis procedure, each juror rating was dichotomized as 1 for scores of 4 or 5 and 0 for scores of 1, 2, or 3. The proportion of endorsing jurors provides the item-level CVI; the thesis reports a final CVI of 1.00 (Yusoff, 2019). Because the raw item-by-juror rating matrix and precise scale aggregation are not included in this article, that reported composite value cannot be independently recalculated here. It should not be interpreted as evidence of reliability or predictive validity.

For five jurors, an item-level CVI of 1.00 corresponds to agreement by all five jurors after dichotomization. The reported overall CVI is reproduced from the original thesis; no additional validity index or statistical test was calculated for this editorial version.

The study followed content-validation procedures discussed by Yusoff (2019). The mean ratings and reported CVI are presented as distinct descriptive summaries because they use different scoring conventions.

Stage 5. Evaluation of the Teachers to the Developed Authentic Assessment Tools. After the evaluation of the Jurors to the developed authentic assessment tools and have established the validity the developed tools were subjected to another evaluation to determine the acceptability and usability. Six (6) Grade 9 teachers from two (2) participating schools have taken part in the study. These teachers had looked into the presence of the indicators in the evaluation tool from the developed authentic assessment tools.

Stage 6. Revision and Analysis of the Teachers Evaluation. In this phase, the suggestions and recommendations of the Teachers to the developed authentic assessment tools were considered. Results of the ratings were analyzed using the weighted mean and interpreted following the descriptive interpretation presented in the *instruments* section of the study. The enhanced authentic assessment tools based on the comments, suggestions, and recommendations were the final output of the study.

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Statistical Treatment of Data

Descriptive means summarized the jurors' ratings and the teachers' usability and acceptability ratings. The original five-point response scales and interpretation bands were retained. Qualitative evaluator suggestions were summarized into five enhancement categories; no inferential significance tests were reported.

Mean ratings were calculated on the original five-point scales for each evaluation dimension and for the reported overall summaries.

Weighted mean was identified by the thesis as the summary measure for evaluator ratings. Where underlying weights or individual ratings are unavailable in this article, the reported means are reproduced without recalculation.

RESULTS

Ten developed authentic assessment tools

The output consisted of ten tasks spanning the quadrilaterals competencies. Table 1 summarizes each task's classroom scenario and intended content; it condenses the longer instructional materials presented in the source thesis without changing their central purpose.

Table 1. *Developed authentic assessment tools for Grade 9 Mathematics*

Assessment tool	Learning competency focus	Authentic task scenario
QUAD! QUAD! Know thy Sign!	Identifies quadrilaterals that are parallelograms (M9GE-IIIa-1).	Acted as a member of the team of exhibit organizers where objects/ signs that resemble a parallelogram have to be identified in the community to serve as materials.
Parallelogramm Able Shot	Determines the conditions that guarantee a quadrilateral a parallelogram (M9GE-IIIa-2).	A simulation of a contest where students have to act as a photographer and photo writer of objects/ signs in the environment that are parallelograms.
Parallelogram Marble Door	Uses properties to find measures of angles, sides and other quantities involving parallelograms (M9GE-IIIb-1).	Acted as a Design Engineer where a house main door has to be created incorporating the properties of parallelogram and presented to the stakeholders.
Solar Parallelogram Mounting Structure	Proves theorems on the different kinds of parallelogram (rectangle, rhombus, square) (M9GE-IIIc-1).	A simulation of scenario where students need to act as a junior electrical engineer by designing a rectangular solar panel mounting structure and deduce on it the theorems on rectangles.
Watch Out! Trap Over the Wheel!	Proves the Midline Theorem (M9GE-IIId-1).	The use of a wheelbarrow to represent the trapezoid and investigate on the dimensions with the goal of deducing a reasoning to prove the Midline Theorem.

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Assessment tool	Learning competency focus	Authentic task scenario
TRAPEcorn Tub	Proves the theorems on trapezoids and kites (M9GE-IIId-2).	Created a task where students have to analyze and make deductions out of the popcorn tub and apply their knowledge about isosceles trapezoid.
eduKITEng Season	Proves the theorems on trapezoids and kites (M9GE-IIId-2).	Students have created a kite and tasked them to identify the properties by following steps and making logical deductions.
The Parallelogram Me!	Solves problems involving parallelograms, trapezoids, and kites (M9GE-IIIe-1).	Parallelogram objects/ structures in the environment were identified and investigated to apply the knowledge of properties of parallelograms in real objects.
Trapezoidal Project	Solves problems involving parallelograms, trapezoids, and kites (M9GE-IIIe-1).	Created and designed a trapezoidal object that can be displayed in the house or classroom while incorporating the important aspects of a trapezoid.
Funmazing Kite	Solves problems involving parallelograms, trapezoids, and kites (M9GE-IIIe-1).	A simulation of kite making and flying contest where students have created a kite applying the mathematical skills and concepts in kites.

Jurors' content validation

The five jurors rated the tools highly across all five dimensions of the validation instrument. Content earned a mean of 4.54, competency alignment 4.57, organization and mechanics 4.76, administrability 4.82, and rubrics 4.73. The overall mean was 4.69 out of 5, classified as excellent by the original evaluation scheme. The thesis further reports a CVI of 1.00 for the developed tools, based on its specified relevance coding. Table 2 presents these results.

Table 2. *Jurors' evaluation of the developed authentic assessment tools (n = 5)*

Evaluation dimension	Mean rating (1–5)
Content	4.54
Learning competency based	4.57
Organization and mechanics	4.76
Administrability	4.82
Rubrics	4.73
Overall mean	4.69
Reported content validity index	1.00

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Teacher-perceived usability

Six mathematics teachers rated usability as high overall (M = 4.20). Efficiency received the highest mean (4.25), followed by effectiveness (4.19) and satisfaction in terms of use (4.17). The findings represent teachers' judgments about prospective practical use, rather than observed classroom performance.

Table 3. *Teachers' usability evaluation (n = 6)*

Dimension	Mean rating (1–5)
Effectiveness	4.19
Efficiency	4.25
Satisfaction in Terms of Use	4.17
Overall Mean	4.20
Descriptive Interpretation	Highly Usable

Teacher-perceived acceptability

The teacher-evaluators also rated the tools as highly acceptable overall (M = 4.21). The highest dimension was clarity (4.33); the remaining dimensions ranged from 4.15 to 4.21, reflecting positive teacher perceptions of relevance, presentation, and usefulness.

Table 4. *Teachers' acceptability evaluation (n = 6)*

Dimension	Mean rating (1–5)
Clarity	4.33
Suitability	4.15
Usefulness	4.18
Adequacy	4.21
Timeliness	4.21
Language, Style and Format	4.16
Overall Mean	4.21
Descriptive Interpretation	Highly Acceptable

Revisions and recommended enhancements

Evaluation feedback informed practical revisions to the materials: clearer competency codes and specific learning objectives, refined scoring criteria, simplified language, sample outputs, improved instructions, and learner journal questions as a feedback mechanism. The study also identified five broader enhancement strategies, summarized in Table 5.

Table 5. *Suggested enhancements for the authentic assessment tools*

Enhancement	Purpose
Localization and need responsive	Assessment tasks that are relevant and meaningful to the local context and incorporates the perspectives, experiences and cultural backgrounds of the students.
Incorporation of Cooperative Approach	Allowing students to work on the task either by group or pair thereby fostering collaboration and teamwork among students.
Structured and specific format in authentic assessment tool	Creating a more structured and consistent approach to objectively assess the student's performance.

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Enhancement	Purpose
Flexible and Inclusive design	Designing authentic assessment tools that will be accessible to the diverse learners regardless of their background and learning needs.
Student Self-Assessment	Incorporating student self-assessment encourage and empower students to assess themselves more effectively.

DISCUSSION

Taken together, the findings suggest that the ten assessment tools possess strong expert-rated relevance and favorable teacher-perceived usability and acceptability within the participating schools. Their GRASPS, project-based, and problem-solving formats translate the abstract properties of quadrilaterals into tangible design and investigation tasks, while the associated rubrics and questions offer a structured way to elicit explanations of mathematical reasoning. These characteristics are consistent with the premise of authentic assessment that competence should be demonstrated through meaningful applications rather than recall alone (Mueller, 2005; Wiggins, 1990).

The jurors' strong ratings across content, competency alignment, organization, administrability, and rubrics support the appropriateness of the tools' intended design. However, a reported CVI of 1.00 is evidence based on the specific panel and scoring procedure, not proof that all forms of validity or reliability have been established. Further evidence would be needed from actual student responses, inter-rater consistency, and performance across different classrooms.

Teachers' perceptions were positive, especially for efficiency and clarity, suggesting that the instruments may be feasible for classroom adoption after contextual adjustment. These are evaluation ratings, not measured improvements in learners' mathematical achievement, motivation, or higher-order thinking. The distinction matters because the study explicitly did not implement the tools with students or assess their instructional effects. Consequently, interpretations of educational impact should remain provisional.

The suggested enhancements highlight the importance of context in implementing authentic assessment. Localization can connect tasks to learners' everyday experiences; cooperative approaches can create opportunities for shared problem solving; standardized and explicit rubrics can improve transparency; accessible task formats can support more diverse learners; and student self-assessment can contribute a reflective feedback process. These proposals are grounded in the evaluators' comments and remain recommendations for further development rather than tested interventions.

Limitations

The study involved only five jurors and six teacher-evaluators from two schools. Ratings were descriptive and depended on the adapted instruments and participating evaluators. The source thesis did not report direct student testing, comparisons with conventional assessment, long-term implementation outcomes, or an independently established reliability estimate for the final set of authentic assessment tools. These limitations restrict generalization and prohibit claims of causal learning benefits.

CONCLUSION

This descriptive-developmental study produced ten authentic assessment tools aligned with Grade 9 Mathematics MELCs on quadrilaterals. The materials received excellent juror ratings (M = 4.69; reported CVI = 1.00) and high teacher-perceived usability (M = 4.20) and acceptability (M = 4.21). The evaluator-guided revisions and five enhancement directions provide a practical basis for refinement and potential

classroom use. Future work should pilot the tools with students, examine scoring reliability and student acceptability, and compare resulting learning evidence with that from traditional assessment methods before making claims about educational effectiveness.

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