Evaluation of Formative Assessments in the Self-Learning Modules (SLMs) for Grade 9 Mathematics

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Abstract

This study critically evaluates the formative assessments embedded within the Grade 9 Mathematics Self-Learning Modules (SLMs), focusing on their classification according to Anderson's Cognitive Process Dimension and assessing their strengths and weaknesses in promoting student learning. Given the widespread adoption of modular learning, especially in distance education contexts, it is crucial to determine whether these assessments effectively engage the range of cognitive processes necessary for deep mathematical understanding. Using a descriptive research design, the study systematically analyzed formative assessment items from selected SLMs and gathered feedback from both teachers and students to identify strengths and areas for improvement. Findings of the study indicate that the formative assessments predominantly target lower-order cognitive skills, such as remembering and understanding. In contrast, only a few of the items engage higher-order thinking skills, including analyzing, evaluating, and creating. This imbalance suggests a limited scope in fostering critical and complex mathematical reasoning. Additionally, qualitative feedback highlighted recurring challenges concerning the clarity of instructions, the limited variety of question types, and the lack of contextual relevance to real-world applications. Both teachers and students expressed that these factors hinder the full potential of formative assessments to support meaningful learning. In response, the study proposes a set of guidelines aimed at enhancing the design of formative assessments within SLMs. These guidelines emphasize incorporating diverse question formats that stimulate higher-order thinking and ensuring contextualized, clear, and engaging assessment items. By addressing these gaps, the research contributes actionable insights toward improving the effectiveness of formative assessments, ultimately enriching the mathematics learning experience for Grade 9 students in modular and distance education settings.

Keywords*: Assessment Design, Distance Learning, Formative Assessment, Mathematics Education, Modular Learning, Self-Learning Modules*

INTRODUCTION

Mathematics serves as a cornerstone of education and society, forming the basis of logical reasoning, analytical thinking, and decision-making. Its applications permeate key disciplines such as science, engineering, economics, and technology (Gutierrez et al., 2015). Despite its significance, mathematics often presents learning challenges for students, which may hinder their academic progression (Mahanta,

2012; Torio, 2015). Effective instruction and assessment strategies are critical to address these challenges and promote meaningful learning.

The onset of the COVID-19 pandemic triggered an abrupt transition from traditional classroom learning to remote modalities. In the Philippines, Modular Distance Learning (MDL) became the predominant delivery method due to limited internet access. As part of the Basic Education Learning Continuity Plan (DepEd, 2020), the Department of Education distributed Self-Learning Modules (SLMs) to ensure continued education. However, concerns regarding the quality, alignment, and instructional effectiveness of these modules have emerged (Hamilton, Kaufman, & Diliberti, 2020; Tria, 2020).

Formative assessment plays a crucial role in supporting student learning during instruction. It provides immediate feedback, allowing teachers to adjust strategies and address misconceptions in real time (Taras, 2008; Evans, Zeun & Stainer, 2014). In a modular context, however, direct teacher-student interaction is minimal, creating a challenge in ensuring formative assessments are properly structured and aligned with learning goals. This gap raises concerns about whether existing SLMs truly facilitate students' mathematical understanding and cognitive development.

The Department of Education's introduction of the MATATAG Curriculum (2023) aims to decongest the K to 12 curriculum and strengthen foundational competencies in literacy and numeracy. Concurrently, the persistence of external disruptions—such as natural calamities and extreme heat—necessitates continued reliance on alternative delivery modes (DepEd, 2024). As such, enhancing the quality and design of SLMs remains a pressing concern, especially for foundational subjects like mathematics.

Despite the widespread implementation of MDL and the development of SLMs, there is limited empirical evaluation of the formative assessments embedded in these materials, particularly within the context of Grade 9 Mathematics. Prior research often overlooks students' cognitive needs and the alignment of assessments with instructional goals (Stojanović et al., 2021; Atkinson et al., 2010). This study addresses that gap by evaluating formative assessments in Grade 9 Mathematics SLMs using Anderson's Revised Bloom's Taxonomy, with the goal of ensuring that assessments promote critical thinking, conceptual understanding, and mathematical proficiency. This study

Consequently, to achieve the goals of this study given the foregoing conceptual foundations, the research processes as shown on Figure 1 was guided the researcher in conducting the study.

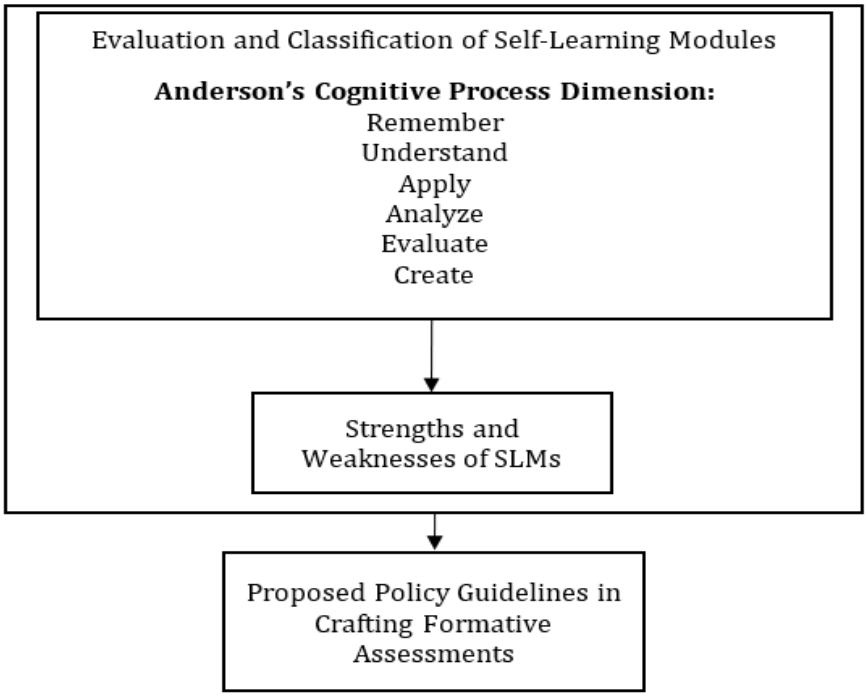

Figure 1. *The Research Paradigm*

The main objective of this study was to evaluate the formative assessments embedded in the Grade 9 Mathematics Self-Learning Modules (SLMs) used during the school year 2024–2025. Specifically, the study aimed to:

1. Classify the formative assessments in the SLMs using Anderson's Cognitive Process Dimension;

2. Identify the strengths and weaknesses of the formative assessments; and

3. Propose guidelines for crafting improved formative assessment tools.

Methodology

This study employed a descriptive qualitative research design to evaluate the formative assessments embedded in Grade 9 Mathematics Self-Learning Modules (SLMs). This design is appropriate for research focused on understanding the nature and quality of educational tools and how they are experienced by learners and educators. The approach facilitated the classification of assessment items using Anderson's Revised Bloom's Taxonomy and allowed the researcher to explore their strengths and weaknesses through both document analysis and semi-structured interviews.

The research was conducted at Bintawan National High School (BNHS), a public secondary school located in Villaverde, Nueva Vizcaya. The school was selected as the research site due to its ongoing implementation of SLMs in Grade 9 Mathematics for the school year 2024–2025. The researcher's familiarity with the institution, access to relevant materials, and direct involvement with the curriculum made BNHS an ideal setting for this evaluation.

Purposive sampling was employed to select a total of nine participants, comprising six Grade 9 students, one master teacher, one subject teacher, and the researcher. The participants were chosen based on their direct experience with the SLMs to ensure that the data collected would be rich and contextually grounded. The students represented diverse perspectives on how the assessments influenced their learning, while the teachers offered expert evaluations of the modules' instructional quality and alignment. Informed consent was obtained from all participants and guardians where applicable, and ethical standards regarding confidentiality and voluntary participation were strictly observed.

To collect data, the study used two primary instruments. First, a Formative Assessment Classification Matrix adapted from Anderson and Krathwohl's (2001) taxonomy was used to categorize the cognitive levels of assessment tasks found in ten SLMs. These modules covered key topics in Algebra and Radicals and were aligned with the Department of Education's Most Essential Learning Competencies (MELCs). Second, a semi-structured interview guide was used to obtain qualitative insights from the student and teacher participants. The guide explored participants' experiences with the assessments, focusing on clarity, relevance, difficulty, and alignment with learning outcomes.

The data gathering process occurred in three phases. Initially, the researcher secured permission to collect and analyze the SLMs. These were reviewed to extract formative assessment tasks, which were then classified under six cognitive process dimensions: Remember, Understand, Apply, Analyze, Evaluate, and Create. In the second phase, interviews were conducted with participants in either face-to-face or virtual settings, depending on availability and safety considerations. These interviews were recorded, transcribed, and analyzed. The final phase involved integrating findings from both the content analysis and interview data.

This study was submitted for approval to the Saint Mary's University Research Ethics Board (SMUREB) at Saint Mary's University, Ponce Street, DMM, Bayombong, Nueva Vizcaya, with email: reb@smu.edu.ph, after receiving approval from the thesis adviser and panel members.

While the researcher maintains a professional relationship with the participants, the potential for a conflict of interest existed due to the dependent relationship between the researcher and the respondents, particularly the students and teachers

involved in the study. The researcher took steps to minimize this conflict by ensuring that participation was voluntary and that responses would be anonymized.

Given that the participants are under 18 years old, their vulnerability is recognized. Special care was observed to ensure that their participation was voluntary and informed. The study involved obtaining consent from both the students and their parents or guardians. The informed consent form was co-signed by the parents or guardians of respondents aged 15 to under 18 years old to ensure their understanding and agreement to participate.

The recruitment of participants followed a clear and transparent procedure. Students and teachers were approached and invited to participate in the study through formal communication, detailing the purpose of the study, the procedures involved, and the voluntary nature of their participation. Information sessions were held to explain the study in detail and to address any questions or concerns that potential participants may have.

The administration of the research instruments was conducted in person, as the restrictions related to the community quarantine had been lifted. Participants did not face any physical or psychological risks. Instead, they were given the opportunity to contribute to the development of more effective formative assessments, which can benefit future students and educators. The privacy and confidentiality of participants was strictly maintained. Personal information and data collected were anonymized and securely stored, with access limited to the researcher. Upon completion of the study, all data were securely deleted or disposed of to prevent unauthorized access.

To avoid any form of deception, the researcher fully disclosed the study's purpose and methods to the participants before data collection. Informed consent was obtained directly by the researcher, not by the class instructors, to avoid any undue influence on the participants' decision to take part in the study. The consent process also included a clear explanation of the study's duration, procedures, potential risks, and benefits to ensure that participants were fully informed.

Results and Discussions

1. The results showed that most of the formative assessments in the Grade 9 Mathematics SLMs focused on the "Applying" and "Analyzing" levels of Anderson’s Cognitive Process Dimension. These included activities where students had to solve problems, interpret graphs, or perform algebraic operations. These types of tasks helped students practice and apply what they had learned. Some tasks also addressed lower level thinking skills like "Remembering" and "Understanding." These were usually seen in exercises such as matching, identifying, and basic simplification. While these are important, they mostly tested recall and basic comprehension. However, very few tasks were designed to reach higher order thinking levels such as

"Evaluating" and "Creating." This means students had limited chances to make judgments, explain their reasoning, or design their own solutions—skills that are important for deeper learning and critical thinking.

2. One of the strengths of the SLMs was their use of real-life examples. Many of the tasks were based on situations students could relate to, such as budgeting, fuel consumption, and everyday measurements. This made the lessons more engaging and meaningful. Some modules also included fun and interactive formats like puzzles and mazes, which helped keep students interested. In addition, a few modules showed a clear progression from easier to more challenging tasks, especially in Modules 1 to 3 and Modules 9 to 10. Despite these strengths, there were also several weaknesses. Many of the tasks were repetitive and focused mainly on computation, with little opportunity for students to think critically. Some modules did not provide enough support for learners who struggled, especially in difficult topics like exponents and radicals. Also, most of the modules lacked feedback tools, so students were not guided on how to improve or correct their mistakes. Finally, the types of assessments were limited, often just short-answer or multiple-choice, without many varieties.

3. To improve the quality of formative assessments in the SLMs, the study suggests a few key strategies. First, it is important to include more activities that focus on higher order thinking skills like "Evaluating" and "Creating." These tasks will help students think more deeply and apply their knowledge in new ways. Second, teachers and module developers should use a variety of assessment types. These can include open-ended questions, real-life problem-solving tasks, group work, and peer feedback activities. This will make learning more engaging and cater to different learning styles. Third, feedback should be a regular part of the assessment process. Adding tools like rubrics, self-check lists, and reflection questions will help students understand their progress and learn from their mistakes. Fourth, there should be more support or scaffolding for students who need help. This can be done by adding step-by-step guides, hints, and examples in the instructions. Lastly, all assessments should be aligned with the Most Essential Learning Competencies (MELCs) and should be based on content that is meaningful and relevant to students' daily lives and experiences.

Conclusions

1. The analysis of the formative assessments in the Grade 9 Mathematics SLMs revealed that a majority of the tasks focus on lower-order cognitive processes, particularly applying and analyzing. Activities designed to foster remembering and understanding were well represented, while higher-order cognitive skills such as evaluating and creating were less prominent. Though some assessments encouraged critical thinking and real-world applications, most relied heavily on procedural problem-solving and multiple-choice formats, limiting students' ability to demonstrate conceptual understanding and reasoning.

2. Based on teacher feedback and content analysis, the strengths of the formative assessments include their alignment with the curriculum, their ability to track student progress, and their usefulness in reinforcing key mathematical concepts. Teachers noted that these assessments provided immediate insights into student learning gaps, allowing for targeted intervention. However, notable weaknesses were identified: Overemphasis on procedural knowledge rather than conceptual understanding; lack of open-ended tasks that promote deeper reasoning, justification, and real-world applications; heavy reliance on multiple-choice questions, which do not adequately assess problem-solving strategies; inconsistencies in difficulty levels, with some assessments being too easy while others were too complex for struggling students; and limited use of technology, interactive tools, or collaborative learning strategies to enhance student engagement.
3. Findings indicate that revisions and improvements in assessment design are needed to better support higher-order thinking skills, engagement, and real-world applications. The study suggests guidelines that emphasize cognitive diversity, conceptual understanding, problem-solving, and interdisciplinary connections. Recommendations include the integration of open-ended tasks, performance-based assessments, and digital tools to enhance student learning experiences.

Recommendations

Based on the conclusions drawn from the study, the following recommendations are proposed to improve formative assessments in Grade 9 Mathematics SLMs:

1. Diversify cognitive levels in assessment design to ensure a balanced distribution of lower-order and higher-order thinking skills (HOTS). Current assessments primarily focus on applying and analyzing, but greater emphasis should be placed on evaluating and creating to encourage deeper mathematical reasoning. Integrating real-world problem-solving tasks will help students develop critical thinking and justification skills while applying mathematical concepts in practical scenarios. Additionally, reducing the dependence on multiple-choice questions in favor of performance-based assessments, written explanations, and interactive discussions will allow students to better demonstrate their problem-solving processes and reasoning.

2. To further strengthen formative assessments, a structured review and improvement cycle should be established to ensure that assessment tools remain relevant, effective, and aligned with student learning needs. This involves conducting regular evaluations and refinements to address inconsistencies in difficulty levels and ensure that each module includes a variety of assessment formats, such as short-answer responses, essay-type questions, and project-based tasks. Additionally, teachers should be equipped

with structured rubrics and scoring guidelines to facilitate consistent and meaningful feedback, enabling students to gain deeper insights into their strengths and areas for improvement.

3. Formative assessments should be aligned with established educational principles and best practices to maximize their impact on student learning. The proposed guidelines for assessment design should be strictly followed to ensure that all assessment activities are fair, inclusive, and supportive of progressive learning. By adhering to these principles, formative assessments can serve as effective tools for tracking student progress, reinforcing key mathematical concepts, and fostering a deeper understanding of the subject while preparing learners for real-world applications.

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