

FORMATIVE ASSESSMENT IN ONLINE DISTANCE LEARNING MODALITY THROUGH THE LENS OF MATHEMATICS AND SCIENCE TEACHERS

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ABSTRACT

Formative assessment provides ongoing feedback to monitor student learning and improve teachers' instruction. But the COVID-19 pandemic has changed the mode of learning delivery and has affected formative assessment. Hence, the researchers explored the practices, challenges, and adaptive strategies of Mathematics and Science Senior High school teachers on formative assessment of students' learning in an online distance learning modality. Narrative inquiry research design was used in which eight teachers and six students who were chosen through convenience sampling were subjected to in-depth interview. The audio-recorded interviews were transcribed and underwent coding, categorizing, and thematizing. Results revealed that teachers employ practices that allow them to provide immediate feedback, utilize online assessment tools, probe questions, encourage students' active participation, and align learning competencies with formative assessment. However, they encounter challenges that affect students' learning such as lack of motivation, unavailability of internet/data connection and gadgets, low digital literacy skills, minimal peer assistance, and authenticity of formative assessment results. But they adapt strategies to address these challenges through designing differentiated assessment, showing empathy, reinventing pedagogical goals through meaningful online tools, promoting student-centered learning, and providing consistent means of communication. Findings implied that teachers use various online formative assessment practices similar to what they do in face-to-face classes. Challenges are evident in the entirety of instruction. However, teachers are dynamic in improving their practices. An action plan consisting of activities, objectives, and description is hereby proposed to improve the online formative assessment practices of mathematics and science teachers to enhance students' learning.

Key words: Formative assessment, online distance learning, practices, challenges, adaptive strategies, Mathematics and Science teachers

INTRODUCTION

The COVID-19 pandemic has drastically impacted almost all sectors of the society. One of the most affected is the education sector (Tria, 2020) which has resulted in the closure of schools to contain the virus and reduce widespread infection (Viner et al., 2020; UNESCO, 2020). Schools have suspended face-to-face classes and

shifted to alternative learning delivery modalities resulting from the abrupt implementation of emergency remote teaching (Ferri et al., 2020). Despite the circumstance, continuing education has prevailed. The Basic Education Learning Continuity Plan (BE-LCP) of the Department of Education (DepEd) have been operationalized to

respond to basic education challenges brought about by COVID-19 pandemic. Alternative delivery modalities have been offered depending on the school context and learner preference. One of which is the online distance learning (ODL) which features the use of open educational resources and other technologies accessed through the internet during remote instruction (DepEd, 2020). Online learning provides interactive teaching and learning since it allows live synchronous instruction in which responses are in real-time. Additionally, the provision of online instruction is recommended to adapt to the new landscape of instruction (Toquero, 2020) to ensure that learners still gain access to quality basic education and opportunities for lifelong learning. However, schools need further study to ascertain how online learning effectively provides outcomes-based education and delivers increased learning gains (Basilaia & Kvavadze, 2020).

Student's learning is shaped by assessment practices as it contributes meaningfully to academic development (Lemanski, 2011). Thus, it is crucial to select assessment tools and plan assessment methods that would be congruent to the learning outcomes to achieve constructive learning practice (Biggs & Tang, 2011). Assessment comes in two forms: formative and summative. Formative assessment provides an on-going process of evaluation of students' learning outcomes through teachers' immediate feedback. This enables students to demonstrate responsibility for their own learning and identify other areas for further improvement (DepEd, 2020). As assessment draws an area of focus in online learning, formative assessment has gained popularity as the preferred assessment approach in online education since it demonstrates knowledge and skills in small fragments that are simpler to grasp and learn. It allows students to fail a task, realize their lapses and learn from it, and not to attain poor final marks. Hence, formative assessment is also termed as assessment for learning as it supports increased learning gains and refines students' learning.

Online teachers have identified online assessment practices that they found to be useful and effective. These include rubric-based assessment that promotes critical analysis,

communication, and understanding between teachers and students (Kearns, 2012), self-check quizzes and enrichment exercises with automatic feedback are popular tools in delivering online formative assessment that are more accessible since feedback-sharing is fast and multiple attempts are possible to scaffold learning (Baleni, 2015), self- and peer assessments that allow students to reflect on their own learning, hence, putting emphasis on self-regulated learning (Yang & Tsai, 2010), discussion forums with students as class moderators that add value to students' learning and improves class engagement, merging formative assessment with online tools to create an environment that promotes collaboration, develops students' independence, and encourages self-paced instruction (Baleni, 2015). In addition, online learning also offers diverse features of assessment that address individual differences and provide in-depth, constructive learning outcomes. Despite the advantages of online formative, challenges are evident.

Though learners considered online learning due to its flexibility and convenience (Hewson, 2012), the demands for accountability are raised in which teachers are expected to be always present, give quicker feedbacks, and show empathy (Perera-Diltz & Moe, 2014). The lack of face-to-face interaction has tested teaching practices to deliver lessons efficiently and provide immediate and clearer feedback. Teachers' workload and time mismanagement in online learning environment have caused less communication and less engagement among students. It has become more time consuming and more laborious for teachers to read huge number of online discussions and check students' submitted outputs, hence, putting less effort and time in providing effective feedback (Kearns, 2012). Moreover, digital divide has been apparent forming barriers among teachers and students in the online environment. The intermittent failure in internet connection has created anxiety among students making them less motivated to learn and participate in class undertakings. Moreover, teachers lack rigorous ICT training and resources to create their assessment tools (De Villa & Manalo, 2020) which resulted to lack of creativity, resourcefulness, and innovation out of available

tools and skills (Doucet et al., 2020). As teachers attempted to achieve normalization despite the rapid change of learning modality (Hodges et al., 2020), complexity assessment become more apparent (De Villa & Manalo, 2020). Therefore, teachers are expected to revisit the fundamental concepts of assessment and reconceptualize their practices in the context of online learning.

In this regard, the researchers explored the emerging practices, challenges, and adaptive strategies of mathematics and science senior high school teachers on formative assessment of students' learning in the new era of learning. As online learning is increasingly implemented among schools as an alternative learning modality to face-to-face discussion, it has become an interest to ascertain how teachers adapt to the dynamic new way of teaching and learning, particularly in online formative assessment.

OBJECTIVES OF THE STUDY

This study sought to explore the practices, challenges, and adaptive strategies of mathematics and science senior high school teachers on formative assessment of students' learning in online distance learning modality. Specifically, this study aimed to:

1. Determine the practices of Mathematics and Science teachers in online formative assessment.
2. Ascertain the perceived challenges of Mathematics and Science teachers on students' learning in online formative assessment.
3. Identify the strategies employed by Mathematics and Science teachers on online formative assessment to enhance students' learning.
4. Propose an action plan to improve Mathematics and Science teachers' online formative assessment practices to enhance students' learning.

To attain the aforementioned objectives, the study anchored the inquiry on the research work of Lajane et al. (2020) which explored the formative assessment practices in nursing education. The present study made use of the framework shown in Figure 1 which focused on the mathematics and science teachers' formative assessment practices, challenges, and adaptive strategies under the online distance learning modality, serving as significant bases to create an action plan that will enhance students' learning.

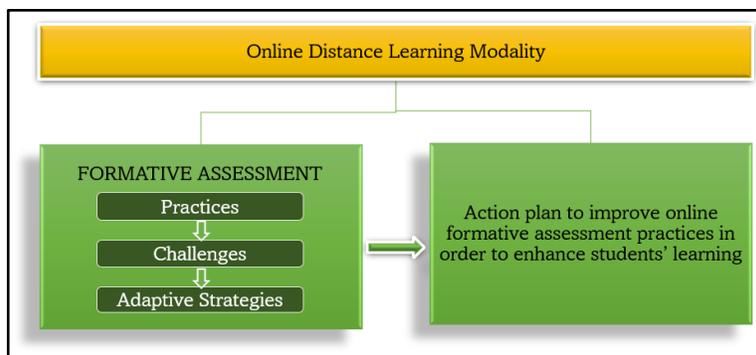


Figure 1. A conceptual framework on the practices, challenges, and adaptive strategies on formative assessment in online distance learning modality (Calixto, Manalo, & Peralta, 2021).

METHODOLOGY

This study employed narrative inquiry research design to discover nuances about the

experiences of teachers in online formative assessment. This qualitative design uses re-storytelling and provides opportunity for intertwined and cyclical dialogue and reflection (Wang & Geale, 2015). The participants of this study were

eight public senior high school teachers in the division of Quezon City, San Pablo City, and Valenzuela City. Furthermore, two students from each division were also included in this study. They were all selected using convenience sampling. The instrument of the study was a semi-structured interview guide. Its contents underwent expert validation. Letter of permission to conduct the study was secured from higher offices. Informed consent forms were obtained to guarantee a full understanding of the purpose of the study, procedure, scope of involvement, and confidentiality. In-depth interviews with teacher-participants were conducted through Google Meet/Zoom. Questions were open-ended to enable the participants to give answers in their own words. The same process was conducted among student-participants to triangulate the responses of teachers on the challenges in students' learning during online formative assessment. The conversations were recorded upon the participants' approval. The audio-recorded interviews were transcribed for data analysis. Data underwent coding, categorized, and thematized. A member-checking procedure via correspondence was conducted to ensure truthfulness of the data.

RESULTS AND DISCUSSION

1. Practices of Mathematics and Science Teachers on Online Formative Assessment

1.1. Providing Immediate Feedback

Formative assessment is a helpful tool that allows teachers to provide immediate and on-going feedback to improve students' learning. Mathematics and Science teachers revealed that after giving online formative assessment, they immediately give written and/or oral feedback on students' outputs and/or performances using different tools like Google Forms, email, Facebook Messenger, etc. Feedback is a powerful means to increase students' sustained commitment towards learning. It allows them to reflect on the topic that they need to give attention to, thus, giving them the sense of ownership and responsibility. For meaningful learning to happen, teachers need to provide meaningful yet constructive feedback so

students would be able to correct their misconceptions and manifest constructive learning (Ogange et al., 2018).

1.2. Utilizing Online Assessment Tools

Technology utilized in formative assessment holds a significant value in online distance learning modality. It creates an innovative way to make the assessment more interesting. Also, it permits customization and personalization of feedback easily and substantially. Mathematics and science teachers mentioned that they use user-friendly and interactive online assessment tools to easily generate assessment results. They consider online assessment tools that encourage students' live participation and promote self-paced, independent learning. Effective technology applied in teaching and learning shall ensure immediate and personalized feedback, teachers' elaboration, reusability, accessibility, interaction, design, and cost (Kebritchi et al., 2017).

1.3. Probing Questions

Good questions allow students to think more deeply and give teachers valuable insight about the breadth and depth of students' learning. During online formative assessment, instead of giving closed-ended questions, teachers give students open-ended questions so students can express their answers in their own words with a clearer perspective. Students are given the opportunity to reflect on their own answers, thus, increases and widens their own understanding. Teacher 1 stated *"Sometimes, formative assessment is not about the numbers that your students are getting, rather it's about what they will learn. At the very end of every concept taught, always ask your students, did they learn something?"* Formative assessment is not about the number of items or type of tests, but rather, giving questions that promote critical and higher order thinking skills. Teacher 6 mentioned, *"I try to avoid using lower-order thinking questions since all of the information can be searched already on the internet so, I use Essay type questions with Rubrics on my quizzes"*. Probing questions in formative assessment serves as a valuable

method for gathering targeted, actionable information on student's manner of thinking and potential misconceptions (Fagan et al., 2016).

1.4. Encouraging Active Participation

Mathematics and Science teachers ensure active participation during online formative assessment. They select online assessment tools that allow everyone to have equal opportunities to participate in class discussions. Participation in formative assessment is not meant to be a one-size-fits-all proposition. There should be an environment where all learning can be able to have access, ensure participation in answering questions, and manifest class interaction (Rodway, 2017).

1.5 Aligning the Learning Competencies with Formative Assessment

Student learning should be reflected in assessment. Mathematics and science teachers ensure that the online formative assessment is congruent to the Most Essential Learning Competencies (MELC) to develop targeted learning outcomes. Formative assessment can be given at any part of teaching and learning process. Hence, teachers select appropriate assessment method, adapt adequate online tools, and create good questions to help students meet the learning standards. Content, performance, and learning competencies are revisited to ensure that the formative assessment is suitable to attain the learning objectives (DepEd, 2019).

2. Teachers' Perceived Challenges on Students' Learning in Online Formative Assessment

2.1. Lack of Motivation in Online Learning

Effective teaching promotes motivation to learn among students. However, results revealed that students lack motivation in online learning, if not totally lost. Some students are not engaged with the lessons, and this has impacted their performance in online formative assessment. Interviews with selected senior high school

students confirmed the responses of the teachers that they feel unmotivated and not interested during online synchronous class discussions due to several factors that include poor internet connection. If students are motivated to learn, then they are more likely to be engaged with the formative assessment and they tend to gain the meet the learning standards. Arousing and maintaining motivation in transition from face-to-face to online learning is essential. The motivational process from the initial arousal of the motivation to the sustained motivation of unfamiliar and sudden environments is necessary (Chiu et al., 2021).

2.2 Unavailability of Internet/Data Connection and Gadgets

Formative assessment was done synchronously (through Messenger chat, Google Meet, and Zoom) or asynchronously (through social media and LMS). Formative assessment requires at least a reliable internet/data connection for students to do it well. However, similarities in Mathematics and Science teachers' responses revealed that the unavailability of internet/data connection and gadgets has been one of the challenges in online formative assessment. Students in the public schools who come from low-income families encounter this challenge and this hampers their performance. One of the most recurring challenges experienced by students in online distance learning is unstable internet connectivity (Rotas & Cahapay, 2020). Teacher 1 even stated that "*Stable internet connectivity and data connection, a good quality device/gadget to help them in online learning, mental unreadiness, and emotional weakness are the main sources of the problems with this online formative assessment... poverty makes students feel that learning is impossible and will not guarantee them success*". Moreover, interviews with Senior High school students indicated that having no Wi-Fi or limited data connection has been the greatest challenge they face nowadays. Since many of them cannot join online classes, they cannot participate in the online formative assessment. It should not be left unmentioned that some students do not even have gadgets to use during online

discussions; what more during online formative assessments.

2.3. Low Digital Literacy Skills

Not all students know how to use different assessment tools used by the teacher during online formative assessment. Digital literacy is imperative to effective learning in an online learning environment. Higher levels of digital literacy result in high output of student performance and learning outcomes (Yustika, 2020). As revealed in the study, mathematics and science teachers use Quizalize, Kahoot, Quizziz, and Google Forms as some of the online formative assessment tools. Since not all teachers in the school are using these, students are not so familiar with them. Unfamiliarity with these assessment tools hampers students' learning. Consequently, teachers are prompted to orient the students on how to use the assessment tool before the assessment starts.

2.4. Minimal Peer Assistance

Mathematics and Science teachers have been encountering challenges in online formative assessment because students receive minimal peer assistance. Unlike face-to-face instruction, when students are asked to answer a formative assessment in the form of recitation or seat work for instance, they may easily ask for help from their classmates. This may not be the case in online learning. If students do not know how to solve a mathematical or science problem, then the student will remain muted as if there is a technical problem. It has been frustrating on the part of the teachers that they cannot hear from their students. Moreover, interviews with students revealed that they find it hard to answer formative assessments given by their teachers because no classmate helps them. When they ask for help, their classmates do not mind their queries or answer them very limitedly. Research shows that building a sense of community among students on online distance learning improves students' learning, retention, and satisfaction with their online learning experience (Fuller et al., 2015).

2.5. Authenticity of Formative Assessment Results

One big challenge that teachers face in online formative assessment is the issue of the authenticity of scores. The use of online formative assessment tools may raise vital concerns vis-à-vis validity and reliability of results. As Teacher 1 stated "... we don't know exactly if the parent/tutor is the one who answers it, a relative/cousin, a friend who shares his/her answer to the student, and the availability of resources online that will give answers for that assessment. The truthfulness of the formative assessment results can hardly be obtained by mathematics and science teachers.

3. Adaptive Strategies on Online Formative Assessment to Enhance Students' Learning

3.1. Designing Differentiated Assessment

Teachers utilized differentiated assessment considering the varied context of students. This demonstrates an understanding of learners' diverse learning styles. Results revealed that mathematics and science teachers utilize different learning activities and assessment methods to consider learners' diversity. They even mentioned that profiling learners helps them to deliver differentiated assessments effectively. Learners' profile serves as valuable tool for instructional planning (De Villa & Manalo, 2020). Also, teachers consider ease of use, convenience, availability of gadgets, and internet stability. They used different online tools powered by technology to ensure access and adequacy of differentiated assessment. Teacher 1 advised "*Teachers may revisit and redesign their assessment methods and tools considering the diverse learning capabilities and different contextual situations of students.*" Teachers should customize the tasks given to students using the diverse features of online technologies. They should provide differentiated lessons and tailor-fit assessments. This boosts students' interest to keep them more engaged in learning (Tomlinson et al., 2015).

3.2. Showing Empathy

Online learning has caused mental and emotional distress among students due to the immediate shift of learning modalities. Students face many challenges including lack of motivation, limitations of available online resources, and shifting boundaries in home and school. This situation is further amplified by fear and anxiety due to COVID-19 pandemic. Hence, this calls for more empathy. Mathematics and science teachers mentioned that consideration, awareness, and kindness can lessen students' academic stress and pressure by scheduling the tests reasonably, considering late submissions, and reducing workloads. Adjustments were made to allow more flexible options. Patience and understanding were shown to still ensure kind yet meaningful learning endeavors amid the situation. Showing empathy can elevate feelings of social connectedness despite the distance. Teacher 3 heralded *"Adjustment and understanding are the keys to learning continuity. We all need to be patient and empathize with them."* In the era of digital literacy, teachers should ensure empathetic practice by listening and understanding. Empathy can help students sustain their interests and self-efficacy to continue learning. This will also alleviate depressing feelings and adverse behaviors (Wang et al., 2010).

3.3. Reinventing Pedagogical Goals through Meaningful Online Tools

Students' engagement with the lesson is driven by teachers' pedagogy. This can influence their performance in online formative assessment. Mathematics and science teachers revisit their teaching practices. They mentioned that they restructure their approaches to fit in synchronous and asynchronous classes since other dimensions of teaching and learning used in face-to-face classes were not applicable in online learning. However, they still consider pedagogical approaches such as inquiry-based, collaborative, and constructivist learning. But they enrich them using technology. Teachers keep on exploring the possibilities and opportunities in online learning. They keep on navigating different online platforms

and tools to improve their practices. Students are more inclined with technology since they are digital natives. Engaging them in online learning will keep them hooked and motivated. This may lead to positive assessment results as students find meaning and relevance to what they learn upon optimizing their online learning experiences (Lansangan, 2020). As Teacher 6 highlighted, *"This new normal shows our resiliency. I recommend to my fellow Science and Mathematics teachers to not stop exploring. Always reconsider your instruction methods to capture an appropriate assessment for students. Let us continue to challenge ourselves and bring the best of our students."*

3.4. Promoting Student-centered Learning

Online learning gives emphasis on student-centeredness as learning process becomes more flexible and cultivates autonomous, self-regulated, and personalized learning. Mathematics and science teachers underscored the importance of encouraging students to capitalize on independent learning. Teacher cited online tools that promote learner-focused activities like WebQuest that centers on inquiry-based learning, Khan Academy and PHET that promotes independent learning, and Quizziz and Kahoot that support game-based assessment. Creative use of technology helps students meet learning goals, leading to a more strengthened student-centered online formative assessment. This agrees with what Teacher 6 has stated *"I let students work independently with minimum guidance. This makes them discover and explore things on their own, learn from their mistakes, and comprehend the lesson. I see to it that I give feedbacks to serve as guide in their undertaking."* As education migrates to new normal, online distance learning should provide more impactful and equitable learning outcomes through personalized instruction and assessment, active engagement, and meaningful learning experiences (Dougherty & Schantz, 2020). However, it is not always the case since not all students are ready for student-centered learning because it requires more work, can be threatening due to unfamiliar environment that causes anxiety, and lack of preparedness due to the responsibility



of becoming an independent learner (Weimer, 2012).

3.5. Providing Consistent Means of Communication

Constant communication opens a wider channel of understanding and mutual desires among students, teachers, and parents. This creates a feedback-sharing community to recognize the roles and responsibilities of everyone towards an undisruptive learning process in online distance learning modality. Frequent conferences are conducted to talk about issues and concerns on students' progress and challenges. The consistent communication among key stakeholders can help to ease off the problems in online distance learning particularly the matters concerning assessment. This demonstrates that everyone is part of the educational process to bring positive gains in student achievement (Lansangan, 2020). Furthermore, communication is evident

among teachers as they do collaboration to exchange resources and share best practices. Teacher 3 told "*I suggest that Math and Science teachers find time to collaborate to share with one another their best practices in conducting online formative assessment*". This provides a professional development practice that allows teachers to interact with one another, learn together, and develop a sense of mutual commitment (Frumin et al., 2018).

4. Proposed Action Plan to Improve Online Formative Assessment Practices to Enhance Students' Learning

Presented below is the table showing the researchers-developed action plan to improve online formative assessment practices to enhance students' learning. This presents a brief description of activities anchored on significant findings derived from the results of the study.

Table 1

Action plan to improve teachers' online formative assessment practices to enhance students' learning

Activities	Objectives	Description
Digital Literacy Program for Math and Science Teachers	To enhance math and science teachers' digital self-efficacy in utilizing different online platforms and technology tools	<ul style="list-style-type: none"> • Hold capacity building programs to enhance math and science teachers' digital self-efficacy • Conduct training to help math and science teachers design, adopt, and utilize learning resources used in online formative assessment
Improving Math and Science Teachers Formative Assessment Practices in ODL	To enrich math and science teachers' online formative assessment practices to enhance students' learning	<ul style="list-style-type: none"> • Build a community of practice that allows the sharing of best practices on online formative assessment among math and science teachers
Conducting Mental Health and Psychosocial Support	To provide support to teachers' and students' challenges on their well-being	<ul style="list-style-type: none"> • Organize guidance counseling programs among teachers and students to help them cope with the challenges in online distance learning modality
Establishing Linkages and Partnership	To strengthen the collaboration between the school and key stakeholders	<ul style="list-style-type: none"> • Encourage stakeholders' support in assisting the school to fill the gap in digital divide on the issues of unavailability of gadgets and lack of internet connection
Holding Regular Conference	To conduct regular conferences on students' performance and progress	<ul style="list-style-type: none"> • Hold teachers' and parents' conferences regularly to discuss matters regarding academic struggles, challenges in assessment, and test results

CONCLUSIONS

The following are the derived conclusions aligned with the objectives of the study:

1. The practices of Senior High school Mathematics and Science teachers in online formative assessment are similar with their practices in face-to-face formative assessment. While the new normal calls for innovative practices, face-to-face formative assessment practices may still be applicable to enhance student learning. However, technology plays an integral part in designing and implementing formative assessment using various online tools.
2. Given that the educational system shifted unprecedentedly from face-to-face to distance learning, challenges have emerged and hampered the students' learning during online formative assessment. Moreover, these challenges have not emerged only during online formative assessment but in the entire online teaching and learning process. Furthermore, there are challenges like the unavailability of internet connection and gadgets that are beyond the teacher's control.
3. Teachers are dynamic in redesigning their formative assessment to cope with the new normal. Mathematics and science teachers devise efficient practices to provide immediate feedback despite the shift in learning modality. Constant communication among key stakeholders provides a feedback-sharing community to bring positive learning gains in student achievement. Nonetheless, teachers ensure empathized practices to sustain students' interest and motivation.

RECOMMENDATIONS

Based on the conclusions of the study, the researchers hereby recommend the following:

1. Learning Action Cell (LAC) sessions that promote sharing of best practices on online formative assessment may be conducted to foster teacher support.
2. Schools may create action plans to alleviate the challenges in online formative assessment that hinder students' learning.
3. Teachers need to be resourceful and innovative in developing adaptive strategies to address the challenges in online formative assessment.
4. Higher offices may provide training on the use of different online assessment tools to enhance the digital literacy skills of mathematics and science teachers.
5. Future researchers in the same field of interest may focus their study in other subject areas in senior high school.

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