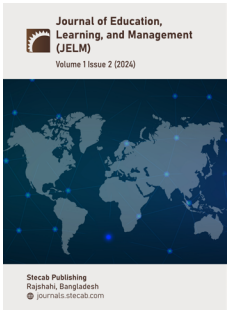

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Language in Math: Narratives of Mathematics Teachers in the Shift of Medium of Instruction in the Time of Pandemic

*[1]Jan Angelo Morata, [2]Kelvin Carl Fulay

About Article

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About Author

[1] Louella Gotladera Alcoba National High School, Sorsogon, Philippines

[2] J. P. Laurel High School, J. P. Laurel, Bulan, Sorsogon, Philippines

Contact @ Jan Angelo Morata
janangelo.morata@deped.gov.ph

ABSTRACT

A widespread effect of the pandemic disrupted opportunities to participate in mathematical activities in educational settings. The education setup shifted from a face-to-face to a modular approach. This qualitative narrative analysis research paper aimed to examine the perceptions of Mathematics Teachers at three separate public high schools about socio-mathematical norms practiced in their respective educational spaces and their usage of language in teaching the subject during COVID-19. A descriptive method of research was used to answer the objectives set in the study. Analysis of data was done through interview questions with three mathematics teachers in Bulan, Sorsogon. Results of the study show the teaching emphasis on the different distance learning modalities, the implementation of learning activity sheets, and the challenges encountered in the shift of medium of instruction in teaching mathematics during the pandemic. Finally, future studies may be undertaken to further analyze the perceptions of mathematics teachers in a broader perspective. This paper also recommends further exploring and revisiting DepEd programs regarding the implementation of modular distance learning.

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1. INTRODUCTION

Attention to educational shifts is greatly highlighted during the Pandemic. Most governments were playing catch-up to COVID-19's exponential spread, thus there was little time for universities and other institutions to prepare for a remote-teaching system. Adjustments and transformational measures have been taken left and right to mitigate the noxious impact of COVID-19 on education worldwide. United Nations International Children's Emergency Fund or UNICEF (2021) claimed that 77 million children have been affected for the last 18 months and that they have lost 1.8 trillion hours and counting of in-person learning due to COVID-19 lockdowns. With varying degrees, first world and third world countries essentially share similar difficulties in sustaining accessibility to education and safety net supports that learners receive in classrooms due to enforced global lockdowns (Garcia & Weiss, 2020; Jena, 2020). Consequently, the shutdowns of schools have evidently driven educational sectors to transition from traditional learning that takes place in school settings to new education modalities to bridge the widening gap of learners' experiential learning that is limited if not completely unavailable to learners situated in geographically and economically challenged locations.

In the Philippines, the government responded to the pandemic at various levels by primarily imposing strict restrictions in the country (Talabong, 2020). Despite stringent closures, Department of Education (DepEd) Secretary Leonor Briones led the release of the Basic Education - Learning Continuity Plan (BE-LCP) as the major response and commitment in protecting the health, safety, and well-being of educational stakeholders (Montemayor, 2020). The plan continuously strives to adapt educational delivery through self-learning modules both in digital and printed forms and different learning distance modalities which include radio, television, and the internet. DepEd ensures that the absence of face-to-face contacts due to COVID-19 does not hinder learning progress (Montemayor, 2020). It is expected that the plan allows customization of the different delivery modes responsive to students' need to access quality education. Teachers and students can choose what convenient instruction method will be adopted with utmost consideration of the students and schools' resources.

The COVID-19 epidemic poses a significant threat to educational systems. Opportunities to experience mathematical activities in classroom settings were abruptly disrupted by the worldwide effect of the pandemic. Teachers were concerned about student progress and engagement in learning especially students who were away from the school environment (Flack, 2020; Kalogerpoulos *et al.*, 2021). Practices in classrooms were no longer accessible, especially in subjects like mathematics that require a different approach to teaching compared to other disciplines. In the discussion of Schleppegrell (2007), he pointed out that mathematics, more than any other discipline, depends on the emphasis on spoken language, the teachers' explanation, and social interaction between the teacher and the learner and the learners themselves seem to be irreplaceable to us. Hence, the absence of face-to-face contact among students and teachers altered the regular norms of mathematics learning practices. Socio-mathematical norms were also taken out of the learner's immediate learning spaces and transferred to a remote learning setting while schools remained closed. Socio-mathematical norms are normative aspects of mathematics discussions specific to students' mathematical activities (Yackel & Cobb, 1996) which are most especially relevant in teaching and learning mathematics. On one hand, school closures prevent and protect against health threats that may affect learners. On the other hand, the education of everyone else is shaken because of this, and thus learning is linked to a range of unproductive and counterintuitive teacher-and-student interactions.

Given the need to teach mathematics to learners in a simple and understandable manner despite limitations brought by the COVID-19 pandemic, the researcher recognizes the valuable contributions of understanding socio-mathematical norms translated in remote learning contexts and linguistic variations as applied in distance learning to deliver quality education. No research has so far offered integrated accounts of socio-matheamatical practices and language usage in teaching mathematics in the time of the pandemic.

This paper aimed to examine the perceptions of Mathematics Teachers at three separate high schools about socio-mathematical norms practiced in their respective educational spaces and their usage of language in teaching the subject during COVID-19. A secondary aim was to provide profound descriptions of challenges concerning socio-mathematical norms and language in their chosen modality as they occur in the time of the pandemic.

2. LITERATURE REVIEW

2.1. Understanding the educational shift in teaching mathematics

Education in the Philippines was redesigned to meet the goals of Sulong Edukalidad program, an educational reform program aimed at achieving quality in basic education and globalizing the Philippine Educational System (Alcober, 2019). BE-LCP is created parallel to the program to advance education in the face of Pandemic. While there is apparent customization of the delivery of education to respond to the challenges of COVID-19, it is observed that in the grassroots levels of teaching subjects, changes are apparent especially that both teachers and students struggle to arrive at shared experience. Sawchuck (2020) claimed that among other subjects, learning loss in math is worse. Both believe that unlike reading, math is almost always formally learned at school. Parents are often less well-equipped to help their children with math, at a time when parent support can be even more crucial to student progress. They also contend that broader stress and trauma related to the pandemic may worsen existing math anxiety in some students, and math anxiety can worsen students' other stress while in class. More so, it can be more challenging for teachers to engage in effective math instructional practices via remote platforms (Sawchuck, 2020). Using a qualitative research method of exploratory and descriptive nature, Chirinda *et al.* (2021) discussed that mathematics teachers became learners themselves during emergency remote teaching (ERT) as they had to adapt to digital teaching, find solutions to unfamiliar problems, and acquire knowledge from a larger mathematics education community around the globe. It is clear therefore that pandemic has necessitated transforming teaching mathematics

into a hybrid process of getting learners to involve in numbers.

2.2. Socio-mathematical norms before and during COVID-19

In the past, central to teaching mathematics is the establishment of socio-mathematical norms that are significant in the classroom environment and developing mathematical aspects of students' activities. Yackel (1996) have elaborated the definition of socio-mathematical norms in understanding classroom practices. They further clarified the distinction of social norms from that of socio-mathematical norms.

"The understanding that students are expected to explain their solutions and their ways of thinking is a social norm, whereas the understanding of what counts as an acceptable mathematical explanation is a socio-mathematical norms. Likewise, the understanding that when discussing a problem students should offer solutions different from those already contributed is a social norm, whereas finding of what constitutes mathematical difference is a socio-mathematical norm" (Yackel & Cobb, 1996). Socio-mathematical norms are said to be the product of teacher and students' interactions. They are interactively constituted in the classroom (Yackel & Cobb, 1996). Students can negotiate their math answers among themselves while teachers can readily provide feedback. Yackel and Cobb (1996) in their extensive study of children from second and third grades, noted that learning opportunities arise when children attempt to make sense of explanations given by others, to compare others' solutions to their own, and to make judgments about similarities and differences. In essence, shared meanings of mathematical concepts are well studied and understood. In one aspect, negotiations of socio-mathematical norms benefit even teachers. Yackel and Cobb (1996) explained that teachers can respond to children's solutions, show their own developing understanding of students' mathematical activity and conceptual development. Socio-mathematical norms are even more established when teachers can know the students' conceptual abilities and their current understanding by the latter's given solutions and explanations. Classroom practices are full of accepted norms and traditions that a teacher and students negotiate. Hence, socio-mathematical norms rest on the essence of mathematics as a communicative context where solutions and answers are understood when the speaker and listener share in a mathematical discussion.

In the advent of COVID-19, students are left on their mathematics Learning Activity Sheets, Modules, and other materials, powerless to negotiate the correct answers with their teachers and students (Kalogerpoulos *et al.*, 2021). More so, if learners find chances to meet their teacher occasionally in monitoring, they cannot follow the discussion for foundational concepts are not yet mastered. There is also no creation of socio-mathematical norms because of restricted face-to-face interactions. The pandemic has abducted the opportunities of students to work collaboratively in a classroom community and to learn through discourse.

2.3. Linguistic variability of mathematics instruction

Teaching mathematics is not just teaching mathematical concepts or limited in that area alone. It is deemed necessary to further account the contribution of language in successful mathematics learning. Mathematics has its own special language and the process of creating mathematical knowledge has its specifics, self-study of mathematics is very difficult for most pupils and students (Csachova & Jurečková, 2020). Schleppegrell (2007) claimed that language is implicated in teaching and learning mathematics much more than is generally realized. Language spells a difference in classroom interaction and activities for it plays a major role in giving students access to mathematics knowledge, making it accessible to those students who have little access to the implicit learning that takes place outside the classroom for other students (Schleppegrell, 2007). It is in this essence that linguistic choices are imperative to put across mathematical meanings in classrooms successfully. In a study conducted by Abedi and Lord (2001), they analyzed the effect of modifying the language features of mathematics assessment tasks to try to make meanings more accessible to struggling learners. They changed standardized assessment math items by shortening nominal expressions, making conditional relationships more explicit, changing complex question phrases to simple question words, and passive to active, and replacing less familiar or frequent non-mathematics vocabulary with more common items (Schleppegrell, 2007). In their interview with students, most chose the revised versions and performed better with those versions. Low-performing mathematics students benefited more from the revisions than those in higher mathematics and algebra, English Language Learners benefitted more than proficient speakers of English, and students identified as having low socioeconomic status benefitted more than others (Schleppegrell, 2007). Of course, the modification of language as applied in mathematics assessment was done pre-pandemic. Therefore, it speaks about the effort of teachers to facilitate students' language ease in understanding math concepts before COVID-19.

Furthermore, there is an added challenge for teachers and students to meet halfway as mathematics is a language of numbers, symbols, notations, and grammars (Leshem & Markovits, 2013) and has merit on its own. It is claimed that Math satisfies components of language that include vocabulary, meaning, grammar, syntax, and narrative (Helmenstine, 2019). Math also is universally understood as no matter what country you're from or what language you speak, the structure of the mathematical language is the same. (Helmenstine, 2019). However, although it is internationally accepted, it is limited in the way math is taught and made understood to learners. One aspect of this is the limitations set by English as the universal channel where Math is rendered. In the Philippines, Math is officially taught using English which is quite different from the native or mother tongue of the learners. It is in this instance that teachers are left without a choice to modify their language to facilitate mathematics teaching.

3. METHODOLOGY

This paper was qualitatively explored and described. The researcher deemed it was necessary to use the qualitative method because data are taken from participants' own accounts and perspectives (McMillan, 2014). It is exploratory in nature as it delves into socio-mathematical norms and the language of

mathematics to acquire a new understanding of the phenomena. Additionally, the paper is qualitative narrative analysis. Mannine and Cullum-Swan (1994), as cited by Merriam (2002) states that narrative analysis typically takes the perspective of the teller, rather than that of the society. The researcher interprets texts generated or collected to identify patterns, themes, or narratives that aid in making meaning of data.

3.1. Research participants

Teachers' feedback and experiences regarding the shift in the medium of instruction in the time of pandemic were identified through the interview with the use of Google Form with open-ended questions among the purposively selected three (3) mathematics teacher-informants (2 Male, 1 female) who were generally new in the service (less than 5 years teaching experience) and are residing at Bulan, Sorsogon. The purposive sampling technique was utilized wherein the participants were chosen because they are the persons who can provide the needed information under knowledge and experience. Only these three mathematics teachers were asked to take part in the research. The researcher explained that participation would not entail extra work and explained that their anonymity would be protected. All of them agreed to participate in this study.

3.2. Data sources

The primary data in this study consists of narrative and reflective texts produced by the mathematics teachers obtained through online written interviews. There were key interview questions utilized in the conduct of the study to show the experiences, issues, and concerns of the mathematics teachers. These key questions were grouped into two themes: (1) Socio-mathematical norms and (2) Language usage. The following are the key questions asked during the interview: (a) In teaching mathematics, what aspects of your teaching modality do you find very difficult to implement? very easy to implement? (b) What challenges did you experience in delivering mathematics? (c) How did you resolve or overcome these challenges? (d) What challenges did you experience in terms of language use in teaching mathematics through your chosen modality? (e) Can you describe the difference between the level of language you used pre-COVID-19 compared to the level of language during COVID?

3.3. Data analysis

To analyze the teacher participants' stories, the researcher adopted the Qualitative Data Analysis Model by Creswell (2014). This model is composed of six (6) phases: (1) Prepare and organize data, (2) Explore and code, (3) Build descriptions and themes, (4) Represent and report qualitative findings, (5) Interpret qualitative findings, and (6) Validate the accuracy of qualitative findings.

Phase 1. prepare and organize data

This is where the researcher developed interview questions and recorded and structured the raw data collected from the Google Form interview on a recorded sheet. This process is also known as data documentation which is the next level after data collection. Researchers' descriptions, views, and insights were also recorded in this phase. This was mostly for the purpose of recording the interview responses.

Phase 2. Explore and code

After writing down the responses from the participants, the researcher prepared for coding. Coding aids in the organization and comparison of data by separating it into groups or themes. In this phase, the researcher presented the sequential structure of the three participants' narrative explanations. This guided the researcher to come up with ideas for themes.

Phase 3. Build descriptors and themes

This phase focuses on the qualitative research participants and themes in order to establish the study's credibility. Based on the results in coding, the researcher identified three (3) themes: (1) Teaching emphasis on the different learning modalities during the pandemic, (2) Implementation of learning activity sheets in mathematics, and (3) Challenges encountered in the shift of medium of mathematics instruction.

Phase 4. Represent and report qualitative findings

After identifying the themes to be discussed, the researcher then compiled the highlights or short excerpts which are grouped by themes from informant interviews to target the research objectives and discussion findings.

Phase 5. Interpret qualitative findings

The outcomes of the research findings were generalized and interpreted in this step. Also, research studies were considered to support the claims of the teacher-participants.

Phase 6. Validate the accuracy of the research findings

Member-checking is used to determine the validity of the research findings. Member-checking is used when the researcher takes summaries of the findings back to the participants in the study and asks them whether the findings are an accurate reflection of their experiences. In this part, after interpreting the qualitative findings supported by research studies, the researcher summarized and presented the findings to the three mathematics teacher-participants.

4. RESULTS AND DISCUSSION

The analysis of the narratives of mathematics teachers during the shift in the medium of instruction during the pandemic reveals the following themes:

(i) teaching emphasis on different learning modalities,

(ii) implementation of learning activity sheets in mathematics,

(ii) challenges encountered in the shift of mathematics instruction. Data gathered from interviews are presented alongside summarized findings in tables and figures for clarity.

4.1. Teaching emphasis on the different learning modalities during the pandemic.

The following are the teacher-informants' feedbacks on the implementation of the different learning modalities during the time of the pandemic. One of the plans of the Department of Education is to address the challenges in the education system despite the pandemic through the Basic Education

Learning Continuity Plan (BE-LCP). Within this BE-LCP is the implementation of different distance learning delivery modalities – printed modular distance learning, online learning, tv-based and radio distance learning, and blended learning.

Table 1. Summary of participants' feedback on modular distance learning.

Learning Modality	Participants (%)	Key Insights
Modular Distance Learning	100%	Most accessible in rural areas; teachers find it convenient.
Online Learning	Occasionally used	Conducted only for topics requiring immediate feedback and thorough explanation.

The findings revealed that 100% or 3 out of 3 participants adopted modular distance learning in their respective schools. This is because modular learning is the most popular type of distance learning. In the Philippines, this learning modality is currently used by all public schools because according to a survey conducted by the Department of Education (DepEd), learning through printed and digital modules emerged as the most preferred distance learning method of parents with children who are enrolled (Bernardo, 2020). This is also in consideration of the learners in rural areas where the internet is not accessible for online learning.

In line with this, a Mathematics Teacher I at Gate National High School in Bulan, Sorsogon stated "We are currently using the modular approach in teaching mathematics." She also added, "It is more convenient on the part of the teacher since all we have to do is just print the materials needed by the learners".

On the one hand, difficulties in dealing with distance modular learning arose. The teacher-informant disclosed that some students find it hard to understand the lesson due to a lack of assistance from the teacher. Feedback from a Teacher I in Bulan, Sorsogon reveals "Compared to the modular approach, it is more effective to teach mathematics through face to face because in that way you can assess your students individually and you can be able to guide them as well.".

A mathematics teacher, who teaches mathematics for four years commented "Although the primary modality that we use is a modular approach, we sometimes conduct online class, especially if the competency needs thorough explanation, immediate feedback, and deepening of understanding." The Department of Education (2020) underlined that it will not necessarily mean that teachers and learners will undergo the traditional in-classroom setup. The choice and contextualization of the learning delivery modality of schools will depend on the local COVID-19 situation as well as access to certain learning platforms (e.g., online learning, etc.) According to the report of Akamai (2017), the Philippines has the slowest internet connectivity in Asia. Such challenges in using the online platform include equity gaps, students' security and safety, quality of learning being compromised, and poor assessment results (Winthrop, 2020).

4.2. Implementation of learning activity sheets in mathematics

Participants noted that they crafted Learning Activity Sheets (LAS) tailored to their students' needs, ensuring alignment with the Most Essential Learning Competencies (MELC). Contextualization of examples and activities was emphasized, as detailed in Table 2.

Table 2. Contextualization of examples and activities in Learning Activity Sheets

Participant	Practice	Challenges
Teacher A	Created LAS from simple to complex; contextualized lessons.	Students lacked time to complete multiple modules.
Teacher B	Ensured LAS were concise, simple, and no more than four pages.	Students copied answers without engaging with content due to answer keys in modules.
Teacher C	Monitored student progress through home visitations.	Limited resources and time to fully monitor all students.

As an emergency response to the COVID-19 pandemic, students from Philippine public schools were provided Self-Learning Modules (SLMs), Learning Activity Sheets (LAS), or Simplified Module Intended for Learning Encounters (SMILE) based on the most essential learning competencies (MELC). These self- learning modules encourage independent study. One of its benefits in delivering instruction is the acquisition of self-learning skills among learners. Although the modules were provided by the Regional or Division Office, the three teacher participants created their modules based on the level of their students. A mathematics teacher in a remote school in Bulan, Sorsogon shares his experiences: "I crafted my LAS in line with the MELC and based on the capacity of my students. I made sure to make examples and activities from simple to complex. I also contextualize the lesson and provide relatable examples."

In addition, a mathematics teacher at San Francisco National High School Bulan, Sorsogon stated "Contextualized LAS must be anchored in the Most Essential Learning Competencies. I see to it that the LAS I've made is brief and simple with at least four pages long."

However, there are several issues with this type of modality. In the study entitled, "The Implementation of Modular Distance Learning in the Philippine Secondary Public Schools", results showed that students do not have enough time to answer all the modules within a week since they often received at least 8 modules in all subjects and each module has 3-5 activities. This may result in copying the answer keys of some students without even reading the material since answer keys are provided in the

self-learning modules for the students to assess their learning. In line with this scenario, a teacher informant at Danao National High School Bulan, Sorsogon stated "I always keep track of the learning progress of my students by conducting home visitation and constant monitoring." Another feedback from a mathematics teacher commented "To ensure mathematics is learned through LAS, I provided quiz without the key to correction at the last page of LAS as a form of formative assessment."

4.3. Challenges encountered in the shift of medium of mathematics instruction.

Although English remained the primary medium of instruction, teachers incorporated local languages to aid understanding, especially in remote or face-to-face monitoring scenarios. Table 3 outlines the participants' language usage patterns.

Table 3. Summary of participants' understanding of usage patterns

Scenario	Language Used	Rationale
Self-Learning Modules (LAS)	Primarily English	English is the standard language in mathematics instruction.
Monitoring and Explanations	Mixed (English, Tagalog, Mother Tongue)	Facilitated better comprehension among students.
Remote/Small Face-to-Face	Predominantly Mother Tongue	Enhanced understanding during limited physical interactions.

Albeit the differences, the languages of Mathematics and English are somewhat similar - both are languages of communication that are important in delivering instruction. English is the primary language used in delivering instructions in mathematics subjects. Self-learning modules for instance in mathematics from grade 4 onwards (in public schools) were also written in the English language.

All three teacher-participants stated the use of the English language in the self-learning modules. One of the teacher participants shares: "Primarily the language used in LAS is English, but during monitoring, I used a combination of English, Tagalog, and Bikol for them to understand the lesson well." This result implies that there is a shift in the medium of instruction. Math is officially taught in the Philippines in English, which is not the learners' native language thus, teachers need to modify their language to facilitate mathematics teaching.

In addition, teacher-participants observed that when teaching mathematics, although it is written in the English language, the native language is used in explaining the topics. According to them, students can understand the lesson well if the medium of instruction is in Tagalog or Bikol. A Grade 7 mathematics teacher said that "I consider using mixed language (Mother Tongue, Tagalog, and English language) in order to easily communicate with my students." In addition, another feedback from the Grade 9 mathematics teacher "Based on my experience it is very effective to use both English and Tagalog in explaining some of the concepts in math." This is supported by the study of Butzkamm (1988) which explains that code-switching to the mother tongue can function as a learning aid to enhance communicative competence in another language.

One of the participants shared her experiences with the difference between the level of language used pre-COVID-19 and during COVID, "In face-to-face classes, you can use English language but during monitoring of students you should use mixed language." Also, a remote teacher participant stated "I conducted limited face-to-face classes on open venue with physical distancing following IATF protocols. Usually, the class does not exceed 5 students, and I used my mother tongue in explaining the lesson." This means that compared to pre-COVID scenario, teachers often used mother tongue or native language in delivering the instruction in monitoring.

On the one hand, this modular distance learning poses a great challenge in the education system. Several challenges emerged especially in the quality of education. Some lessons are not learned and mastered during modular distance learning due to limited time and resources. Participants concluded that the quality of outputs of students, assessment of students learning, and the process of reaching out to students in flung areas are the challenges encountered in these trying times. As mentioned by one of the participants, "Not all of my students can copewith the lesson especially with the learning modality at present." This means that although teachers prefer the English language in teaching as the standard language used in mathematics, it is also important to consider and deviate from those standards to meet the needs of the students.

5. CONCLUSIONS

Modular distance learning is an alternative approach to face-to-face in the current educational setup. The shift in the medium of instruction is one of the challenges encountered since it could affect the students in understanding the lesson which is commonly taught in English once face-to-face classes resume. Also, other languages (Bikol, Tagalog) are often used since there is less support compared to the face-to-face setup, thus teachers connect with students through mother tongue. The provision of regular conduct of training and seminars as part of the professional development program of teachers be conducted to have a thorough grasp in implementing modular distance learning. This paper recommends minimal usage of the English language during home visitation by the teacher, adding informants to have a broader perspective and to further explore and revisit DepEd programs regarding the implementation of modular distance learning.

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