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Beliefs, Practices, and Challenges of Integrating Multimodality in Science in the New Normal

Louiesito Jr. Magnaye[1], Jamielou Bustarde[2*], and Antriman Orleans[3]

[1]College of Education, Northwest Samar State University, Calbayog City, Philippines

[2]College of Arts and Sciences Rizal Technological University, Mandaluyong City, Philippines

[3] College of Graduate Studies and Teacher Education Research, Philippine Normal University – Manila, Metro Manila, Philippines

*Correspondence: jbustarde@rtu.edu.ph

Abstract

This paper discussed science teachers' beliefs, pedagogical practices, and challenges in integrating multimodality in teaching science in the New Normal. Data were gathered through semi-structured interviews with the eight selected participants and were analyzed through Colaizzi's descriptive phenomenological method. Beliefs and pedagogical practices in integrating multimodality in science include inculcating a variety of modes, techniques, and strategies, considering student differences, using pictures, symbols, and models, using technology and interactive media online, and encouraging students' active participation and engagement offline. The study also identified pedagogical, technological, content, and behavioral challenges. Positive attitudes, such as being adaptable to changes, being eager to acquire basic skills, being well-rounded, patient, and motivated, being creative, and embracing effective professional development, were developed. The findings underscored the need for education policymakers, curriculum designers, and science teachers to strengthen the teaching-learning process by integrating more multimodality approaches.

Keywords

science education, multimodality, phenomenology, Philippines

INTRODUCTION

Science teaching and learning are multimodal (Kress et al., 2001), in which scientific ideas are encrypted with various modes of representations (Gilbert, 2010), such as mathematical equations, graphs, drawings, images, and hand gestures, written and verbal language. In addition to textbooks, science teachers also employ physical models, symbols, and other visual aids to communicate scientific ideas (Yeo & Nielsen, 2020). Papageorgiou and Lameras (2017) argued that meaning-making is demonstrated through a progression from more teacher-directed modes to more student-centered modes through gestural representations that tie together and combine multiple modes spurred by visual communication, cooperation, and discovery.

Although research suggests that students need more supervision when evaluating and interpreting representations, abstract and complicated processes are frequently taught and explained in Science by visual representations (Eilam, 2012). In addition, scientists continuously create representations of the

world, whether they take the form of written, verbal, visual, or multimodal writings (Unsworth et al., 2022). Consequently, science classes, as multimodal, should develop scientific reasoning, creativity, problem-solving, and collaboration skills by connecting various aspects and phenomena as part of students' reality and everyday life (Arroio & de Souza, 2012; Lamanauskas, 2003).

As such, students are thought to create their own representations rather than understanding those generated by others, for instance, the drawing-to-learn in Science (Ainsworth et al., 2011) and the model-generation approaches (Gilbert & Justi, 2016). Similarly, teachers struggle to assist learning in a representation-focused classroom (Waldrip & Prain, 2013). Hence, identifying science teachers' practices and beliefs in integrating multimodality in teaching science in the New Normal might improve science learning.

Today, the most advanced methodologies in all learning areas are Information and Communication Technologies (ICT). These offer access to learning platforms and provide resources critical to high-quality and relevant science learning. It expands experiences and allows students to view and comprehend the world differently. As the era of digital technology development progresses, literacy broadens to encompass the capacity to perceive and create utilizing a variety of representational modalities, paving the way for multimodal methods (Lankshear & Knobel, 2011).

However, teachers often need to understand the limitations of various forms of representation or the difficulties students have when trying to understand the representations used in teaching, even though they frequently utilize a variety of representations to demonstrate scientific notions (Eilam & Gilbert, 2014). Hence, teachers and students face challenges in multimodality in science teaching and learning. Moreover, the study by Cook (2011), which looked at how science teachers employ visual representations in their teaching, also suggests that students may need help understanding the teachers' representations in the intended manner. Thus, Cheng et al. (2020) recommended that investigations of thematic patterns in science classroom discourse must incorporate multimodality.

During the pandemic, many challenges arose in the field of education. As reiterated in various studies (Bozkurt & Sharma, 2020; Cahapay, 2021; Chaves, 2022; Dela Cruz, 2020; Fura & Negash, 2020; Henaku, 2020; Irawan et al., 2020; Rahiem, 2020; Rotas & Cahapay, 2020; Suhail et al., 2020), students and teachers have been forced to adapt and face various challenges as they make the transition to the new forms of teaching and learning that are often complicated and multifaceted. Since the entire education system has been affected, teachers are left with no choice but to become familiar with digital technology and include a variety of digital tools in their teaching (Evans-Amalu & Claravall, 2021). Due to these changes, teachers feel overwhelmed in this new instructional environment where everything is digital and potentially multimodal (Lankshear & Knobel, 2011). Hence, this paper presented the lived experiences of science teachers in integrating multimodality education amidst the pandemic using the conceptual framework (Figure 1) as a direction for this study.

This paper aimed to identify the different beliefs and practices of Science teachers in integrating Multimodality into the New Normal. Given their lived experiences, researchers also gathered the challenges experienced by Science teachers. As these beliefs and practices relate to the challenges, the authors also sought how the participants make sense of these experiences in their teaching practice. Sensemaking posits that individuals continually process action, selection, and interpretation to retrospectively make sense of unforeseen and disruptive events (Weick, 1995; Dougherty & Drumheller, 2006). This sensemaking will give rise to meaning and structure by merely deducing disorders to relevant and significant details.

Only a few studies have been conducted in the Philippines regarding multimodality in science classrooms. The study of Quillao (2020) concentrated on adopting a multimodal education technique to improve the students' capacity for remembering vital scientific ideas. Guevara and Quimbo (2011)

examined how the multimodal representation technique affected students' conceptual knowledge of college genetics and its implications for teaching biodiversity. Quillao's (2020) and Guevara and Quimbo's (2011) studies focused on multimodality in face-to-face science classrooms. However, it should have tackled this approach in remote instruction. Hence, this present study contributed significantly to fill this gap in the literature on multimodality in science teaching. Moreover, the comprehensive insights gained from this study are substantial in developing flexible and adaptable science classroom activities attuned to the constantly changing education landscape.

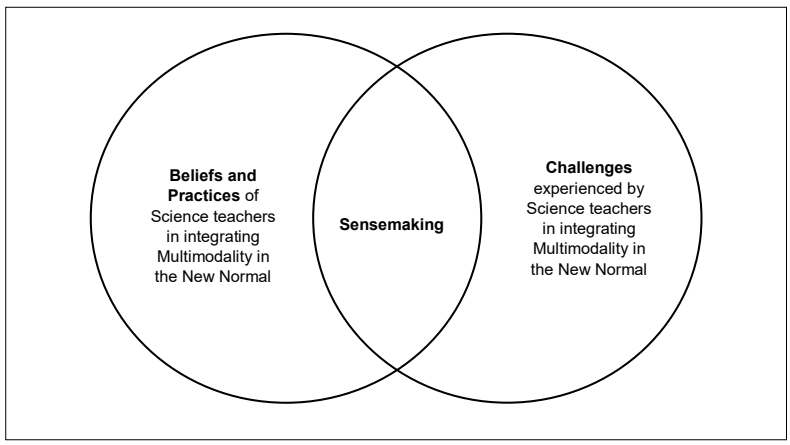

Figure 1. *Conceptual Framework of the Study*

Purpose of the research

The data were used to explore the following questions:

1. What are the beliefs and practices of science teachers about integrating multimodality in teaching Science in the New Normal?;
2. What challenges are Science teachers encountering in integrating multimodality into the New Normal?; and
3. How do science teachers make sense of these challenges of multimodality in their teaching practices in the New Normal?

METHODS

Research Design

This qualitative study utilized phenomenological design to explore science teachers' beliefs, practices, and challenges about integrating multimodality in Science teaching in the New Normal. In a particular cultural or social environment and human context, a qualitative research study looks at a phenomenon that affects people's daily lives (Creswell, 2014; Mills & Birks, 2014). To capture the essence of experience (Creswell, 2007), the phenomenological design seeks to correctly depict the phenomena without the benefit of prior framework knowledge while staying factually accurate (Groenewald, 2004). In this study, researchers built a rich understanding of the participants' experiences regarding aspects mentioned through thematic analysis of transcriptions from the informant's interview.

Participants and Sampling

The study included eight participants purposely selected from two private sectarian high schools in the Philippines. These participants were currently teaching Science for grades seven to ten during

the pandemic and had at least three years of science teaching experience. As evidenced by the signed electronic informed consent document, these participants willingly agreed to participate in this study.

Data Collection

The researchers collected the data through semi-structured interviews they designed and validated by three experts in Science Education. The authors used Facebook Messenger for convenient communication. A video conference application (Archibald et al., 2019; Bawanti & Arifani, 2021), such as Zoom, facilitated individual interviews. The researchers recorded the interviews with the consent of the participants, stored them, and transcribed them accordingly.

Data Analysis

To analyze the gathered data, the authors used Colaizzi's descriptive phenomenological method (Morrow et al., 2015; Speziale et al., 2010). The authors reviewed and reread each participant's responses and interview transcript to get a general feel of the content. The researchers marked essential statements related to the investigation topic. Then, the authors derived significance from these important assertions. The formed meanings were labeled following the study objectives and arranged into categories, clusters of themes, and subthemes. Additionally, bracketing was observed to avoid researchers' biases. Figure 2 shows the detailed steps in Colaizzi's descriptive phenomenological method (Morrow et al., 2015; Speziale et al., 2010).

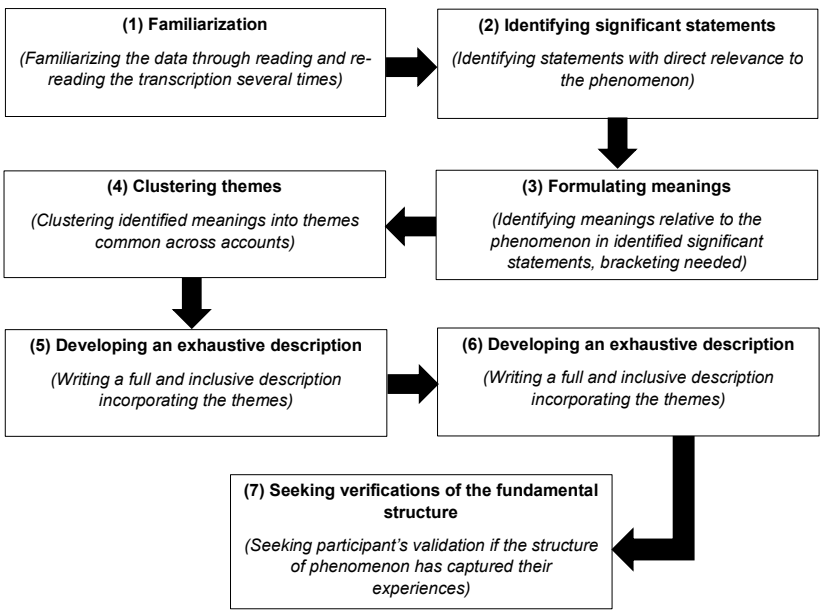

Figure 2. *Steps in Colaizzi's Descriptive Phenomenological Method*

Finally, the authors sought the research participants' validation of the findings to compare our descriptive findings to their experiences and address validity during data analysis. It was done through a post-conference with the participants individually, which was conducted virtually. Sandelowski (1993) stressed the importance of validity in qualitative research studies, and Oiler (1986) stated that validity is

reached when research findings are acknowledged by those who live the experience. It should be noted that the data saturation was attained through interviews with eight participants, indicating that sufficient information and themes were comprehensively explored in the study.

RESULTS AND DISCUSSION

This study aimed to describe the beliefs and practices of Science teachers and determine the challenges they encountered in teaching multimodality in the new normal. The school administrators may use this data to assist the teachers in improving the quality of education through multimodality in the teaching and learning process. The following paragraphs discuss answers to each of the three research problems.

Teacher Beliefs and Pedagogical Practices

The science teachers' beliefs and pedagogical practices have been heavily anchored on using varied techniques through instructional materials applicable to different learning modalities to elicit student participation and engagement.

Theme 1: Teaching with a variety of modes, techniques, and strategies to consider students' differences

Kress et al. (2001) emphasized that Science teaching and learning is multimodal. Participants described multimodality in science classrooms through the use of a variety of modes, including techniques and strategies. One teacher responded:

> *"Multimodality allows the teacher to use various strategies and approaches when teaching Science. To attain the Most Essential Learning Outcomes, multimodal education should be tailored to the learner's learning style." [Teacher 1]*

This narration coincides with the statement by Yeo and Nielsen (2020) that it is possible that students probably do not understand the teacher's representations in the manner intended if the lesson is not anchored on students' learning styles since they have different ways of learning. It implies that teachers use a variety of modes, techniques, and strategies to fit students' learning styles.

Moreover, since learners represent different personality types, generations, and varying learning styles, teachers and designers are responsible for seeking multiple methods to meet the needs of the students (Picciano, 2009). This supports teachers' belief that a multimodality approach is teaching a science topic considering the students' differences in different circumstances.

Theme 2: Using pictures, symbols, and models

Yeo and Nielsen (2020) stated that science instruction is multimodal, so science teachers employ images, symbols, physical models, and other forms of representation to convey scientific concepts. These beliefs are also evident to the participants as they highlight the importance of using multiple models in science so that the students can see and understand the concepts better. PowerPoint presentations, simulations, books, texts, and images are among the materials used by the participants in teaching multimodality in Science.

Theme 3: Using technology and interactive media online

The pandemic enabled science teachers to adjust their teaching approaches. According to the participants, they teach multimodality in Science by using technology to deliver lessons through interactive media platforms. The interactive platforms used are PowerPoint presentations, online videos, gamification, and simulations for experiments during laboratory classes. Teachers frequently use their

learning management system (LMS) as their medium of instruction, and Google services such as Google Meet and Google Classroom. Since media serves as a mediator to permit the generation, dissemination, and reception of semiotic signs, this facilitates effective communication between teachers and students (Rippl & Etter, 2013).

Theme 4: Encouraging Student Engagement Offline

The pandemic allows education to venture into different modalities, including learning through asynchronous activities. Participants admitted that engaging students offline is one of the most challenging tasks. To ensure learning continues offline, participants shared some practices:

> *"In my chemistry subject, since using the laboratory is a prerequisite, I am prerecording my teaching process for my students. This is to ensure clear instruction and teaching for learners. I also provide ready-made modules and learning activity sheets for my students to answer while watching the video as their aid." [Teacher 2]*

> *"Based on my experience, when using the multimodal strategy in teaching science, I make sure to use the modular book given to the learners as a guide in teaching and creating lesson plans. When I give quizzes, homework, and tests, I always use the book as a reference." [Teacher 3]*

> *"…For instance, by having performance-based outputs such as performing simple experiments at home, they would take a video of themselves while performing it. I also have performance tasks requiring them to be creative in some crafts, such as doing DNA models, cell models, plate tectonics, etc. Through this, I am confident that they are learning and enjoying well even though we are just meeting on screen." [Teacher 4]*

Challenges of Integrating Multimodality

Theme 1: Pedagogical Challenges

Although the pandemic offered different learning opportunities, participants shared several pedagogical impediments. This result coincides with Lansangan and Gonzales' (2020) study findings, which concluded that although the pandemic disturbs teachers' preparedness, they continue to have an unwavering willingness to interact with the students. The following are pedagogical challenges voiced out by science teachers in integrating multimodality:

Lack of contact time for supervision and direct guidance

Davey et al. (2019) stressed that it may be challenging to establish a social presence so that an online learner feels a part of the learning community. Due to the lack of face-to-face interaction, it has become a challenge for participants to integrate multimodality into their science teaching. One teacher shared:

> *…."Unlike in face-to-face classes, we can assess how the students comprehend the presented materials. Also, when physically present with the students, we can immediately give instructions and corrections. But when the pandemic hit, there were many adjustments in teaching." [Teacher 5]*

This statement manifests that science teachers are unprepared to face the new set-up of science teaching as they are not equipped with pedagogies suited for adverse situations like the pandemic.

Many learning materials to be made to satisfy student differences

To continuously support education, the participants have emerged to produce online and offline learning resources to cater to different learning modalities suited to their students' needs. Their workloads have doubled compared to the face-to-face modality since they must prepare many learning

materials to satisfy student differences. One participant shared:

> *"In the new normal way, science teaching is too difficult considering the multimodality technique of the teaching process. I am making a ready-made video ensuring the different factors like the audio, camera quality, angles, etc., and simultaneously making Learning Activity Sheets (LAS) to enrich learning." [Teacher 2]*

Another participant mentioned that:

> *"The individual differences of my students are a notion that I should also make a teaching process and materials such as making a module, learning activity sheets, pre-recorded video teaching, and online sessions. Solidifying learning is way too difficult in different modes, whether online or offline." [Teacher 7]*

Such statements are consistent with the research of Lansangan and Gonzales (2020), who found that science educators had tried to learn how to create ebooks and video presentations and even tried using various platforms.

Theme 2: Content Challenges

Science topics are predominantly sequential. To understand a concept thoroughly, students must have the pre-requisite knowledge from a previous grade level. As the pandemic hits the educational landscape, these aspects are placed in frustration as science teachers experience these challenges.

Laboratory classes

Barrot et al. (2021) posited that the pandemic had reduced students' learning opportunities through laboratory activities and experiments. Translating multimodal laboratory activities into contextual at-home learning activities has become a challenge. The lack of conventional hands-on activities and the rapid and forced change in modality produced a unique situation for students and teachers in laboratory education (Watts et al., 2022). One participant shared:

> *"We must think of improvised ways and materials to deliver and perform the lesson's experiment. This is helpful, but the experience of being in a laboratory is still different than performing it at home. They can see the laboratory tools and experience how they should be used if they are in the laboratory, and this is engaging for every student. For me, this is a big factor and struggle as a science teacher." [Teacher 4]*

However, participants have been adaptive by contextualizing and localizing the integration of multimodality to some extent, highlighting materials readily available in their students' homes.

Students' limited understanding of the pre-requisite knowledge

Applying students' prior knowledge to a learning endeavor improves learning (Altas, 2015). Thus, teachers must first monitor students' ideas, which shift as learning progresses, using past information and beliefs (Bransford et al., 2000). However, science teachers reported, "Prior knowledge is important, but because of this new normal, some students have limited understanding of a certain topic." This result is alarming since science learning is considered sequential; thus, multimodal activities also capitalize on prior knowledge.

Theme 3: Technological Challenges

Technology is one of the most prevalent factors that shape education today. It allows teachers to teach and direct students from a distance using various tools that establish communication with the class, groups, or individual learners. Although it makes educational resources interactive, collaborative, and accessible (Starkey et al., 2021), there were challenges seen concerning technology:

Poor Internet connection

Poor internet connection is the most identified hindrance for teachers in online distance learning. Rasheed et al. (2019) stressed that the issue of quality connection is one of the main challenges students face and a potential problem for staff, particularly teachers, in a blended learning environment. One participant added:

> *"Second, is the poor internet connectivity when teaching Science during online classes. I experienced technical errors that interrupted the lesson flow, leading to not understanding the lesson well. Additionally, because of poor or unavailable internet access, most students found it challenging to complete the required learning activities." [Teacher 5]*

Power outage

Although this does not apply to all, power outages are one of the challenges pointed out by the participants in delivering lessons online. The power supply interruption not only interrupts classes but also creates other problems. According to the United Nations Department of Economic and Social Affairs [UNDESA] (2024), the lack of electricity at primary and secondary schools generates considerable complications in escaping poverty and correlates with many factors that contribute directly to it. Thus, power interruption will disrupt education and branch out to different problems connected to it.

Unavailability of technological gadgets

Different modes, such as printed or digitized modular, online learning, radio and television-based instruction, or blended learning, were implemented to promote continuity of learning (Department of Education Philippines [DepEd], 2020). Consequently, using technological gadgets is crucial as they augment face-to-face classroom interaction through video conferencing via Zoom, Google Meet, and MS Teams. However, participants complained that technological gadgets are unavailable for students and themselves. Cleofas and Rocha (2021) disclosed that students without access to laptops and desktop computers showed more significant anxiety. Because of this, activities in online sessions were ineffective in integrating multimodality.

Unfamiliarity with some technological applications

The unfamiliarity with some technological applications has challenged the participants. One participant shared, "unfamiliarity with the use of some technological applications and limitations since some require a subscription and are difficult to navigate." Participants mentioned that the injection of representations had not been easy since they first needed to master the technical know-how in using technological applications, compromising the use of multimodality in teaching.

Administrative support

The administration has a fundamental role in keeping everything in place in schools. However, participants have disclosed that the school administration needs more support in their pedagogical undertakings. Educational administrators are responsible for developing these remote capabilities with input from their teachers and other stakeholders, focusing on nurturing connections (DeMartino & Weiser, 2021). Consequently, minimal support from the school administrators has also impacted the science teachers' integration of multimodality in their teaching practices, as they were not provided with complete learning resources.

Making Sense of the Experiences

Meaning-making manifests the experiences the participants gained in multimodality in the new normal. Despite their challenges, science teachers viewed the integration of multimodality as an excellent

opportunity to have the best and most engaging learning experiences doing activities. One respondent stressed:

> *"…They are enjoying and learning simultaneously. I can see that they are thinking critically because one medium of instruction I used involves different modes or areas wherein they can express themselves. I taught students HOW to think and not just WHAT to think." [Teacher 3]*

As Cheng et al. (2020) discussed, students' engagement with a series of multimodal representations can help them realize the scientific meanings. Moreover, the problems and experiences of these science teachers taught them to prioritize their students' needs, particularly their learning pace. The science teacher added:

> *"…Through this, I can give equal opportunity to my students who are learning at their own pace. I will incorporate multimodality by being creative in the activities that will help them develop in many areas." [Teacher 5]*

> *"…With the experience of multimodality, I can improve by crafting different sets of activities for the needs of my students." [Teacher 8]*

These coincide with the findings of Picciano (2009), who stressed that using several modalities allows students to experience learning in the ways that they are most comfortable with while simultaneously pushing them to experience and learn in other ways.

Furthermore, participants point out several ways to address their challenges, such as being adaptable to changes, practicing basic skills, being well-rounded, patient, and motivated, being creative, and most significantly, through effective professional development. As one teacher stated:

> *"…Through effective professional development. It improves my abilities and benefits the school as a whole. There must be a system of feedback and collaboration regarding my personal and professional development. Collaboration with peers encourages active learning and modeling of best practices. Knowing this emphasizes the value of professional growth and development." [Teacher 2]*

CONCLUSION

The findings have shown the science teachers' beliefs, practices, and challenges in integrating multimodality in teaching science in the new normal. Hence, the researchers concluded:

1. Science teachers perceived the integration of multimodality in science as teaching with various modes, techniques, and strategies using pictures, symbols, models, technology, and online interactive media.
2. Teachers consider using multimodality in teaching science to cater to students' differences and encourage offline participation and engagement.
3. Although participants viewed the pandemic as an eye-opener for many learning opportunities, challenges were experienced that hindered engagements, such as pedagogical impediments and technological and content challenges.
4. Problems encountered by the participants during the integration of multimodality in the new normal taught them to prioritize and attend to the needs of their students.
5. Positive attitudes such as adaptability to changes, practicing basic skills, being well-rounded, patient, and motivated, creativity, and effective professional development are ways to address challenges.

Overall, this paper highlights the need for science teachers to integrate multimodality in teaching science to meet the needs of the learners. Following the study of Picciano (2009), learners represent different personality types, generations, and varying learning styles; thus, teachers and designers are responsible for seeking multiple methods to meet the needs of diverse students.

Recommendations

While this paper documented the beliefs, practices, and challenges in integrating multimodality in science classrooms encountered by science teachers, it should be noted that the insights gathered from this study cannot be generalized as true to all the science teachers in the Philippines but to only seek patterns. However, the following instructional and curricular recommendations were identified:

1. Science education should be viewed as multimodal. Hence, teachers should be updated on pedagogical tools to enhance student learning and engagement in science. Science curriculums should be enriched with various multimodality approaches to align with current trends in education.
2. There is a need for education policymakers, curriculum designers, and science teachers to strengthen the teaching-learning process by integrating more multimodality approaches, especially in teaching Sciences, to cater to students' differences. In doing so, active engagement from the students, even in various learning modes, is expected.
3. Local and state governments should recognize and acknowledge the science teachers' challenges and assist them in improving science education.
4. Science teacher leaders may consider as an important facet in building effective science instruction. Therefore, there is a need to develop not only the content and pedagogical aspects of these teachers but also positive attitudes, such as adaptability to changes the likes, to address current and future challenges.
5. This paper also gives some direction for future researchers to address other issues relating to integrating multimodality in science classrooms.

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