



## Online Science Teaching Success is Pre-Determined by Pedagogical & Technological Preparations

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### Abstract

Online science learning is a new educational norm adapted at the start of the COVID-19 pandemic in the Philippines. This study aimed to investigate the experiences of grade school science teachers through interpretative phenomenological analysis. Five (5) teacher-participants who were on the forefront of preparation, implementation, and evaluation of online science learning were selected and interviewed on March 7-11, 2022. Results implied that a thorough preparation on the pedagogies, curriculum, technologies, and training of skills are crucial in the implementation of the learning modality. These are factors that require the collaboration and establishing of guidelines among school stakeholders (faculty, parents, support staff, and administrators) to be successfully implemented. When shifting to online science learning, schools need to prepare by taking into consideration the following: 1) Redetermine the curriculum; the coverage (breadth and depth) should focus on the grade level competencies and topics that are pre-requisites to the next level; 2) Redefine the teaching-learning pedagogies and academic guidelines; the delivery of the lesson, activities, and assessments should be flexible to the online environment and learners' context; 3) Acquire appropriate technologies such as computers for teachers and learning management system that suits the remodeled curriculum and redefined pedagogies; 4) Provide adequate training for teachers and support staff in the use of technology, planning and implementation of the lesson, and providing holistic supervision and assistance to pupils; and 5) Orient the parents and the pupils with curriculum, pedagogy and academic guidelines, required technologies, and skills.

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### Introduction

Online learning has become the new educational norm in teaching and learning Science in the time of COVID-19 in several countries (Li & Lalani, 2020) including the Philippines (Department of Education, 2020). To deliver Science learning online effectively, it

is important that teachers have sufficient training and workshops on the integration of pedagogy, content knowledge, and technology (Chua et al., 2020). However, with this abrupt change in the teaching-learning modality, teachers were unprepared for such integration of factors (Moralista & Oducado, 2020). Thus, this study

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investigates the lived experiences of the teachers in teaching Science online through Interpretative Phenomenological Analysis (IPA).

Online Science learning has been employed and studied in other countries; however, those studies were focused on Higher and Secondary Educational Institutions. Positively, this modality has flexible learning approaches (Deshmukh, Forawi, & Jaiswal, 2012), avenues for authentic learning (Hallyburton & Lunsford, 2013), and constructively encourages creation of learning (Miller, 2008). Nonetheless, this modality requires a pedagogical shift (Anderman, Sinatra, & Gray, 2012; Clark, 2016; Ferlazzo, 2021) and personal adjustments (Kebritchi, Lipschuetz, & Santiague, 2017) among teachers and learners.

In the pre-pandemic Philippines, Science educational landscape relies heavily on the face-to-face interaction. Online learning in the Higher Education Institution was implemented but issues on technological, pedagogical, and curricular support (Arinto, 2016), financial and communal funding (Calpo, 2020; Baticulon et al., 2021), and digital skills of both learners and teachers (Alipio, 2020) arose. The same concerns are projected in the basic education level (Galeon, Garcia, & Cruz, 2019; Daniels, Sarte, & Cruz, 2019). Thus, there were no progressive training programs for the teachers regarding online learning in the country. However, due to the pandemic, schools were forced to employ the learning modality and training of teachers and development of the curriculum were done in a short amount of time. Although training is ongoing, unfortunately, most of the online trainings provided by the Department of Education was focused on the use of online applications and learning management systems (Department of Education, 2020) and limitedly involved the employment of various approaches and strategies on teaching the discipline such as Science in the current set-up.

Prior research has been conducted on the experiences of the learners in learning Science online, but little has been explored on the experiences of the teachers. The experiences of the teachers, who are the frontliners of the Philippine's pandemic-stricken educational system will be of value to identify gaps that would help improve the teaching-learning process of science. As such, this study aimed to provide explanation of the lived experiences on the teaching of Science in an online modality. This specifically identified the personal and professional challenges and opportunities teachers

have experienced, the motivation that they have in teaching Science online, and the needed assistance to augment and improve their skills in teaching Science in an online set-up.

## Objectives

This study aimed to provide explanation of the lived experiences on teaching Science in an online modality. This specifically determines the following:

1. The challenges and opportunities faced by the teachers.
2. The kind of motivation that teachers have in teaching online.
3. The assistance needed to augment and improve the implementation of online Science teaching.

## Literature review

Online learning is a whole separate field than the traditional learning modality but its success is mostly determined by the academic achievement and satisfaction of the learners. Abuhassna et al. (2020), aimed to develop a theory in improving the learners' achievement and satisfaction in an online environment. Results have shown that providing opportunities for learners to have meaningful, collaborative, and autonomic experiences and interactions heightens their level of achievement and satisfaction. Thus, schools need to have a rigorous plan and appropriate learning pedagogy to implement such activities.

Similar findings are observed by Hamann et al. (2020) among college students in political science courses. Findings show that the success of online learning is inversely proportional with online course load. Although there are factors that the study has not explored on as to the reasons of increasing course load with low level of success, they recommended that the shift towards online learning has to take into consideration the coverage of the lesson offered to the learners.

These show that demands on teachers to improve their communication, technological, and teaching learning strategies are higher compared to the traditional learning environment which agrees with the findings of Roddy et al. (2017). They further argued that academic support, especially in maintaining student engagement, is among the critical areas that pedagogical approaches and competences of the teacher should address. Zweig and Stafford (2016) suggested similar training areas that should be given to teacher to have a successful online learning modality. They reasoned that the bulk of the

online learning work comes from the teacher. Thus, ample training on related skills—pedagogy and technological be provided to the teachers to cater to the needs of the learners in a different online environment.

Aside from pedagogical concerns, technological capabilities of the school and the teachers are also critical factors in the success of online learning. Paul and Jefferson (2019) have found that learners have better academic achievement among college students in an online delivery with the effective use of learning platforms that highlights interactions. Although online results and achievements are arguable, due to its nature, it can still be argued that the effective use of technology by the teachers to provide interactive and engaging learning experience has a relevant impact. Moreover, physical facilities such as computer gadgets and strong internet connection are determinants of the online learning success. Basar et al. (2021) have found that learners and teachers have to be comfortable with the use of the computer gadgets and that they be provided for it to effectively deliver the lesson. Government should work together with telecommunications companies to provide strong and quality internet connection to maintain the teaching-learning experiences.

### Conceptual framework

Effective implementation of online learning is dependent on the learning environment and the educational interactions therein (Anderson, 2008). According to Anderson, an online learning environment should consist for four components: learner, knowledge, assessment, and community-centered. Across these, the environment should be highly flexible, accessible, and adaptable to immediate changes. Nevertheless, it must be acknowledged that limitations exist in an online learning. Therefore, pedagogy has to be adjusted based on the context of the components and the learning environment. Thus, it demands heavily on teachers to constantly develop their skills in the preparing and implementing online learning. Teachers are expected to provide activities that allows learners to interact with each other, with the content, and with the teacher. Consequently, teachers, in order to further improve have to establish interactions with fellow teachers, learners, and the content.

More than the pedagogy and content relationship, teachers must be well adept with technology being the primary tool in an online learning modality. According to Mishra and Koehler (2006) in the Technological

Pedagogical Content Knowledge (TPACK) Model, technological knowledge and skills have to be learned separately from content and pedagogy. However, technology alone does not constitute good teaching-learning, it has to be integrated with pedagogy and content (in pairs or in triad). Only when a balanced integration of these components can there be effective teaching. Thus, teachers should be train in the different educational technologies and the optimum usage of technologies with pedagogy.

This is further supported by Clark and Mayer (2016), their E-Learning Theory suggests the use of appropriate educational technology with the applied pedagogy. It implies that the use of technology should be part of the strategy used in the implementation of the lesson to allow focused learning on the essential knowledge and skills. Needless to say, most of the task on online learning preparation lies on the use of appropriate strategies and technologies that depends on the competence of the planning and implementing knowledge and skills of the teacher.

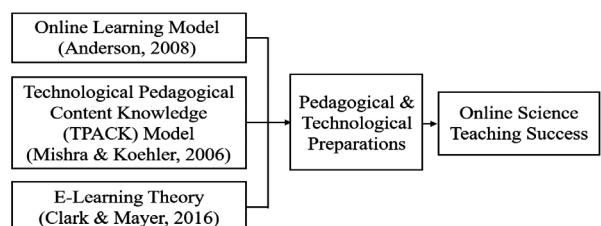


Figure 1 Conceptual framework

### Research methodology

This study employed a qualitative research method through interpretative phenomenological analysis (IPA) to investigate, understand, and interpret meaning of the experiences of the teachers in preparing, implementing, and evaluating Science learning through the online learning modality. A thorough and in-depth analysis was conducted to center on the challenges and opportunities that the teachers have experienced in the process of teaching Science online inferring plausible contingencies, fortifications, and supports that can be given to them.

The IPA research method is a process of making sense from the experiences of the participants of the study on their own terms in a detailed manner (Smith, Flowers, & Larkin, 2009; Laverty, 2003). This method requires the researcher to be personally immersed into the phenomena in question to attain insider's information

and observation on the subjects being observed (Tallman, 2019; Creswell & Poth, 2017). The ability of the researcher to interpret the content, language, and implied meaning of the data is the key in fully understanding the phenomenon being studied (Smith et al., 2009; Larkin, Shaw, & Flowers, 2018).

### Selection of participants

IPA focuses on how different individuals perceives and make sense of the same phenomenon (Smith & Osborn, 2014). Creswell and Poth (2017) suggested and emphasized the selection of heterogeneous set-up of participants. However, Smith et al. (2009) and Larkin, Shaw, and Flowers (2018) suggested on the selection of homogeneous participants to gather several perspectives on the same phenomenon that were experienced. Since the focus of the study was to gain detailed account on the teachers to develop clearer and deeper understanding of Science online learning, five (5) teacher-participants were selected purposively and homogeneously (Sim, 2020).

The inclusion criteria on the selection of the participants required that the teacher:

- (1) had taught Science prior to online learning,
- (2) is involved in the preparation of the instructional and learning materials for science online learning,
- (3) is/had taught Science in an online set-up, and
- (4) is involved in the evaluation of program in the school affiliated.

Based on the criteria, five (5) teacher-participants qualified. The table below shows the demographic data of the selected teacher-participants relevant to the goals of the study.

**Table 1** Teacher-Participant Demographics

Teacher-participant number	Age	Gender	Number of years in service	Grade level taught
1	25	Female	4	2
2	25	Male	4	4
3	28	Female	5	5
4	31	Female	9	6
5	39	Female	18	3

### Ethical consideration and Research rigor

Creswell and Poth (2017) emphasized the adherence of qualitative research studies to the ethical standards throughout all the phases of the study. As such, this study was conducted after receiving approval from the research review board and the administrators of the affiliated school of the research participants. The affiliated school and the participants were informed of the purpose of the study; its objectives, aims, data

collection and analytical process to assure that the participation to the study did not cause any direct and apparent harm to the participants and the institution.

Personal identifications were also encrypted into codes to maintain the anonymity and privacy of the participants and confidentiality of the shared information in accordance with the Data Privacy Act of 2012 of the Philippines. All gathered data were stored with all information coded and shall remain to be the property of the teacher-participant and the school they are affiliated with. Furthermore, whenever the participants request to withdraw before and during the scheduled interview, they were given the freedom to stop, pause, or withdraw from the research procedure.

### Data collection

IPA requires an ample and substantial collection of data, as such, participants should be provided with the opportunity to express their stories, feelings, and concerns (Smith et al., 2009; Tallman, 2019). In order to supplement the data from interviews, the researcher needed to write memos on the intricacies and nuances of the participant which were not captured by transcriptions to bridge the conceptual meaning implied to the phenomenon being studied (Birks, Chapman, & Francis, 2008; Saldaña, 2021).

Following the suggestion of Smith et al. (2009) and Noon (2018), this study employed a semi-structured interview. This form of interview allows the researcher to have an interaction with the participants in order to probe deeper on the experiences shared (Tallman, 2019). An interview schedule was crafted based on the guidelines presented by Creswell and Poth (2017) and based on the guidance from the research adviser. The interview process followed the responsive interviewing model of Rubin and Rubin (2011) allowing the researcher to sequence the questions depending on the situation and flow of the interview. Notes of the observations done on the participant's thoughts, emotions, actions, and non-verbal cues were recorded as these provide context of the data being gathered during the interview. Focus group discussion on the teacher-participants was conducted to cross-refer the individual answers.

The data gathering phase was conducted during March 7-11, 2022. The interviews were conducted through an online video conferencing application to adhere to the health standards and protocol to prevent the spread of COVID-19. In accordance with the Data Privacy Act of 2012, letter of intent and consent on the conduct of the study were solicited from the

teacher-participants and to the school's research and academic council they are affiliated with. The consent includes the permission to record the video and audio of the conversation and that confidentiality of the information shared and anonymity of their identity will be highly assured.

### Data analysis

This study employed the suggested analysis procedure of Smith et al. (2009) on IPA and consisted of the repetitive and inductive cycle of coding and interpreting of lived experiences of the individual teacher participants. In this process, themes were derived separately for each teacher participant and underwent the elimination process of themes that were not aligned to the identified research problems. Finally, themes were categorized to generate the superordinate themes.

In detail, the analysis includes six (6) sequential steps. The first step was reading and re-reading which required the repetitive reading of the transcripts and viewing of the video conferencing of the interview to understand the context of the data. The second step was initial noting of the descriptive, linguistic, and conceptual meaning of the data to exhaust the descriptive and interpretive meaning of the data. The third step was to develop emerging themes to systematically reduce the volume of data into chunks but at the same time, maintain

the connections, inter-relationships, and patterns of the exploratory notes. The fourth step was categorizing the emergent themes through identifying connections among them and developing a bigger umbrella of themes. The fifth step was to perform the process for the data collected from the other teacher-participants. Lastly, the sixth step was to look for patterns across the cases and generate unifying themes that represented and generalized the lived experiences of all the teacher participants. The timeline that follows shows the flow of the processes.

### Results

This study explored the experiences of teachers teaching Science in an online set-up. With this goal in mind, in-depth interviews were conducted on the teacher-participants and the data were collected and analyzed through the interpretative phenomenological qualitative research methods. The results categorized the teaching experiences into three themes of eventful encounters. The three superordinate themes of the identified salient teaching experiences are: pedagogical challenges and opportunities, barriers and links for online teaching, and teacher's improvement. The subthemes included within the superordinate themes are detailed in Figure 2.

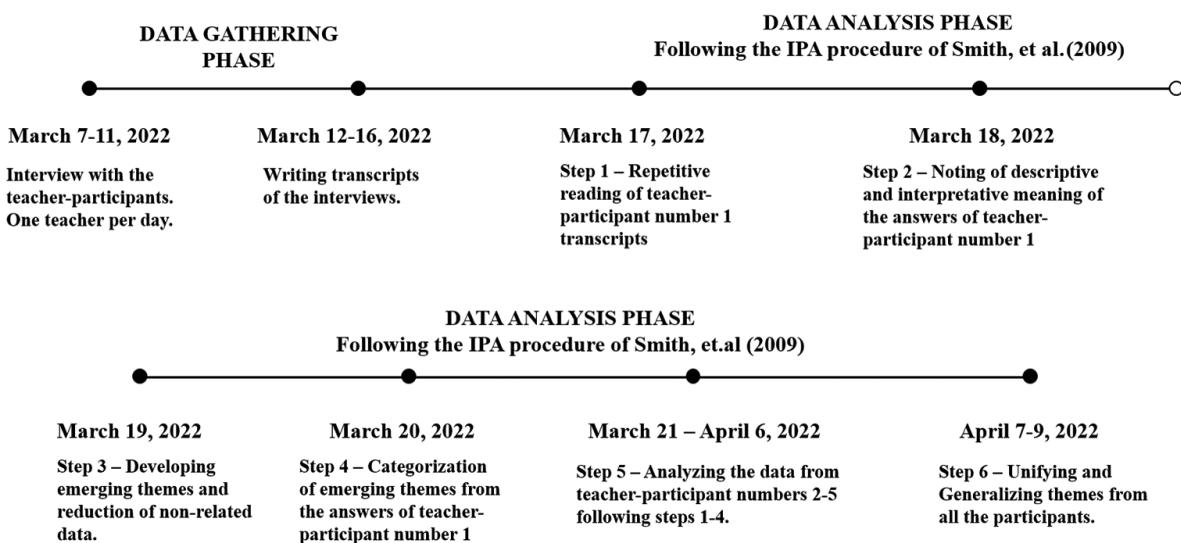


Figure 2 Data gathering and analysis timeline

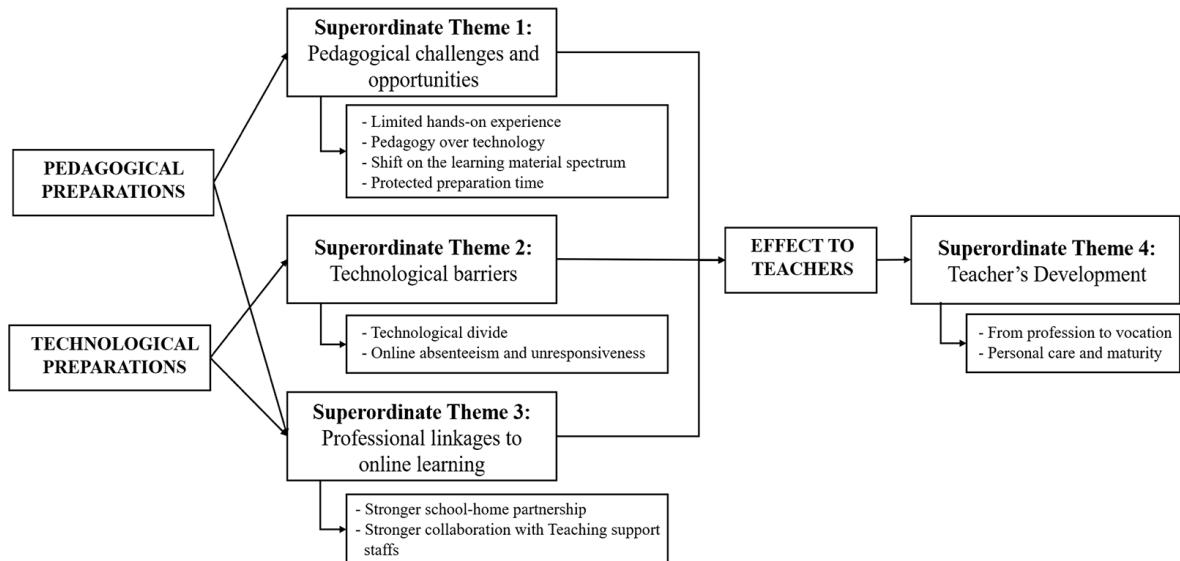


Figure 3 Emerging Themes

The first thing that the teacher-participants remember in the Science online teaching experience were the pedagogical concerns that they encountered. Their first-time experience on the teaching process involved challenges, mainly the challenge of the new teaching-learning modality. Since it was the first year in transforming face-to-face lessons to that of an online, most of the pedagogical approaches that were applied and employed, although researched and studied, were done on a trial basis. They did not know if the approaches would work unless they tested and try it in a real set-up.

#### **Limited hands-on experience**

There is no one approach to deliver all science lessons. Appropriateness of the approach and strategy affects the implementation of the science lesson. In the current online set-up, developing basic scientific skills without direct guidance from the teacher have found to be difficult especially in the foundation level of the learners.

*"Science is a content and skill subject. If it is just based on content in science, it's just okay to teach Science online. But, if we focus on developing the skills in science, it's quite hard because pupils, especially in their foundation level in their learning, they really need to learn it through experience. Not just virtual experience but really on hands-on experience." (#1)*

*"In general, I find it easier to explain those topics that are content based but for those topics that would*

*need I a physical set-up, it was kind of hard for me. It was hard because especially when we had the measuring. I was teaching them the laboratory tools, the instruments that they can use to measure the different properties of matter. There were activities that we used for them to learn how to do but I think it would really be different when they are doing it with physical set-up." (#4)*

The teachers have emphasized that although the virtual laboratories, simulations, and videos do provide the needed tool to learn the content, but the authentic experience that greatly stressed in science learning was lost. They have expressed evidently that traditional laboratory is still better in honing the Science process skills among young learners until an appropriate application or software is developed that fits the requirement. Thus, unless an appropriate virtual laboratory or simulations for the lesson, grade level, and context of the learners, Science teachers will continue to make use of traditional laboratory activities that are modified to fit the online set-up. This also suggests that teachers would require time allocated to the modification of the activities.

#### **Pedagogy over technology**

The Teacher-participants were wary about the tendency to be caught on the features of the applications and technological tools for online teaching. It should be emphasized that technology is just a tool towards learning and that online teachers should curate and select appropriate teaching pedagogies.

*"I usually do the inquiry-base strategy, the asking of questions, the strategy by solving, give them questions before hand, then further discussion. We answer the questions through the discussions. I stick to my goals for the day to deliver. That's why I always check on the goals before I create the power point presentation for each day, for each lesson." (#1)*

*"Before I do the instructions, I always think first what the profile of the students are and at the same time the suitability of tasks in an online setting. Unlike before, I can't see them in an online set-up. So, if there are strategies and activities that I develop, I really relate it to the online set-up or setting. I always put myself at the situation of my students. For example, if it is in their level, or do they have a very short attention span, or have I prepared a lot of activities. At the same time, I change it after the instructions of each class because maybe this doesn't work with another class." (#5)*

#### **Shift on the learning material spectrum**

There is a need to revisit, refashion and shift the learning materials to an online version. Although there are available ready-made online learning materials however, not all of it will fit the context of the learners and of the lesson. A shift on learning assessment and its modality is also imminent. Old practices on the conduct of assessment does not apply with an online set-up.

*"I don't have that much resources. Most of my resources are online. The book that I am using is the book that we have this year. It is better if I have other books as well. I forgot to bring all of them. There are more examples online. By providing them with more video clips that would make them understand further and give them idea more about the lesson. But it will take time to dig deep and make the simulations simpler or to find a simulation that is fit for their age." (#1)*

*"To be honest, starting from my presentation, I really started from scratch. I changed everything including my performance task, my summative test, and my activities. I even added more. I also make evaluations after semester. I involve them in my classes like the activities that they want to do, or they want me to include in our science classes." (#5)*

#### **Protected preparation time**

Whether it is online or face-to-face teaching, teachers need to prepare for all the parts of the lesson to be implemented and evaluated. Since it is the first time for the teacher-participants to prepare for an online teaching, the curation, selection, and development of appropriate pedagogy, activities, and materials to employ

require time.

*"Yes, I require enough time because first you have to prepare all the hardware. Apart from that, I need to review the materials upon preparing and read about the topic. Sometimes, some kids want instant answer right away to their questions. So, I am always challenged to keep myself updated because kids get curious of things they read online. I need to prepare the materials ahead so that if I get disconnected, learners can access the materials on their own. Even if it's free-period, I use it for consultation for the kids. I follow-up if they have difficulties in learning and in accessing their assessments online. That in itself is already taking time out from the usual schedule." (#2)*

*"Since everything is new to me, I feel like everything is an adventure, a journey, a learning process also. So, while the students are learning how things are done, I am also learning to do things myself. So, it's a challenge especially that of course the students are there, you have to be guiding them. And you can't be guiding them with a blind eye. So, I have to be ahead of my pupils also. I'd hope to be better. To learn from my experiences now and grow from there. For example, there are lapses or there are things that were not done properly at this time, I hope to have it done better the next school year or the next time around." (#4)*

The teacher-participants have emphasized the importance of having the time that is free from distraction and other educational activities be allocated to the preparation of their lesson design, learning materials, and training on the online platform that will be used. The educational system must be prepared to all the learning possibilities and concerns that will happen in online modality.

#### **Technological barriers**

Science online learning requires the use of the technology and internet connection. As such, the teaching-learning process is affected by issues and technical difficulties of the hardware, software, and connectivity. These issues hindered the smooth delivery of lessons and in establishing connections with the learners and the stakeholders.

#### **Technological divide**

This new modality of teaching and learning is greatly reliant on technology. However, not all teachers had the gadgets that were appropriate and the internet connection was dependent on the telecommunications provider. From time-to-time, depending on the weather, hardware, and internet conditions, classes may be

cut-short and halted. This resulted in a loss of teaching-learning time.

*"In the online set-up, the issue is really the connection, and then, I think that's one the most things that hinder the implementation. It's quite challenging sometimes because it's not just me who is affected with the connectivity issues but also the pupils. That is why some of them cannot attend. There are more issues now compared to the face-to-face classes." (#1)*

*"One of the real-life challenges that I have encountered is the connection. The connection and the time. There are lessons that I want to run smoothly from the video down to the processing but sometimes internet connection won't cooperate. Another frustrating thing is that every time a pupil will get disconnected or will have hardware difficulties. Although these are some uncontrollable things but it makes me frustrated that the lesson does not proceed smoothly. But yeah, it's a constant challenge every day to be able to have a smooth discussion and everything. If only the connection is better and smooth, but of course we cannot go away with it." (#2)*

#### Online Absenteeism and Unresponsiveness

The physical and digital divide of the teachers and the learners caused problems in communication and monitoring of the academic performance of the latter. Since teachers have less control of the behavior of the learners, issues about unresponsively joining classes and non-submission of learning task were prevalent.

*"Some of the pupils do not attend to class, even after several personal calls and messages. Especially on some pupils who I sent an appointment with their parents because they are caught just playing online games during class time." (#1)*

*"The attendance of the children is poor. It affects the delivery of the lesson because there are only a few, sometimes only few are attending, and most are absent, or they only go to the class at the middle of the time, and others intentionally disconnect." (#2)*

*"Sometimes, I feel like there is a barrier. I feel like I am talking to the wall because there is no one answering me. But of course, there are always those pupils who keep on raising their hands, pupils who would like to come to the rescue to those pupils who would not unmute themselves. I would have wanted it more. It would have been better if students are really there to participate like maximum participation. Because even though they are in the participants list, I cannot really know for certain if they are in the meeting especially if they don't*

*reply or they don't send messages or confirm that they are in the meeting." (#4)*

#### Professional linkages to online learning

The bulk of demand on preparation and implementation of the academic activities and learner monitoring and supervision are relied on by the capabilities of the teacher. However, there is a limitation as to the expanse of supervision with learners at their own homes, especially on the completion of the required academic tasks. Thus, they express the need to establish strong partnership with the parents and guardians and vice versa. Furthermore, with the diverse needs of the learners including psycho-emotional and physical health, the need for the intervention and collaboration of support staff such as the guidance counselor, character prefects, and school nurses are highly welcomed by the teachers.

#### Stronger school-home partnership

In the elementary level, learners need guidance coming from a more knowledgeable person. However, in the current set-up wherein they are at home, teachers cannot help but to co-facilitate the learning tasks and activities with the parents and guardians. The teacher-participants have found it more effective if they and the parents and guardians work closely together.

*"The school-home partnership is very important. Aside from the teachers and the school days or hours, the parents at home need to follow-up with the children. The pupils also need assistance in accomplishing their requirements in school. It's not just merely the responsibility of the teacher anymore but also with the parents in monitoring their children during their class time because it's very important that they check on their pupils every now and then." (#1)*

*"Basically, the parents have a very big part in the learning also of the students because they are at home. So, there really is a need for a strong parent-teacher or parent-school collaboration in this case because I noticed that for those pupils whose parents are busy, or might not be there, or no guardian at all to help them at least to follow-up or prod them with what they still have to do, there's really a difference with the turn out for their submissions specially in the primary since they, still need a lot of guidance." (#4)*

*"If the parents don't take part in this teaching-learning process, I don't think it would be successful. Because you know, there are somethings that are beyond our control. If the parents or guardians will not help us in motivating, it will be hard for the Grade 2 learners. I think they really need the assistance of their parents. And*

*if the parents will not do it then, it will be hard for me to monitor the progress of the kids.' (#5)*

### **Stronger collaboration with teaching support staff**

Teaching online has made the collaboration among school stakeholders to be more evident. With the physical and digital divide from its main clientele, teacher-participants have found it important to establish stronger links with colleagues in order break through the digital void into the learners. Additionally, with the other issues that learners are experiencing of the current set-up, more specialized staffs are needed in the link to provide support and assistance.

*"At first, it's a very hard, I don't know what to do at first. I have asked for help from the character prefects, guidance counselors, and the principal's secretary to help me establish connection with pupils online." (#2)*

*"The professional learning conversations with the support staff does help and constant communications. I personally am not really into chat because there are lot of people chatting and it disrupts the flow in a way but there's no other way but chat, so constant communication with co-workers in science also among Grade 5 teachers. And I send a list of pupils to the guidance counselors which helped me in getting through to the pupils and the parents." (#3)*

*"I also provide reminders to the different class advisers so that they will also be able to remind the class of the things that they need to do. It helped me. It's easier that way compared to when I'm just doing it alone. It's easier to ask the help of the adviser and the help of the counselor because that way there's more than one reminding them, so they get the task done quicker compared when I'm the only one reminding them." (#4)*

### **Teacher's development**

Teachers have seen the challenges brought upon the online teaching experience as opportunities as well to grow and develop professionally and personally. They focused on the things that they are able to do instead of stressing themselves on things that are uncontrollable such as managing their own time, looking for their own avenues for professional development, and self-care.

### **From profession to vocation**

The passion to teach the subject to the young minds amidst the unprecedented difficulties, have driven the teachers to find opportunities to adapt and to grow as teachers. These learning avenues ranges from international webinars to peer observation and self-realizations towards self-actualization.

*"My driving force is that I really like to teach. I really want to be with children. We just got to experience everything while the students are also experiencing it at the same time. So, at least now that we have 1 year experience of this online platform, at least we will be able to look at it from a different angle from a different perspective and so we will be able to make things better." (#4)*

*"This is my life! This is already my life. I have discovered in myself that I really want all my students to be with me in this class in this teaching-learning processes. I don't want anyone to be left behind and that's why as long as I can provide in any possible alternative ways to be with me in the class, then I would really do it. I just realized that what I'm doing right now, it actually makes me happy because I can really see the progress of my pupils." (#5)*

### **Personal-care and maturity**

With the demands of the work as an online teacher, it is crucial that they take good care of themselves. Work and life balance is not an easy feat, but the teacher-participants have managed to do so through establishing routines and schedules.

*"Actually, it's a roller coaster of emotions of being frustrated but being satisfied at the same time. Now, I appreciate life, the value of taking good care of myself. I was reminded that the time of pandemic has given me more time for me to reflect on how I am giving importance to my health. So, every day I read which I also appreciate in this time of the pandemic because it's my "me" time. We own our time. We can budget our own time. We get to establish our own personal and professional development by learning new things." (#2)*

*"It's stressful to balance school and the work plus the responsibilities at home. It feels like, the work does not end at 4:30 because you are just at home. So even if it is late at night, the work still continues but I try to have a boundary between a time for work and a time to be with the family. A time assisting my children with their tasks. So, I think a matter of time management or resource management would also help. Though of course in the weekends, we also make sure that we also have a break time from gadgets. At least to meet some family. At least to have a change of the venue, a change of surroundings At least to refresh and to unwind." (#4)*

## **Discussion**

### **Pedagogical preparations**

Online learning requires that teachers possess

technological, pedagogy, and content knowledge (Mishra & Koehler, 2006). Teachers must be skilled in combining suitable technology to the appropriate learning pedagogy and to the concept that will be taught (Johnson, Jacobina, Russell, & Soto, 2016). As experienced by the teacher-participants, even with the technological advancement, the number of available applications, and resources, these things become ineffective in developing intended concepts and skills without the right planning and strategy. The experiences of science online teaching demonstrate that even in technology-based education, the basics and science on teaching stays the same.

Pedagogy is the driving force of an educational system. Technology will not be able to solve the educational problems in a long-term perspective (Sharples, 2019). Although technology does provide learning engagement, however it does not equate to mastery. Pedagogy as the science-behind teaching should be considered first before the technology that has to be employed (Ash-Brown, 2020; Glazer, 2016). Yet, in this science online teaching where everything is reliant in technology, it may become the driver to educational process (Renwick, 2016). It must be noted though that pedagogy should be partnered with it and still should take precedence over technology, and this is well expressed by the Science teachers. Unfortunately, with the limited time, teachers rely on the use of hit-and-miss method and in learning from their and other's experiences to generate possible method, techniques, and strategies that would fit well to the new context. Hence, administrators should provide, look for, and create trainings and workshops for science teachers with regard to pedagogies: approaches, strategies, and techniques in the teaching of science in an online environment.

There are three roles in which administrators should engage to ensure the quality of online learning according to Yang (2010): Administrators as (1) Planners and Managers, (2) Motivators, and (3) Supporters. These suggest that they, administrators, should plan in advance the details of the curriculum to be developed and implemented, the adaptative developmental activities for teachers based on varied teaching styles, the student services to provide, and the needed pedagogical support. They should provide holistic support on the teachers needs that are influenced by the change in the learning modality such as professional growth, personal satisfaction, incentivization, and emotional and spiritual motivation. Furthermore, administrators should be aware of the needs of the learners. Learners and parents should

be informed of the learning programs, the means in accessing learning materials, and the grading system. They should be provided with training and orientation, technical assistance, and available support staff that will cater to their needs and concerns.

Consequently, teachers are to develop and implement lessons utilizing pedagogies that suit the online environment and context of the learners. According to Yao, Rao, Jiang, and Xiong (2020), teachers should assume three roles: Teachers as (1) Learning Facilitators, (2) Leaders, (3) Guides. Teachers are expected to provide learning experiences that allow learners to constructively develop the knowledge on their own. However, more than the interaction of the learners with the content, the importance of providing teacher-learner and learner-learner interactions were apparent. With the social skills hampered by the online environment, teachers are to lead and jumpstart such interactions and provide guidelines to the learners on methods to exchange ideas.

### **Technological preparations**

With the shift to a new educational platform, learning materials need a transition as well. Education now is focused on the use of online applications, tools, video conferencing, and software (Li & Lalani, 2020) which are not readily available for teachers to use especially in a country that doesn't have online education programs before the pandemic started. Consequently, teachers have to modify their learning materials to the online set-up in order for the teaching-learning process to continue.

Although technological advancements have opened new horizons for online tools, however, they come with limitations. As such teaching-learning instructions need to adapt in the new educational landscape and must be flexible to cater to the changes and needs brought by the transition (Darvasi, 2020). With the limitations presented, teachers need to take into consideration the context of the learners and the readily available online tools in delivering the lesson and in conducting assessments. They must be innovative to think within and beyond the given possibilities, available materials, and set guidelines. Intrinsically, such preparations would require time for the Science teachers to craft and develop such learning materials. Administrators, then should provide educational technologies, trainings for teachers, protected time, and offer support staff that helps teachers on the utilization of effective technology in teaching science.

Internet connection is vital in any online learning modality as it is the lifeline. The lack of such would disrupt the educational continuity of the learners. Unfortunately, connectivity is not constant especially in places that are not reached by a good signal and some teachers and learners are economically struggling (Prescott, 2020). In this online learning set-up where all of the learning activities and tasks take place, having a poor internet connection would certainly affect teaching and learning performance (Cullinan, Flannery, Harold, Lyons, & Palcic, 2021). Yan and Philip (2006) have found a strong correlation across bandwidth, learner interaction and performance. A slow internet connection causes less learner interaction and poor academic performance.

In conjunction with internet connection are the other technical and technological issues and concerns. The lack of access on the appropriate technology, gadgets, devices, and tools at home (Moore, & Fodrey, 2018) and the inefficient use of the online applications and platforms impedes online learning (Almaiah, Al-Khasawneh, & Althunibat, 2020; Schaffhauser, 2017). The teacher-participants have identified that access to the online platform and learning materials, availability of appropriate gadgets and devices, and efficient usability of the mentioned software and hardware hinders the smooth flow of the online teaching-learning process. Hence, more than the preparation done by administrators and teachers, parents need to prepare as well for the learning technologies needed by their children. They need to provide a suitable learning environment and a strong internet connection for a seamless learning experience.

### **Learning experience preparation**

Science education in the grade school level depends deeply on providing learning experiences to impart relevance and concretization of concepts. This is achieved through the different laboratory activities among other learner-centered activities that highlights real-life applications. However, with the change in modality, science teachers ask to develop ways in utilizing virtual laboratories so that it will fit in their teaching strategies and style and will suit the learners' context.

Several studies have found though that virtual laboratory is effective. It was observed that virtual laboratories have improved national achievement scores (Sudlow-Naggie, 2020), conceptual knowledge (Kolil, Muthupalani & Achutan, 2020), practical skills (Donkin, Askew, & Stevenson, 2019), and it feeds the curiosity and interest of the learners (Aljuhani et al., 2018;

Rajendran & Veilumuthu, 2010). However, these are results observed in high school students. Compared to elementary level, there are only a few virtual laboratory activities, simulations that fit the level and the expected learning goals and competencies (Pramono, Prajanti, & Wibawanto, 2019). This leaves the primary science teacher to review several virtual laboratory activities and modify the content and instructions necessarily.

Furthermore, although the virtual laboratories and simulations can provide comparable experience as that of the traditional hands-on laboratory (Darrah et al., 2014), their operability and opportunities for discussion and processing of experience differs. Students find the traditional laboratory experience easier to operate, understand, flexible and satisfying (Chan & Fok, 2009). Teachers also have found the traditional laboratory experience to be more effective in imparting practical and problem-solving skills that fits the competencies (Shimba, Mahenge, Sanga, 2017). This is the same sentiment that the teacher-participants have shared in the interviews; that there is difficulty in curating virtual laboratory activities and in guiding learners over the process. Although learning is achieved by doing the activities it differs in the ability to hold the actual apparatus, materials, and objects, and performing the experiments in real-life, which provides a different experience that involves all the senses of the learners than the virtual laboratory can offer. Thus, science teachers should develop laboratory activities that can be done at home with the use of alternative materials or make-shift apparatuses. They need to take into consideration the planning and implementation of the laboratory activities at home and the availability of materials, difficulty of the tasks, and the safety of the learners.

### **Home-school partnership**

The home-and-school partnership has been instrumental in the holistic development of the learners. This helps the continuity of learning to flow cohesively from school to home and until they go back to school (Brinn, 2020). Although this concept and practice have existed way before the online learning started, it has not been fully operationalized and sustained (Pepito, 2019; Sormunen, Tossavainen, & Turunen, 2011) because no clear established roles have been developed regarding the parents involvement (Okeke, 2014). Brinn (2020) and Stevens and Borup (2015) have found the potentiality of the home-and-school partnership to boost learning engagement and achievement, however, the roles and

partnership of both the teacher and the parent should be clearly identified and understood.

Student absenteeism is a chronic problem with online learning which stems from reasons that concerns mental health, social well-being and internet and technological infrastructure (Garun, 2020; Robbins, 2021). This chronic problem both in a face-to-face and online learning have negatively affected the academic performance and social-emotional development of learners (Abdullah, 2020; Goldstein, Popescu, & Hannah-Jones, 2020; Santibañez & Guarino, 2020). Students being present but unresponsive online is also common in this online set-up. Learners do not participate in classes nor even turn-on their cameras due to poor internet connection, social-emotional engagement (Castelli & Sarvary, 2021; Saminathan, 2020). Learners may be able to learn passively, however teachers will have difficulty assessing whether they have truly understood the lesson without the responses and non-verbal cues from the learners.

These issues demand that teachers establish a strong teacher-learner relationship. Studies have proven that such relationship positively affects academic, behavioral, emotional (Lee, 2012), and social engagement and performance of the learners (Wanders et al., 2019). So, teachers are encouraged to go beyond their usual methods and strategies and establish a closer link and ties with the learners in an online set-up (Darvazi, 2020). They are to provide more interactions with the learners and parents to further understand the issue and find solutions.

Hence, in this online learning set-up, the home-and-school partnership is vital (Ondrasek, 2020), especially in science where there are activities that would need the supervision of a more-skilled and knowledgeable adult. Parents have become co-facilitator of learning of the teacher as they become more hands-on in teaching their children (Bhamani et al., 2020; Smith et al., 2016). However, it must be noted that teachers should not just dump the responsibilities to the parents alone but instead work closely with them. Parents have their own working responsibilities as providers of the family and are inadequately equipped with the skills for online learning (Dong, Cao, & Li, 2020). The other work and household responsibilities (Sarkar, 2020), parental practices, and psycho-emotional well-being also affects the learning of the students at home (Morelli et al., 2020). As such, teachers are called to have a strong relationship with parents as partners; orient and guide the parents in

mentoring and in facilitating the learning of their children. Parents, subsequently, should cater with the educational needs of the learners at home and should have an open communication with the teachers and support staff to assist them with the other needs of their learners.

### **Role of support staff**

Learning thrives in a positive climate and environment. Although teachers are the primary players in the process, creating the backbone of a safe learning environment is founded by the teaching support staff (Littlecott, Moore, & Murphy, 2018). The presence of a positive teaching support staff impacts the teaching-learning and interpersonal relationships of learners as they create a sense of being physically, socially, and emotionally safe in the learning environment (Bako, 2020).

In this online learning platform, the role of teaching support staff such as the guidance counselors, character prefects, online librarians, etc., is to provide social and emotional bridges also to pupils who have issues and concerns on the mentioned areas (Hinton, Fischer, & Glennon, 2016) that may be inherent to them or brought about by the current situation. They need to be available to assist pupils with the other needs that teachers are not able to offer with online teaching. In the current learning modality where establishing connection and stronger relationships among pupils is important, the support staff are vital to these links (Rosales, 2017). Thus, teachers must develop harmonious relationship and shared responsibilities with them to have a strong united front in providing effective and efficient student services.

### **Teachers' personal preparation**

Teachers have become more vital in an online set-up despite the wide array of educational materials and opportunities. With the stresses and demands on the teachers in the Science online teaching, practicing self-care has become even more important with the threat of the pandemic lurking (Clay, 2020). Practicing self-care will help maintain the overall health of the teachers to continue performing at their best (Glowiak, 2020).

Undeniably the teaching profession is demanding physically, emotionally, socially, and even financially expectations from a teacher (Zariņa, Drelinga, Iliško, & Krastiņa, 2016). As the societal needs change, so does the role and the expectations from teachers (Sirk, Liivik, & Loogma, 2016). With the shift to the online learning set-up, more than the clerical work of a teacher, guidance

in terms of technical-operation, task-orientation, psycho-emotional, and social wellbeing is strongly needed (Cox & Prestridge, 2020; Yengin, Karahoca, Karahoca, & Yucel, 2010). Consequently, although teaching is a balance of profession and vocation (Buiks, 2005), teachers are leaning further to the side of vocation in order to cater to the needs and context of their pupils.

Regardless of the demand, teachers need to find ways to balance work and life to establish a positive social-emotional relationship within their personal circle, work colleagues, and school clienteles (Mensah & Adjei, 2020; Gautam & Jain, 2018). One must work on things that they are in control of and learn to let go of those that cannot. It is also important that teachers establish a schedule or routine and boundaries that separates work and personal time to avoid teaching exhaustion (McCarthy, 2020) that affects teaching performance (Arvidsson et al., 2019).

### Conclusion and recommendations

Teaching science in an online set-up is a first-time experience to most teachers in the Philippines. Although the teaching-learning platform have shifted to an online modality, the pre-requisites to an effective and efficient delivery of the lesson remains the same: teaching pedagogy, tools, and skills. Thus, preparation time in identifying, harmonizing, and evaluating appropriate pedagogy, technology, and essential content should be adequately provided and protected. Since technology is an important aspect in online Science teaching, it is also important that hardware and software needs of the teachers are provided.

Indeed, it would take a (virtual) community to rear and develop a child. Establishing effective and efficient personal and professional linkages with the pupils, parents or guardians, and teaching support staff is necessary for online science teaching. These linkages have formed a community that provides support and care for each member. With the shared effort of the school community while being guided by the school's mission and the teaching vocation, the teachers can achieve balance to learn, unlearn, and relearn things to cater and deliver the needs of the pupils with utmost competence and compassion for their pupils and for themselves.

Transitioning to online learning takes ample amount of time and preparation to be successfully implemented. Administrators need to have detailed plans including the curriculum, pedagogy to utilize, physical facilities, and educational technology to employ. Science

teachers should be trained thoroughly with the pedagogy and technology to be used and should be given sufficient time to craft their learning plans and instructional materials that is suited to the online environment and the context of the pupils. Furthermore, they should be well assisted with support staff in terms of the other needs that the pupils have such as mental, emotional, social, physical health related concerns. Parents should also be oriented and trained on the curricular and co-curricular programs and in becoming teaching partners to further the implementation of instruction and supervise and monitor academic progress and holistic development of the pupils. They are to provide their pupils as well as appropriate educational technologies needed for the online modalities. Lastly, pupils are to be oriented as well on the online modality, and the things expected of them.

This study is focused on the experiences of the grade school science teachers. In order to further enrich the gathered experiences, it is suggested that science teachers in the secondary and tertiary level be taken into consideration. Furthermore, to expand and generate common and central themes to determine further the means of succeeding in teaching science online, it is suggested to take into consideration the experiences of the pupils, parents, administrators, and support staff.

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