ELECTRONIC JOURNAL FOR RESEARCH
IN SCIENCE & MATHEMATICS EDUCATION
VOL. 26, NO. 2, 56-76

Articulating the Barriers in the Online Learning Engagement in Chemistry of Junior High School Students: A Photovoice Study

Ryan Villafuerte Lansangan
University of Santo Tomas, Philippines

ABSTRACT

Understanding the challenges and preferences perceived by learners is crucial in helping institutions devise strategies to support the continuum of learning during the COVID-19 pandemic. This study used photovoice to examine the barriers in the online learning engagement in chemistry of junior high school students in the lens of their experiences in the online education during the health crisis. The inquiry uncovered four themes: difficulty in understanding the nature of chemistry as a subject matter; lack of intrinsic motivation towards online learning; difficulty in accommodating academic responsibilities in an online platform; and technical challenges associated with online learning. As a participatory mode of research, the students were engaged in a root cause analysis through focus group discussion to account for the causes of their challenges and their perceived solutions to the factors identified. The utilization of photovoice as the platform of inquiry was able to capture the chemistry learning experiences of students and the barriers that hinder their optimum engagement.

Keywords: photovoice, online learning engagement, chemistry education, chemistry online learning, online learning engagement factors

Introduction

Amidst the crisis in many aspects of society brought about by COVID-19, education continues to do its role by embracing different modalities of instructional delivery as it affected almost 98% of the student population worldwide (UNESCO, 2020). This pandemic caused a sudden shift in the face of education worldwide. With the foremost concern for the safety of the school community stakeholders, the disruption in the sphere of education paved the way to embrace a new space of learning through distance education. With indefinite time as to when it would end, the shift to online teaching and learning was a manageable option (Martinez, 2020) with varying degrees of integration and infusion in the educational systems (Starkey, 2020). There is an urgency to rethink, revamp and redesign the educational system and respond to the demands of disruption (Mishra et al., 2020).

In the Philippines, the pandemic became a turning point for its educational system (Toquero, 2020) as the country needed to respond, to alleviate digital divides and racial disparity, and offer an inclusive education adhering to the mantra that no students will be left behind. Among the areas of interest that can be explored is in terms of how the ongoing crisis of learning is perceived by the learners who are at the core concern of the entire educational system. The process of understanding the challenges and preferences perceived by the learners can help institutions devise strategies in which remote learning will be a feasible option (Aguilera-Hermida, 2020). Notwithstanding the combination of the health crisis, social isolation and associated problems brought by the pandemic that affect students' mental health and can hinder the optimization of their learning (Singh et al., 2020), it is crucial to understand where the students are coming from and how they respond to instructional

delivery in the implementation of online education. Mourlam et al. (2020) affirmed that children have a right to be heard and they are considered their own experts in describing their experiences and their impact on their well-being. Kalman et al. (2020) examined the views of students on the learning process in the online platform during the pandemic and concluded that due to the restrictions on the conduct of conventional face-to-face instruction, teachers need to become aware of the learners' needs and passions and devise ways on how to motivate them amidst the crisis.

This qualitative inquiry was explored in the context of chemistry online education of junior high school students. Previous research highlighted the challenges perceived by both teachers and learners in teaching chemistry online, such as familiarity with internet-based technologies and application tools, adjustment of teaching methods, maintaining student interest and engagement (Huang, 2020); effect of synchronous problem-solving exercises in organic chemistry classes on student's attendance rate and learning (Sunasee, 2020); impact of internet affordances and financial burden affecting chemistry students' engagement (Tigaa & Sonawane, 2020); inequity to chemistry education between urban and rural areas (Soares et al., 2020); and limitations on communications and socialization among learners (Lansangan, 2020). This study used an unconventional way of soliciting the responses from the learners with regards to their online learning experiences: the photovoice methodology.

Caroline Wang and Mary Ann Burris are credited to the inception of photovoice methodology. Their work is rooted in Paulo Freire's critical pedagogy, feminism and visual research (Wang & Burris, 1994). Photovoice is an example of participatory action research in which informants use cameras to take photographs of persons, contexts, or situations they consider representative of a particular aspect of their individual and/or social life (Sutton-Brown, 2014) and document reality and interpret it (Malka, 2020). Photovoice supports participants, who might be unexpressive of their perceptions in some research experiences and issues (Harkness & Stallworth, 2013), reflecting their interests instead of fulfilling the agenda of researchers (Lam et al., 2020). Through photovoice, participants can share their lived experiences in dealing with difficulties and problems within a dialogic group space making them feel empowered and are capable of promoting changes (Malka, 2021a).

Initially, the use of Photovoice mushroomed in social science research works (Liebenberg, 2018), more specifically on promoting public health, and eventually extended into different groups of people such as the youth (Ho et al., 2011) and the community (Suffla et al., 2012). While its nature was explored as a research methodology, some researchers attempted to note its pedagogical applications (Latz et al., 2016). It was adapted in an educational atmosphere and was used to provide insights into students' unique lives and their experiences in classrooms (Harkness & Stallworth, 2013). Photovoice was used to explore various aspects of teaching and learning, such as the genuine participation of high school students as learners (Warne et al., 2013). Ciolan and Manasia (2017) suggested the utilization of photovoice as an enrichment tool in diagnosing the way learners engage in learning and support communications on how learning takes place and what the students think of the process.

In the field of science education, some research works have explored the use of photovoice methodology in the science learning experiences of students. Cook (2015) affirmed this methodology as a way of reconceptualizing science knowledge, practitioners of science, and science education at large. Stroud (2014) effectively employed photovoice as a student-centered learning activity in undergraduate introductory chemistry while making the subject matter relevant. Cuansing (2018) used photovoice as a source of qualitative data on students' understanding of some topics in physics thereby developing positive appreciation as they reflect on the photos that they took. Behrendt and Machtmes (2016) utilized photovoice to account for biology students' illustration of their learning experiences in attending field trips. Feldman (2005) applied photovoice to science teacher education.

Other researchers used photovoice to document the online learning experiences of learners. Some of these include Tanhan (2020) who developed Online Photovoice (OPV) to reach diverse

participants with the purpose of allowing participants to express the factors that facilitate or complicate a particular problem. Bunga et al. (2021) examined youth's online learning experiences in synchronous and asynchronous classes while Doyumğaç et al. (2021) explored the facilitators and complicators in distance learning using this visual data collection technique. In addition, Raza et al. (2021) documented the journey of undergraduate students in the early months of the pandemic while Malka (2021b) used photovoice as a coping tool with the pandemic crisis in the practical training of social work students.

It is in this perspective and theoretical underpinning that this study would like to explore the different barriers affecting students' online learning engagement in chemistry using photovoice as the platform of inquiry. Dumford and Miller (2018) emphasized the importance of learners' engagement in online learning, which Sun and Rueda (2012) defined as the quality of efforts the learners make to perform well and achieve desired outcomes. Miltiadous et al., (2020) identified engagement as a predictor of success in online chemistry learning. This paper envisions to highlight students' voices and their lived experiences in learning the subject matter as a basis for the improvement of instructional practices and policy formulations towards a reflective and responsive chemistry online learning and teaching.

Methods

Participants and Research Locale

The participants of this research consisted of 45 Grade 9 students, 20 male and 25 female, aged 15-16 years old, enrolled in a private sectarian institution in Metro Manila, Philippians. The school adopted an enriched virtual mode of instruction during the school year 2020-2021 in response to the learning crisis brought by the pandemic.

Context

The school used Cloud Campus (CC), a cloud-based infrastructure powered by Blackboard, a world-class learning management system (LMS), maintained by the school's Educational Technology Center and enhanced by Google for Education. The students attend chemistry classes twice a week, 1 hour synchronous per day and 3 hours asynchronous sessions per week. Four days in a week are allotted for the different academic subjects and another day is allotted for consultation and other school activities. The school follows a discipline-based curriculum in science, having chemistry as the focus of the science instruction for the ninth grade.

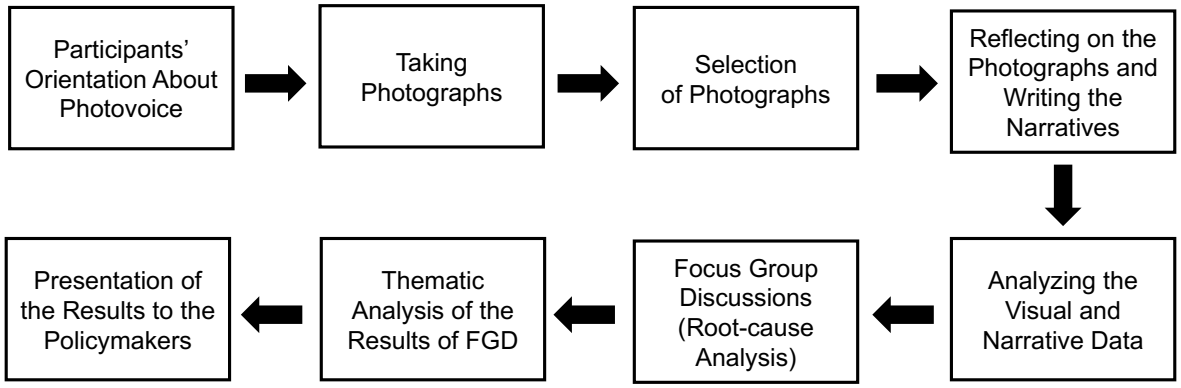
Data Gathering Procedure

The investigation started by obtaining parental consent and child assent forms before implementing a photovoice methodology in the context of their experiences in participating in chemistry classes in an online platform. A letter was sent to the parents of the students bearing the description of the research, the mechanism of upholding the confidentiality of the process, and the associated risks and benefits in the participation of the learners. The request for informed consent was submitted through the learning management system (LMS). Photovoice as a visual data collection technique was used in conjunction with focus group discussion on the issue at hand. As part of their year-end reflection in chemistry, orientation about the use of photovoice was done to inform the learners about the expectations and objectives of the activity. The diagram in Figure 1 summarizes the employed procedure.

A standard three-staged approach in conducting photovoice methodology (Wang & Burris, 1997) was employed in the entire analysis. First was the selection of photographs. Students were asked to take a picture that best represented the challenges they encountered in learning chemistry in an online platform. Their narratives on the pictures were also included. Second was the contextualization and discussion of photographs. According to Tsang (2020), analysis of findings in a photovoice methodology includes analyzing both visual data (participants' voice) and narrative data (interview data) based on the perspectives of the participants to establish a more credible way of theorizing the phenomenon. After the submission of the photos, students were asked to group themselves based on their perceived category of their photos depicting their challenges in learning chemistry. The categorization was used as the basis in the conduct of a series of group discussions that revolve around the root-cause analysis of their perceived challenges in online learning.

Figure 1

Photovoice Procedures



Data Analysis

The learners' narratives and the transcript of the focus group discussion were analyzed through thematic analysis which involved extracting significant responses adhering to the variables being explored; formulation of codes from significant statements; converting them into themes; and validation of the findings through member checking. As cited from the work of Lofton and Grant (2020), the key component of this kind of participatory research is to engage stakeholders to influence policy. After tabulating the themes for the perceived causes and solutions identified by the students, it was shared with authorities which involved a guidance counselor, science teacher, level head teacher, learning area coordinator, and members of the school council. Their comments and suggestions were noted and further coded and analyzed.

Results and Discussion

This discussion covers the various barriers affecting students' online learning engagement in chemistry culled from the photos the students provided. From the perceived challenges, root cause analysis was discussed and analyzed, and the corresponding solutions were outlined as a result of the participatory discussion with the learners.

Barriers Affecting Students Online Learning Engagement in Chemistry

Table 1 presents the categorization of the students' perceived barriers that affect their learning of chemistry in an online platform.

Table 1

Barriers Affecting Students Online Learning Engagement in Chemistry (N = 45)

Barriers	Categories	N	Excerpts Culled from the Students' Narratives
Difficulty in Understanding the Concepts of the Subject Matter	Difficulty in Problem Solving	7	*"I chose an unsolved Rubik's cube as this symbolizes that before you solve a problem you must first know the principles of the problem. You cannot solve a Rubik's cube just by turning and twisting it without fully knowing how it works, and just like in chemistry you cannot just solve and answer the problem, you must first understand it's idea and fundamentals before you can truly solve the problem. My problem in chemistry is that I just solve and answer blindly without understanding the problem first. I rush too much resulting in me making mistakes after mistakes."* (S6)
	Lack of Imagination and Concrete Learning Experience	3	*"I chose this picture because the dead flowers represent the lack of imagination. Imagination is a strong brain builder because it encourages you to think in unconventional ways. Your imagination can assist you in finding solutions that your brain may find unexpected, but it may also create situations that address problems in the most efficient manner. Chemistry requires imagination especially during class when the teacher asks to picture a scenario in your head, or when they ask you a specific question that requires this. This picture can also symbolize the confusion and things we forget along the way. Chemistry has a lot of terms that are new to most students & requires a lot of solutions and numberings for other lessons. Some students, like me, tend to forget some of these after some time and these specific solutions might be needed later."* (S4)
			"I feel like Chemistry is easier to understand when you can do experiments. I feel like it's a very hands-on topic and we can't do it that way right now because of the pandemic." (S41)
	Difficulty in Understanding the Concepts	3	*"This toy sword represents my overall experience through Chemistry this year. The toy itself represents the easiness of some parts of Chemistry for me personally. I found some parts of all the lessons fairly simple and straightforward. However, it wasn't all sunshine and rainbows for me, thus my second representation, the sword the toy represents. It means that despite it being a toy, it is a representation of a real-life sword, much like how Chem is a double-edged sword."* (S2)
Lack of Intrinsic Motivation Towards Online Learning	Frustration in the Set Up for Learning	3	*"The picture provided above represents my frustration and confusion not only in this certain subject but this whole school year. This leaves a question on my mind if there is still hope left for our education system. I am frustrated because this whole school year we students weren't given the experience and face-to-face education that we deserved."* (S15)

Table 1 Continued

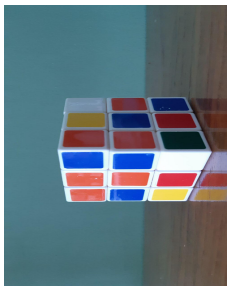
Barriers Affecting Students Online Learning Engagement in Chemistry (N = 45)

Barriers	Categories	N	Excerpts Culled from the Students' Narratives
Lack of Intrinsic Motivation Towards Online Learning	Lack of Interest and Motivation in Studying Online	3	*"Sunflowers usually symbolize joy and prosperity. The flower's bright yellow petals are reminiscent of the bright sun, and as the name of the flower suggests, it usually points to the direction of the sun. But despite its bright yellow petals, my sunflower is slowly withering away. It's kind of like me and my problems and challenges, not just in Chemistry, but in the whole online learning itself. Sometimes I'm bright and cheerful and I'm able to face the challenges of learning in an online setting, however as time goes on, I slowly lose motivation and energy to participate in class. Sunflowers usually grow in a field together, being bright and facing the sun together, but the sunflower in the picture is all alone and isolated. Back then, even if it was challenging, learning Chemistry and other subjects was still enjoyable to learn, mostly because of the actual face to face interactions with classmates, friends and teachers, but now because we are learning in an online setting, there are less interaction and it makes learning it demotivating and tiring instead." (S17)*
Difficulty in Accommodating Academic Responsibilities Online	Academic Overloads	6	*"In identifying and classifying all the challenges I went through, in this online environment in my Chemistry class this year, I took into account all the pressures and insecurities I felt, during the year. With this said, I would describe my challenges and problems this year, like a jam-packed book, in which, I would describe myself as a strong and bold Chemistry book that keeps on receiving tons and loads of information, everyday of my life, so much so, that the amount of information passed unto me is already more than enough, for my taste. This "too much info" I am referring to is of course the papers hidden within the book, in which the book can be seen as filled to the brim or even nauseatingly full, that is how I feel with the information given to me in this Chemistry subject, that sometimes all the concepts and learnings that I gain from this class, can sometimes prove to be too much, for myself. Basically, the problem I am referring to is the Chemistry subjects lack of awareness that sometimes all this information and insights that it brings us can sometimes be a little too much for us, as students, so much so that it is very hard to digest, even for me. With that said, the challenge that I identify within this school year is of course, the jam-packed amount of information given for us to digest and consume, which I for one think gives the student body nauseatingly too much information." (S24)*
	Distractions	5	*"I chose this because I tend to get distracted and tempted to open my other gadget whenever there's a class. Because of this, I can't really give my whole attention in class and that leads me to not fully understand the lessons given." (S29)*
	Time Management and Setting Priorities	9	*I chose a photo of my personal to-do list which I used in this school year, because I had difficulties managing my time. I was so overwhelmed with requirements that I couldn't focus entirely. (S22)*
Technical Challenges	Technical Affordances	6	*"I honestly think that the biggest and the only problem that I have faced during my Chemistry experience for this school year is the unstable internet connection that is present in my current home; I honestly though that I was able to properly adapt to each topic that came in my way from the first topic of 4.1 up until the last topic of 4.9, however, adjusting to find a proper internet provider so that my online classes will be stable without disconnections during an important part of the zoom meetings have been the greatest dilemma of my entire school year." (S40)*

From the pool of submitted pictures, learners were asked to categorize their chosen picture as to what factor it conveys. From their categorization, pictures were coded into 11 categories and further thematized into 4 major themes. Figure 2 conveys sample photos associated with Table 1. Twenty-nine percent of the learners had difficulty in understanding the concepts of the subject matter; 13% considered lack of intrinsic motivation towards online learning as the major factor affecting their learning; 44% conveyed their difficulty in accommodating academic responsibilities in an online medium; and another 13% perceived technical challenges associated with online learning. To account for the organic responses of the learners under each perceived challenge, significant responses were culled and analyzed. Pictures of the sample excerpts were also included in the discussion.

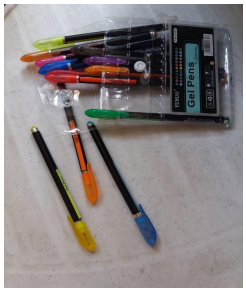
Figure 2

Sample Photos Associated with Table 1


(S6)

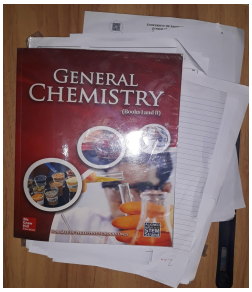

(S4)


(S2)



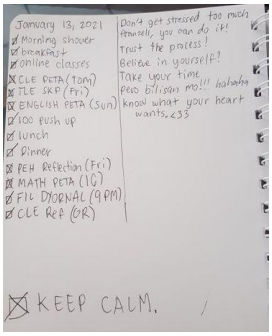
(S15)


(S17)

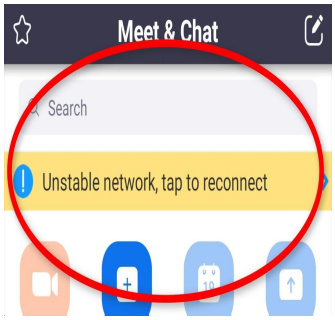


(S24)


(S29)



(S22)



(S40)

The first theme that hinders students' engagement in learning chemistry online revolves around its nature as a subject matter. The challenges perceived by students under this theme are coded in terms of the nature of the chemistry concepts, problem-solving, and the microscopic nature of the

subject, which for them, are difficult to comprehend. S2 modeled the difficulty associated with chemistry concepts into a double-edged sword. The student acknowledged the balance between the easy and difficult chemistry concepts he learned in the school year. S6 used Rubik's cube to convey the difficulty he encountered in solving chemistry problems which is common among learners especially in basic education, as the work of Yuriev et al. (2017) contends that it can be associated with the lack of knowledge on the concept embedded in the problems, presence of alternative conceptions, and lack of appropriate strategies in approaching a chemistry problem. Due to the microscopic nature of the subject, the lack of imagination in comprehending the concepts was affirmed by S4 as dead flowers. Having specialized jargon in terms of chemical formulas and equations is one of the hurdles that may hinder learners' optimum understanding of chemistry concepts which is what Lim (2019) affirmed that for students to learn and understand the nature of chemistry, they must believe that they can see, touch, or taste the concepts embedded in the subject. As they explore the concepts, they find difficulty in understanding the interrelationships of the contents because they need to consider different levels of representations ranging from the macroscopic to microscopic. S41 highlighted the usefulness of conducting experiments to fully comprehend concepts in chemistry. Positive engagement towards science is associated with practical experiments (Hampden-Thompson & Bennett, 2013), and students find it uninteresting if not being incorporated in the lessons (Barmby et al., 2008).

The second theme deals with lack of intrinsic motivation in learning the subject matter in the online platform. It has always been emphasized in educational research how motivation significantly impacts the learning and performance of students (Bandura, 1993). For instance, S17 took withered sunflowers representing the lack of interest and motivation in studying chemistry online. It can be deduced from this photo narrative an intrinsic aspect of the learner's motivation, which is what Priniski et al. (2018) equates to learners' satisfaction and capacity to have personal value for the learners.

The way students deal with this more abstract cognition is affected by both teaching and the learning atmosphere (Corno, 2009), in this case, migration of instruction to the online platform. Aside from lack of motivation, S15 used colored pens to convey his frustration in the current set up of learning chemistry online. As they coped with the feeling of isolation and loneliness due to lack of socialization (Besser et al., 2020), it has been underscored in some studies how learners experience boredom, anxiety, and frustration (Aristovnik et al., 2020). Since the learners under study are used to the conventional way of learning through face-to-face platforms for many years, they find frustrations in the current set up which can be associated with lack of actual interaction with their friends and absences of school activities they are used to experiencing before.

The third theme corresponds to the difficulty of the students in accommodating their academic responsibilities associated with online learning. S24 took a book conveying the feeling of academic overload; S29 represented the distractions through a gadget; and S22 portrayed a to-do-list note for lack of time management. Chen (2021) described these aspects as academic stressors that change learners' behavior against some environment, social or internal demands. Learners are taking several subjects, not only chemistry, and they need to conform to the demands of all these disciplines. Workload conundrum was believed to be one of the dilemmas confronting learners in the beginning of mainstreaming the online platform during the pandemic. In the context of the learners, several academic ease were requested by the student body calling school administration to lessen the academic workloads of the students.

The fourth theme corresponds to the challenge associated with technical affordance, as exemplified by S40 as a screenshot of unstable internet connection. Due to the rapid utilization of online platforms to deliver education, many students were caught unprepared to account for the needed technical requirements associated with remote learning such as stable internet connection and gadgets. All the learning experiences of the students depend on their internet connection, thereby affecting their learning engagement when confronted with poor connectivity.

Root Cause Analysis of the Perceived Barriers

After categorizing the perceived challenges of the learners, group discussions were completed with students to articulate the causes of these challenges. This was also done to account for the learners' perceived solution to the problem hindering their engagement in the online learning platform. For this part of the study four batches of focus group discussions for the root cause analysis were conducted. Figure 3 shows the summary of the results of the root cause analysis while the specific items are reflected in Table 2.

Figure 3

Root Cause Analysis of the Perceived Barriers

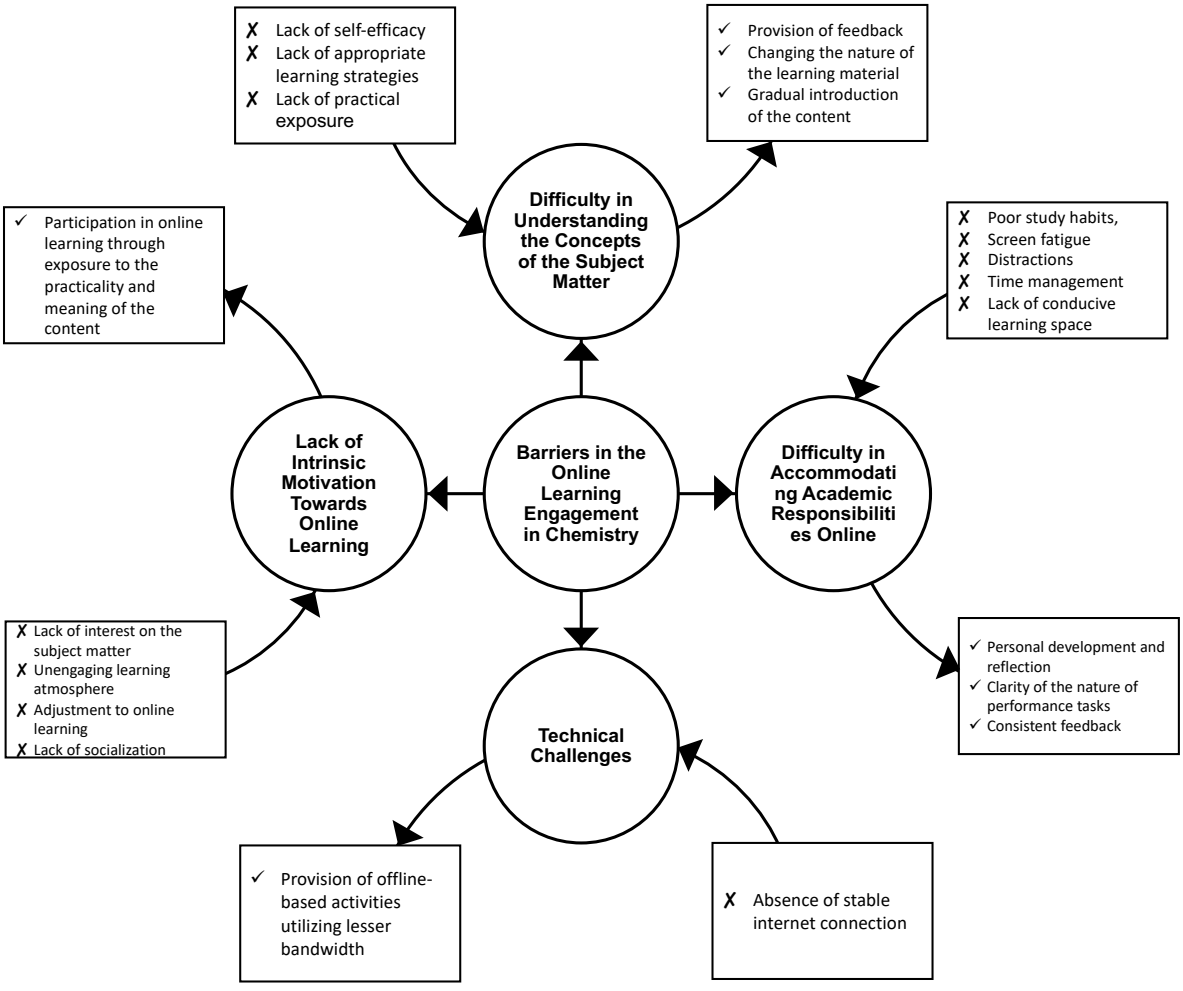


Table 2

Anecdotes Culled from the Root Cause Analyses Drawn from the Focus Group Discussions

Barriers	Learners' Perceived Causes	Learners' Perceived Solutions
Difficulty in Understanding the Concepts of the Subject Matter	F1C1 - Carelessness (S12) F1C1 - Lack of focus to the lessons (S3) F1C1 - Lack of self-confidence (S1) F1C2 - Poor memorization (S2) F1C2 - Lack of appropriate strategies in problem solving (S6, S11) F1C2 - Difficulty in abstracting the concepts (S4, S7, S8) F1C2 - Lack of analytical skills (S4, S7, S8) F1C3 - Lack of practical experience (S5, S9, S43)	F1S1 - More follow ups and formative exercises (S5, S11) F1S1 - Consistent feedback (S7) F1S2 - Provision of fun-related and engaging learning material (S11) F1S3 - Lessen the academic workload of the different subjects (S1, S6) F1S3 - Gradual introduction of the content (S2)
Lack of Intrinsic Motivation Towards Online Learning	F2C1 - Inability to see the sense of the lessons (S16, S18) F2C1 - Lack of interest on the subject (S16, S18) F2C2 - Monotonous learning atmosphere (S19) F2C2 - Time allotted for the subject (S14) F2C3 - Overwhelming feeling during online classes (S13) F2C3 - Unpreparedness for the demands of online learning; has not yet adjusted to online platform (S15, S41, S42) F2C4 - Lack of social interaction (S17, S14, S16)	F2S1 - Solicit students' profile in terms of their interest where they can connect (S19) F2S2 - Provision of the practical applications and connections of the lesson into real life setting such as in career and profession (S19) F2S2 - Provision of varieties of activities other than the traditional seatwork (S18) F2S2 - Provision of more student-centered activities that call for active participation (S17) F2S2 - More encouragement to participate (S16) F2S2 - Provision of student-to-student interaction and collaboration (S14)
Difficulty in Accommodating Academic Responsibilities Online	F3C1 - Overthinking (S23) F3C1 - Impulsiveness (S30) F3C1 - Laziness and Irresponsibility (S26, S34) F3C1 - Procrastination (S22, S39) F3C2 - Screen fatigue (S27, S31, S36) F3C2- Information overload (S20, S24) F3C2 - Excessive school works (S24, S25, S33) F3C3 - Visiting social media platforms during synchronous classes (S21, S29) F3C3 - Frequent use of cellular phones during online classes (S32, S39) F3C4- Lack of enough time to study the lesson (S24) F3C4 - Lack of time management (S37, S38) F3C4 - Lack of balance between curricular and extra-curricular involvement (S28) F3C5 - Absence of conducive online learning space (S39)	F3S1 - Personal development on time management, self-discipline, way of learning, goal setting (S24, S26, S27, S35, S30, S36, S29, S21, S20, S38) F3S2 - Reasonable deadline and nature of the requirements in consideration to other subjects (S26) F3S2 - Setting clear expectation and instructions to performance tasks (S39) F3S3 - Consistent open communication between students and teachers/ and between students (S33, S35, S39, S29) F3S3 - Continue the practice of having consultation day in a week (S36)
Technical Challenges	F4C1 - Unstable internet connection (S35) F4C1 - Current subscription to internet plan (S40, S45) F4C1 - Financial problem (S44) F4C1 - Not enough gadgets at home (S44) F4C1 - Home location (S45)	F4S1 - Lessening the kind performance tasks that require high bandwidth (S40) F4S1 - Provision of more offline activities (S44) F4S1 - Consistent uploading of class recording that the students can review (S42) F4S1 - Lessening of the kind of requirements that simultaneously require internet (S42)

Note: F = factor, C = causes, S = perceived solutions

Discussion 1: Difficulty in Understanding the Concepts of the Subject Matter

The first group discussion included learners who identified the difficulty in understanding chemistry concepts as the dominant barrier affecting their online learning engagement in chemistry. From the anecdotes culled from their narratives, causes of this challenge can be thematized into lack of self-efficacy, lack of appropriate learning strategies, and lack of practical exposure to the subject. However, students had a consensus that their perceived difficulty is not entirely due to the nature of the subject matter, but also because of the other external factors affecting their sense of focus in understanding the subject. Table 3 includes excerpts of the significant statements drawn during the first group discussion with the students.

Table 3

Excerpts from the Group Discussion on the Students' Perceived Solution in Addressing the Difficulty in Understanding the Concepts of the Subject Matter

Student	Comment
S1	*"For me, this past school year in chemistry is ok. But because we need to comply with the different requirements of the subjects, it affects how we perform in the subject. Though I get the point why teachers need to give the requirements, I suggest making it reasonable especially when it comes to the time allotted to complete it."*
S2	*"I cannot really speak for everyone here. We all have our own difficulties, personal problems, strengths and weaknesses, especially in chemistry Sir, so, I am not really sure of the definite or most universal solution. There was a quarter where there were a lot of concepts to study. Because of my lack of experience and strategies, I think that concepts need to be introduced one at a time, little by little."*
S6	*"I think, I agree with S1 regarding the allotment of reasonable time to complete the different requirements of the subject to give us enough time to study the lesson."*
S11	*"I actually don't have a problem in chemistry but I personally find more practice exercises to be helpful in understanding the subject. I think it will also become helpful if chemistry will add fun-related activities because it can help us become more active in dealing with the subject."*
S5	*"Similar to the answer of S11, I think the interest of the students can also be considered in the materials that the students use in the subject. I think it seems that everything becomes mechanical just for the sake of compliance. I think there should be more reinforcement or follow up activities to check our learning."*
S7	*"I have to agree with my classmates most especially when it comes to doing practice in understanding chemistry. It is important to have self-discipline in understanding this kind of subject. However, consistent giving of feedback is helpful for us to know if we are on the right track. I also agree with the aspect of providing reasonable time to complete the requirements not only in chemistry."*

Their perceived solutions include the provision of feedback, changing the nature of the learning material, and gradual introduction of the content. S5 and S11 agreed that the provision of more follow-ups and formative exercises can help them better understand the content of the lesson. For them, these mechanisms will reinforce their understanding of the content and scaffold the complex concepts that they are studying. In fact, Leenknecht et al. (2021) opine that these modes of assessments are associated with learners' autonomy, competence, and motivation. As they participate in the online platform of learning, their independence to self-study the content can be best supported

by providing them with the learning materials that remediates their conceptual understanding. S11 pointed out the utilization of materials that are engaging to them to keep them motivated to study the lesson. In connection to this, S7 affirmed the role of consistent feedback on them to be informed about their progress and as to whether they are on the right track or not. However, S2 pointed out the complicated nature of chemistry concepts based on his experience and that these concepts need to be introduced gradually. Literature termed this mechanism as content chunking (Miller, 1956), a process of breaking content into smaller manageable pieces that would ease students' challenges with processing it. Heath and Shine (2021) identified it as one of the teaching techniques to facilitate time management as well in online teaching. Despite their consensus to provide these kinds of mechanisms to support their learning, S1 and S6 believed that lessening their academic workload among the different subjects could help them focus on a deeper understanding of the contents.

Table 4

Excerpts from the Group Discussion on the Students' Perceived Solution in Addressing the Lack of Intrinsic Motivation Towards Online Learning

Student	Comment
S19	*"The overwhelming feeling in online learning… Chemistry has a lot of technical terminologies to comprehend. It affects my motivation to study it. The solution that I can think of is to consider the individual interest of the students. I think it would be better to integrate areas we are interested and that we can easily connect with."*
S18	*"Regarding the monotonous learning atmosphere, I think as compared to the normal face to face school, our online activities now usually only have seatworks, answer them, that's it. I think we should try changing the way we give learning activities, make it interesting to make it more inspiring. Yes Sir, variety of activities."*
S17	*"I think there should be more activities that require class participation even if it is online. Since we are not in the classroom, we are easily distracted at home when we are just simply listening to lectures."*
S16	*"I usually think that the lack of interest is mostly my personal problem. But my mom told me that just because the subject is boring, doesn't mean that you are not going to give it your best because you will encounter them in real life. I try to make myself interested in chemistry class by participating even if I am shy. Because I learned when I participated in the classes. If I don't participate the lessons will just simply go over my head and I will suffer in the quizzes. Encouraging me to participate really works for me."*
S14	*"Regarding the lack of social interaction and monotonous learning atmosphere, unlike in the face to face before, it would be better if there are more collaborations with our classmates to validate as to whether we are on the right track especially when learning a complex lesson. It gives me a sense of relief knowing that you have the same experience."*
S19	*"Most students like me don't have the opportunity to see the importance of the subject. I think it would be better that chemistry lessons must also integrate its actual connections in reality such as in terms of career opportunities."*

Discussion 2: Lack of Intrinsic Motivation Towards Online Learning

In the second group discussion pertaining to the lack of intrinsic motivation towards online learning, the primary causes of the challenge that students identified are lack of interest in the subject matter, unengaging learning atmosphere, adjustment to online learning, and lack of socialization. In

solving such, student participants dwelled mainly on the role of students' active participation in online learning through exposure to the practicality and meaning of the content as the solution to boost their motivation. Leading the unanimous perceived solution is from S19 student's disposition that varieties of activities other than the traditional seatwork must be provided. In doing so, S19 suggested the solicitation of their interest where they can connect, such as the practical applications and connections of the lesson into real-life settings, such as in career opportunities. The students also suggested that the lesson be student-centered to allow them to actively participate, as shared by S17. S16 emphasized that encouraging learners to participate can help them be motivated in online chemistry learning. These resolutions are consistent with the work done by Tan et al. (2020), that appropriate digital tools in the online teaching of chemistry are a predictor in achieving engagement and active learning among students. Table 5 presents the excerpts from the second group discussion.

Consistently, in the study of Broman and Simon (2015) on students' ideas to improve chemistry education, learners contented to make it relevant to everyday life, more practical, and student-centered. Among the commonly utilized way of igniting the relevance of chemistry to learners' context include the use of real-world applications and socio-scientific issues (George et al., 2021), sustainability-oriented socio-scientific issues (Gulacar et al., 2020); and project-based learning (Hugerat, 2020).

Table 5

Excerpts from the Group Discussion on the Students' Perceived Solution in Addressing the Difficulty in Accommodating Academic Responsibilities Online

Student	Comment
S24	*"Personally, in terms of the difficulty in accommodating academic responsibilities online, I am affected with procrastination, laziness and screen fatigue. It delays my tasks. I think we have to develop some sort of personal clock on better time management for oneself. I am encouraging personal development on ourselves, on our part."*
S26	*"I have a lot of insights about this actually. Starting from the extra-curricular activities and my goals in academics, I need to always consider the two. I need to learn to manage my time well whenever tasks are given in each role. With regards to excessive activities given by the teachers, I understand their motives, but I think teachers need to consider not only the bulk of activities being given in the individual subject but all the subjects. This should be planned well especially in terms of the deadlines."*
S33	*"Based on my experience, I actually improved on time management this school year. And I think the best solution that I did was to communicate with my teachers about my academic concerns. I also hope that teachers should also have this sense of communication with each other where they can give feedback about the learners."*
S36	*"I think rest is important. The idea of having Day 5 for consultation in our school is good. It is a way for us to take some rest after synchronous and asynchronous sessions. Being tired onscreen affects our performance in school. I remember during the third quarter where there were almost no Days 5, it was tiring. That extra day in a week can help us reset."*
S39	*"I procrastinate when I do not know how to start doing a particular task. I agree with S33 about open communication between students and teachers to clarify instructions and expectations…"*
S38	*"My problem lately is time management and overthinking. The root of my time management is lack of motivation and low self-esteem...I find it a lot harder this school year. I find myself getting insecure because others find it easier staying at home…As a way of fixing this problem is by having new habits, coping mechanisms…people should have personal development, self-discipline and having time for themselves as well..."*

Discussion 3: Difficulty in Accommodating Academic Responsibilities Online

Themes that emerge as primary causes of difficulty in accommodating academic responsibilities in online learning include lack of study habits, screen fatigue, distractions, time management, and lack of conducive learning space. To orient learners on how to accommodate academic responsibilities in online learning, the group affirmed the importance of personal development and reflection, clarity of the nature of performance tasks, and consistent feedback. The group unanimously agreed with S24 that learners need to become reflective on their responsibilities with the guidance of the school. To relay their concerns regarding their online engagement, maintaining open communication between the teachers and the students was perceived by S33. Like the main agenda of the second group discussion, some of the solutions nominated by the participants are associated with how academic requirements in the form of learning activities and performance tasks are being given. Performance tasks, which are the major requirement of the different subjects, must have clear instructions and expectations (S39) and a reasonable deadline of submission must be considered (S26). In addition, S36 affirmed the benefits of having the consultation day as part of the weekly schedule for them to take some rest free from academic-related stress. The excerpts of significant transcripts culled from the third group discussion are included in Table 5.

Discussion 4: Technical Challenges

In the last group discussion, participants affirmed the notion that problems with internet connectivity cannot be resolved instantly, and that is a given and common problem associated with online learning. However, the student participants suggested that teachers may also consider this learning dilemma when it comes to giving learning activities that require students to have a stable internet connection. S40 pointed out lesser bandwidth associated with performance tasks; more offline activities for S44, and consistent provision of the session recordings as emphasized by S42. For them, their experiences can still be optimized if the said aspects will be provided to support their learning. Similarly, recent studies on online learning during the pandemic explored other alternatives to solve students' problems on poor internet connection, including the use of social media (Perguna et al., 2021), and conversion of high-definition media and other large-size files into smaller ones (Octaberlina et al., 2020).The excerpts of significant transcripts culled from this discussion are included in Table 6.

Table 6

Excerpts from the Group Discussion on the Students' Perceived Solution in Addressing the Technical Challenges

Student	Comment
S40	*"For me, I honestly think that we can't do anything about this problem on internet connection since our medium is really online. But it would be better if subjects will give performance tasks that are doable but at the same time utilizes lesser bandwidth or use of internet connection."*
S44	*"I agree with S40 that we can't do anything with technical challenges on internet connectivity. I think more offline activities can be provided. Based on my experience, whenever teachers ask us to do something, it always allows us to stay longer in front of the screen."*
S42	*"For me, I noticed that not all subject teachers upload their class recordings. I wish it will become mandatory to upload class recordings. Another is when there are a series of scheduled long tests and other activities to be done, it becomes difficult if our internet connection is not that stable…"*

Comments from School's Policy Makers on Learners' Perceived Solutions

Using in vivo coding, the comments and suggestions of the stakeholders involved in policymaking were tallied in Table 7. The remarks given are classified as affirmations and suggestions.

Table 7

Anecdotes Coded from the Responses of the Invited School Stakeholders (N = 5)

Barriers	Affirmations	Comments/ Suggestions
Difficulty in Understanding the Concepts of the Subject Matter	• Provision of feedback and constructive criticisms (P1, P2) • Provision of fun-related and engaging learning material (P1, P2, P3) • Content chunking of lessons (P1, P2, P3)	• F1S1 - Provide feedback using sandwich method (P2) • F1S1 - Provision of personalized feedback (P3) • F1S2 - Finding out the rationale of the given outputs/ requirements (P2, P4)
Lack of Intrinsic Motivation Towards Online Learning	• Allow students to learn individually and collectively (P1, P2, P3) • Incorporating students' likes and interests (P2 and P3) • Employing various means to elicit reactions and participation (P2)	• F2S1- Engagement in meaningful dialogue and independent learning (P1) • F2S1 - Giving recitation that calls for practical applications (P2) • F2S1 - Teachers should not just ask-ask, but ask-do (P2) • F2S1 - Contextualization of the lessons (P1) • F2S1 - Incorporation of current events in the class (P2, P3) • F2S2 - Optimizing HRO sessions as communication opportunities (P1, P4) • F2S3 - Teacher himself or herself exhibits the needed level of energy in the OL class (P2) • F2S4 - Provision of repository of students' interest (P3) • F2S4 – Utilization of guidance data (P4) • F2S4 - Introduction of applications that students' find interesting (P2) • F2S5 – Provision of refresher webinar for faculty on latest online approaches (P4)
Difficulty in Accommodating Academic Responsibilities Online	• Learners' challenges in the online platform for learning (P1)	• F3S1 - Teachers' careful planning of expected outputs and submissions (P1, P4) • F3S1 – Maximize the use of Weekly Instructional Schedule (WIS) • F3S2 - Orientation to family members about their roles in assisting the learners (P2) • F3S2 - Building home-school collaboration program (P2, P4) • F3S3 - Communication with guidance counselor (P3, P4) • F3S4 - Teachers should identify students for consultation (P3, P4)
Technical Challenges	• Allowing learners to do some off-screen time (traditional pen-and-paper activities) (P2, P4)	• F4S1 - Developing modules (P1) • F4S1 - Provision of lessons in advance and consistent recordings of the lesson (P3, P4) • F4S2 - Setting up individual consultations to students with problems in connectivity (P1)

Note: F = factor, C = causes, S = perceived solutions

All concerns raised by the Grade 9 students were positively regarded and are considered essential in the improvement of the institutional practices in the context of online teaching and learning. In terms of the conceptual understanding of the students, the provision of feedback and rationalizing the content was given emphasis. To improve learners' intrinsic motivation, the stakeholders highlighted contextualization of the lessons, communication opportunities, teachers' modeling, profiling of learners' interest, and further professional development for teachers. In regulating students' academic workloads that result in difficulty in accommodating academic responsibilities, suggested actions are revisiting the monitoring of existing policies, the building of home-school collaboration, and maximizing consultation periods. Lastly, the provision of flexible and alternative learning materials is suggested to support learners who have problems with internet connectivity.

The items reflected in Table 7 provide opportunity for the policymakers to recalibrate the existing practices in online learning using the empirical evidence gathered from the voices of the learners. This may address some gaps and further improve the learning engagement of the students not only in chemistry, the context of this study, but also in other learning areas.

Conclusion

Aside from being used as a research method, the study considered photovoice as a pedagogical tool in terms of fostering dialogue with learners regarding how their learning experiences can be improved. Latz et al. (2016) and Harkness and Stallworth (2013) support this approach in an educational atmosphere and have shown the potential for photovoice to provide insights into students' experiences. As a form of reflective inquiry to both the teacher and the students, this photovoice study was able to capture and articulate the chemistry learning experiences of junior high school students and the barriers affecting their engagement in learning the subject on an online platform like what Tanhan and Strack (2020) explored as way of reaching out to participants' expression even in the virtual platform.

The factors drawn from the photovoice inquiry were capped into four themes, identified as (1) difficulty in understanding the nature of the subject matter; (2) lack of intrinsic motivation towards online learning; (3) difficulty in accommodating academic responsibilities in an online platform; and (4) technical challenges associated with online learning. Through participant-led discussion, the conduct of root cause analysis was able to bring out the perceived causes of their encountered barriers and solutions which they think are significant in studying the subject matter. Identified causes of their challenges range from the cognitive aspect of learning chemistry, personal disposition in approaching chemistry as a subject, and social aspect in dealing with the other factors that affect their online learning. In addition, the students' perceived solutions encompassed personal development based on the factors that they identified, consistency of the existing policies on online learning, and consideration of the provision of appropriate materials that can help and support them in their learning process. The challenges and opportunities outlined in this work supports the investigation done by Warne et al. (2013). The aforementioned themes transpired in the context of pandemic is also consistent to Malka (2021b)'s work in which the use of photovoice served as a coping tool among students.

Implication and Recommendations

Considering the findings drawn from this study, four implications can be deduced. First, this approach offers active participation among the learners by empowering them to be part of understanding a particular problem and extracting the solutions from their perspectives. Photovoice gives them a sense of value while highlighting the significant role that they have in the process of learning, especially for those who are unexpressive about their perceptions (Harkness & Stallworth, 2013). Second, this approach gives a new platform and style of communication between the teacher

and the learners that gives a premium not only to verbal forms of responses, but in a different way on how students convey the meaning of their values and lived experiences, while at the same time leading the researcher to find solution to the identified problem (Lam et al., 2020). Third, as a participatory learning exercise, photovoice fosters socialization among learners by exchanging ideas and perspectives through the root cause analysis of the problem. Finally, the policy-making process in the field of education becomes participatory and consultative while considering the voices of the learners with regard to the impact of the existing policies on their learning experiences. This may further cascade into promoting changes (Malka, 2021b) in improving teachers' instructional practices, being more reflective, and offering direction to innovations.

Regarding further research, it can be recommended for future work to explore the utilization of the photovoice methodology on the aspect of the learners' attitude and efficacy in learning other disciplines. Responses to the limitations on this work can also be done as this is limited to the online learning experiences solely in the context of the school of the students. Since the exploration was done as part of the year-end reflection of the students and that the time allotted in immersing the participants in the protocols of photovoice is short, it can also be suggested to formalize the work in a much longer period. Finally, while this work documented the factors affecting learners' engagement in the online set-up, it is crucial to point out that these experiences are dependent on the context of the participants. Therefore, the insights gathered from the entire research procedure cannot be accounted as true and applicable to all students.

The authors received no financial support for the research, authorship, and/or publication of this manuscript.

Ryan Villafuerte Lansangan (rvlansangan@ust.edu.ph) obtained his Doctor of Philosophy in Science Education from the Philippine Normal University. Currently, Mr. Lansangan is a Junior High School chemistry teacher and the Science Learning Area Coordinator of the Junior High School Department of the University of Santo Tomas from the Philippines.

References

Aguilera-Hermida, A. P. (2020). College students' use and acceptance of emergency online learning due to Covid-19. *International Journal of Educational Research Open, 1*, 100011. https://doi.org/10.1016/j.ijedro.2020.100011

Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustainability, 12*(20), 8438. https://doi.org/10.3390/su12208438

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148. https://doi.org/10.1207/s15326985ep2802_3

Barmby, P., Kind, P. M. & Jones, K. (2008). Examining changing attitudes in secondary school science. *International Journal of Science Education, 30*(8), 1075–1093. https://doi.org/10.1080/09500690701344966

Behrendt, M., & Machtmes, K. (2016). Photovoice as an evaluation tool for student learning on a field trip. *Research in Science & Technological Education, 34*(2), 187-203. https://doi.org/10.1080/02635143.2015.1124410

Besser, A., Flett, G. L., & Zeigler-Hill, V. (2020). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students. *Scholarship of Teaching and Learning in Psychology.* Advance online publication. https://doi.org/10.1037/stl0000198.

Broman, K., & Simon, S. (2015). Upper secondary school students choice and their ideas on how to improve chemistry education. *International Journal of Science and Mathematics Education, 13*(6), 1255-1278. http://dx.doi.org/10.1007/s10763-014-9550-0

Bunga, B. N., Adu, A. A., Damayanti, Y., Takalapeta, T., Pello, S. C., & Kiling, I. Y. (2021). Synchronous vs. Asynchronous: Photovoice study on Indonesian youth's online learning experience. *Child & Youth Services,* 1-14. https://doi.org/10.1080/0145935X.2021.1901572

Ciolan, L., & Manasia, L. (2017). Reframing photovoice to boost its potential for learning research. *International Journal of Qualitative Methods, 16*(1), 1-15. https://doi.org/10.1177/1609406917702909

Cook, K. (2015). Grappling with wicked problems: exploring photovoice as a decolonizing methodology in science education. *Cultural Studies of Science Education, 10*(3), 581–592. https://doi.org/10.1007/s11422-014-9613-0

Corno, L., & Mandinach, E. B. (2009). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist, 18*(2), 88-108. https://doi.org/10.1080/00461528309529266

Cuansing, J. (2018). An Action Research: Enhancing Learning in Undergraduate Introductory Course Physics Courses Using Photovoice. In Proceedings of the 4th International Conference on Education (Vol. 4, No. 2, pp. 68-75). http://tiikmpublishing.com/data/conferences/doi/icedu/24246700.2018.4209.pdf

Doyumğaç, İ., Tanhan, A., & Kiymaz, M. S. (2021). Understanding the most important facilitators and barriers for online education during COVID-19 through online photovoice methodology. *International Journal of Higher Education, 10*(1), 2021. https://doi.org/10.5430/ijhe.v10n1p166

Dumford, A. D., & Miller, A. L. (2018). Online learning in higher education: Exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education, 30*, 452–465. https://doi.org/10.1007/s12528-018-9179-z

Feldman, A. (2005). *Photovoice in science teacher education.* Paper presented at the North East Regional Meeting of the Association of Science Teacher Education.

George, A., Zowada, C., Eilks, I., & Gulacar, O. (2021). Exploring chemistry professors' methods of highlighting the relevancy of chemistry: Opportunities, obstacles, and suggestions to improve students' motivation in science classrooms. *Education Sciences, 11*(1), 13. https://doi.org/10.3390/educsci11010013

Gulacar, O., Zowada, C., Burke, S., Nabavizadeh, A., Bernardo, A., & Eilks, I. (2020). Integration of a sustainability-oriented socio-scientific issue into the general chemistry curriculum: Examining the effects on student motivation and self-efficacy. *Sustainable Chemistry and Pharmacy, 15,* 1-8. https://doi.org/10.1016/j.scp.2020.100232

Hampden-Thompson, G. & Bennett, J. (2013). Science teaching and learning activities and students' engagement in science. *International Journal of Science Education, 35*(8), 1323–1343. https://doi.org/10.1080/09500693.2011.608093

Harkness, S. S., & Stallworth, J. (2013). Photovoice: Understanding high school females' conceptions of mathematics and learning mathematics. *Educational Studies in Mathematics, 84*(3), 329–347. https://doi.org/10.1007/s10649-013-9485-3

Heath, S., & Shine, B. (2021). Teaching techniques to facilitate time management in remote and online teaching. *Journal of Teaching and Learning with Technology, 10*(1), 164-171. https://doi.org/10.14434/jotlt.v10i1.31370

Ho, W. C. , Rochelle, T. L. , & Yuen, W. K. (2011). 'We are not sad at all': Adolescents talk about their 'city of sadness' through photovoice. *Journal of Adolescent Research, 26*(6), 727–765. https://doi:10.1177/0743558410391255

Huang, J. (2020). Successes and challenges: Online teaching and learning of chemistry in higher education in China in the time of COVID-19. *Journal of Chemical Education, 97*(9), 2810-2814. https://doi.org/10.1021/acs.jchemed.0c00671

Hugerat, M. (2020). Incorporating sustainability into chemistry education by teaching through project-based learning. In S. O. Obare, C. H. Middlecamp, & K. E. Petterman (Eds.), *Chemistry education for a sustainable society volume 1: High school, outreach, & global perspectives* (pp. 79-96). American Chemical Society. https://doi.org/10.1021/bk-2020-1344.ch007

Kalman, R., Macias Esparza, M., & Weston, C. (2020). Student views of the online learning process during the COVID-19 Pandemic: A comparison of upper-level and entry-level undergraduate perspectives. *Journal of Chemical Education, 97*(9), 3353-3357. https://doi.org/10.1021/acs.jchemed.0c00712

Lam, G. Y. H., Holden, E., Fitzpatrick, M., Raffaele Mendez, L., & Berkman, K. (2020). "Different but connected": Participatory action research using photovoice to explore well-being in autistic young adults. *Autism, 24*(5), 1246-1259. https://doi.org/10.1177/1362361319898961

Lansangan, R.V. (2020). Teaching junior high school chemistry during the COVID-19 community quarantine season: Lessons, challenges, and opportunities. *KIMIKA, 31*(1), 20-37. https://doi.org/10.26534/kimika.v31i1.20-37

Latz, A. O., Phelps-Ward, R., Royer, D., & Peters, T. (2016). Photovoice as methodology, pedagogy, and partnership-building tool: A graduate and community college student collaboration. *Journal of Public Scholarship in Higher Education, 6,* 124–142. https://doi.org/10.1163/25902539-00201008

Leenknecht, M., Wijnia, L., Köhlen, M., Fryer, L., Rikers, R., & Loyens, S. (2021). Formative assessment as practice: the role of students' motivation. *Assessment & Evaluation in Higher Education, 46*(2), 236-255. https://doi.org/10.1080/02602938.2020.1765228

Liebenberg, L. (2018). Thinking critically about photovoice: Achieving empowerment and social change. *International Journal of Qualitative Methods, 17,* 1–9. https://doi:10.1177/1609406918757631

Lim, K. F. (2019). Education: A picture is worth a thousand words. *Chemistry in Australia,* 34. http://chemaust.raci.org.au/article/marchapril-2019/picture-worth-thousand-words.html

Lofton, S., & Grant, A. K. (2020). Outcomes and intentionality of action planning in photovoice: a literature review. *Health Promotion Practice*, 22(3), 318-337. https://doi:10.1177/1524839920957427

Malka, M. (2021a). Real-time lived experience of social work students in their field training during the coronavirus crisis: Insights from photovoice-based research. *The British Journal of Social Work*, *52*(1), 311-333. https://doi.org/10.1093/bjsw/bcaa240

Malka, M. (2021b). Photovoice as a creative coping tool with the COVID-19 crisis in practical training seminar for social work students. *Qualitative Social Work, 20*(1-2), 544-552. https://doi.org/10.1177/1473325020973309

Malka, M. (2020). Photo-voices from the classroom: Photovoice as a creative learning methodology in social work education. *Social Work Education,* 41(1), 4-20. https://doi.org/10.1080/02615479.2020.1789091

Martinez, J. (2020). Take this pandemic moment to improve education. EduSource. https://edsource.org/2020/take-this-pandemic-moment-to-improve-education/633500

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review, 63*(2), 81-97.

Miltiadous, A., Callahan, D. L., & Schultz, M. (2020). Exploring engagement as a predictor of success in the transition to online learning in first year chemistry. *Journal of Chemical Education, 97*(9), 2494-2501. https://doi.org/10.1021/acs.jchemed.0c00794

Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International Journal of Educational Research Open, 1*. https://doi.org/10.1016/j.ijedro.2020.100012

Mourlam, D. J., DeCino, D. A., Newland, L. A., & Strouse, G. A. (2020). "It's fun!" Using students' voices to understand the impact of school digital technology integration on their well-being. *Computers & Education, 159,* 1-11. https://doi.org/10.1016/j.compedu.2020.104003

Octaberlina, L. R., & Muslimin, A. I. (2020). EFL students perspective towards online learning barriers and alternatives using moodle/google classroom during covid-19 pandemic. *International Journal of Higher Education, 9*(6), 1-9. https://doi.org/10.5430/ijhe.v9n6p1

Perguna, L. A., Apriyanti, N., & Kurniasih, D. (2021). Alternative online learning using social media as a panacea. *International Journal of Emerging Technologies in Learning, 16*(7), 257-264. https://doi.org/10.3991/ijet.v16i07.21209

Priniski, S. J., Hecht, C. A., & Harackiewicz, J. M. (2018). Making learning personally meaningful: A new framework for relevance research. *The Journal of Experimental Education, 86*(1), 11-29. https://doi.org/10.1080/00220973.2017.1380589

Raza, M. H., Khatri, N., Intikhab, S., & Iqbal, R. (2021). The new normal in urban Pakistan: A journey of undergraduate students through photovoice. *Journal for Undergraduate Ethnography, 11*(1), 108-131. https://doi.org/10.15273/jue.v11i1.10870

Singh, S., Roy, D., Sinha, K., Parveen, C., Sharma, G., & Joshi, G. (2020). Impact of COVID-19 and lockdown on mental health of children and adolescents: A narrative review with recommendations. *Psychiatry Research, 293*, 1-10. https://doi.org/10.1016/j.psychres.2020.113429

Soares, R., De Mello, M. C. S., Da Silva, C. M., Machado, W., & Arbilla, G. (2020). Online chemistry education challenges for Rio de Janeiro students during the COVID-19 pandemic. *Journal of Chemical Education, 97*(9), 3396-3399. https://doi.org/10.1021/acs.jchemed.0c00775

Stroud, M. (2014). Photovoice as a pedagogical tool: Student engagement in undergraduate introductory chemistry for nonscience majors. *Journal of College Science Teaching, 43*(5), 98-107.

Suffla, S. , Kaminer, D. , & Bawa, U. (2012). Photovoice as community engaged research: The interplay between knowledge creation and agency in a South African study on safety promotion. *Journal of Psychology in Africa, 22*(4), 517–528. https://doi.org/10.1080/14330237.2012.10820563

Sutton-Brown, C. (2014). Photovoice: A methodological guide. *Photography & Culture, 7,* 169–186. https://doi.org/10.2752/175145214X13999922103165

Starkey, L. (2020). A review of research exploring teacher preparation for the digital age. *Cambridge Journal of Education, 50*(1), 37–50. https://doi.org/10.1080/0305764X.2019.1625867

Sun, J. C.-Y., & Rueda, R. (2012). Situational interest, computer self-efficacy and self regulation: Their impact on student engagement in distance education. *British Journal of Educational Technology, 43*(2), 191–204. https://doi.org/10.1111/j.1467-8535.2010.01157.x

Sunasee, R. (2020). Challenges of teaching organic chemistry during COVID-19 pandemic at a primarily undergraduate institution. *Journal of Chemical Education, 97*(9), 3176-3181. https://doi.org/10.1021/acs.jchemed.0c00542

Tan, H. R., Chng, W. H., Chonardo, C., Ng, M. T. T., & Fung, F. M. (2020). How chemists achieve active learning online during the COVID-19 pandemic: Using the community of inquiry (CoI) framework to support remote teaching. *Journal of Chemical Education, 97*(9), 2512-2518. https://doi.org/10.1021/acs.jchemed.0c00541

Tanhan, A. (2020). COVID-19 sürecinde online seslifoto (OSF) yöntemiyle biyopsikososyal manevi ve ekonomik meseleleri ve genel iyi oluş düzeyini ele almak: OSF'nin Türkçeye uyarlanması. [Utilizing online photovoice (OPV) methodology to address biopsychosocial spiritual economic issues and wellbeing during COVID-19: Adapting OPV to Turkish.] *Turkish Studies, 15*(4), 1029-1086. https://doi.org/10.7827/TurkishStudies.44451

Tigaa, R. A., & Sonawane, S. L. (2020). An international perspective: teaching chemistry and engaging students during the COVID-19 pandemic. *Journal of Chemical Education, 97*(9), 3318-3321. https://doi.org/10.1021/acs.jchemed.0c00554

Toquero, C. M. D. (2020). Emergency remote teaching amid COVID-19: The turning point. *Asian Journal of Distance Education, 15*(1), 185-188. https://doi.org/10.46661/ijeri.5113

Tsang, K. K. (2020). Photovoice data analysis: Critical approach, phenomenological approach, and beyond. *Beijing International Review of Education, 2*(1), 136-152. https://doi.org/10.1163/25902539-00201009

UNESCO. (2020). Education: From disruption to recovery UNESCO. https://en.unesco.org/covid19/educationresponse

Wang, C., & Burris, M. A. (1997). Photovoice: Concept, methodology, and use for participatory needs assessment. *Health, Education & Behavior, 24*(3), 369–387. https://doi.org/10.1177/109019819702400309

Warne, M., Snyder, K., & G. Gådin, K. (2013). Photovoice: An opportunity and challenge for students' genuine participation. *Health Promotion International, 28*(3), 299–310. https://doi.org/10.1093/heapro/das011

Yang C, Chen A, & Chen Y (2021) College students' stress and health in the COVID-19 pandemic: The role of academic workload, separation from school, and fears of contagion. *PLoS ONE 16*(2), e0246676. https://doi.org/10.1371/journal.pone.0246676

Yuriev, E., Naidu, S., Schembri, L. S., & Short, J. L. (2017). Scaffolding the development of problem-solving skills in chemistry: Guiding novice students out of dead ends and false starts. *Chemistry Education Research and Practice, 18*(3), 486-504. http://doi.org/10.1039/C7RP00009J