Video Teleconferencing as a Tool for Science Education: Perceptions and Experiences of Tertiary Students in a Rural School in a Post-Pandemic Era

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Abstract

A qualitative study that tries to investigate perceptions and experiences of tertiary students regarding the application of video teleconferencing as an educational tool in science learning among students of a rural school in pandemic and post-pandemic. Interviews, focus group discussions, and observation revealed rich insights into how video teleconferencing technology could indeed be integrated in science courses. Various themes from research findings are brought out; among them is the influence of video teleconferencing exerts on the level of students' engagement and their comprehension of the science curriculum. Others include approaches to pedagogy and challenges which face the students. To this end, students described having a more active engagement in science education via video teleconferencing, for it was interactive, thus allowing maneuverability around. However, they encountered challenges such as technical issues, accessibility barriers, and distractions. Nonetheless, video teleconferencing was found to be a crucial component of the educational process, which increases accessibility, broadens chances, and fosters the development of lifetime learning abilities. These results emphasize the necessity of resolving issues in order to maximize the efficiency of video teleconferencing in science instruction.

Keywords: Learning, Post-Pandemic, Rural School, Science Education, Video Teleconferencing

INTRODUCTION

The whole world experienced a great shock when schools were closed indefinitely because of the COVID-19 pandemic. Higher Education Institutions were encouraged to apply varied modalities and flexible learning. Schools use technology to increase student access to instruction online and create novel teaching and learning experiences. The health crisis has reignited interest in employing synchronous tools for communication and teamwork in open, remote, and digital education. The demands of the COVID-19 epidemic have caused an almost instant evolution in open, distant, and digital education. Today's most popular synchronous communication solutions involve video, video, or web conferencing (Camilleri & Camilleri, 2022; Riedl, 2022). Teachers and students log on and participate in web conferences from anywhere with a reliable internet connection.

A synchronous class is when the teacher and the students learn online at the same time (Amiti, 2020). Teleconferencing refers to a situation where one or more sites have a group of such persons while the other site has some of the groups. It is a real-time, live program with interactivity. The teleconference enables the communication between at least two locations using audio, video, and maybe additional modalities. There are several ways to set up a teleconferencing unit (Bixler, et al., 2021). Without any restrictions or barriers related to geography or time, it provides access to the best educational resources and experiences. It facilitates communication and simplifies the learning process (Ratan, et al., 2022). Instruction, at present, has now moved online with the available existing digital platforms and ICT-based educational initiatives intended to deliver quality education (Martin, et al., 2023). Among the most visible results of the Covid-19 pandemic is the accelerating pace of digitalization in the educational landscape (Fabriz, et al., 2021).

The introduction of video teleconferencing technologies into the educational setting has truly changed the face of teaching and learning, especially in the area of science education (Pregowska, et al. 2021; Mpungose, 2023). Immediately after the advent of COVID-19, virtual learning systems took on a different life and transformed educators and researchers into explorers, seeking to understand the role of video teleconferencing in students' engagement and comprehension levels in science (Sung, et al., 2021; Caton, et al., 2021; Fatani, 2020).

Recent research shows that innovative teaching approaches in

science education are already on the way. In a study, Empiengco and Mustacisa-Lacaba (2022) proved the efficacy of FBLI to improve engagement and physics understanding. The authors propose the integration of FBLI with digital tools, video teleconferencing for instance, to be effective. Cabubas and Mustacisa-Lacaba (2022) also highlight the significance of visual aids and analogies, such as colored stick models, to explain complicated scientific concepts that make it easier for the learner. In addition, Mustacisa (2016) has pointed out that the structure of the family and involvement of parents, especially in rural areas, supports innovations in the classroom and amplifies the effects of digital learning platforms. These strategies collectively underscore the potential of combining pedagogical innovations with technological tools to transform science education for diverse contexts.

Furthermore, research on the impact of video teleconferencing on students' participation and understanding among different educational contexts is available in many existing repositories; however, such studies are lacking with respect to science education in rural school settings (Alalwan, et al., 2020; Kormos & Wisdom, 2021). Challenges of science education in rural areas are a new dimension that stands between the innovative teaching strategies and the digital tools being applied in schools (Sofi-Karim, et al., 2023; Dube, 2020). Among the most critical shortcomings for schools without good internet connectivity, there are modern devices and infrastructure facilities that support digital learning (Basar, et al., 2021). Such technological disadvantages make students and teachers unable to participate fully in virtual or blended learning environments. In addition, professional development does not provide these teachers with the time or resources to learn about the innovative teaching methods and to be able to adopt them. Rarely do they receive any professional development focused on current pedagogical approaches (Hennessy, et al., 2022). More importantly, some of the external factors which are significant in defining the experiences of students in their entire science learning include family support (Harefa, et al., 2023). In rural populations, for instance, children may often have household and labor work responsibilities prioritized over education, thereby essentially inhibiting parental involvement in children's educational activities. Quite a lot of people are not well versed in the use of technology, which makes it hard for them to assist their children with

learning via digital tools or to facilitate participation in virtual classrooms effectively.

METHOD

This study employed a qualitative research design, which Merriam and Tisdell (2015) define as basic qualitative research. The research questions aimed at investigating the effects of video conferencing as a teaching tool on students' learning experiences, engagement, and comprehension in science-related courses like in environmental science and science-technology and society classes in pandemic and post-pandemic well-aligned with the methodology. Such an alignment would allow a thorough understanding of the phenomenon within its real-world context. The participants in this study were tertiary students enrolled these science-related courses in a Higher Education Institution in Northern Philippines that integrates video conferencing as part of its instructional methods.

Participants of the Study

The participants in this study were tertiary students enrolled in science-related courses in a Higher Education Institution in Northern Philippines that integrates video conferencing as part of its instructional methods. Purposive sampling technique was used to ensure participants who were found most relevant to the aims of the study. This specified students to have ones who had extensive experience of using video conferencing in pandemic up to post pandemic in their courses so that their opinion could yield rich and meaningful data. The participants encompassed a wide variety of science disciplinary subjects, in science, technology and society, and environmental science, so as to also capture diverse views and experiences.

Research Instruments

A number of methods for data collection were used. Individual semi-structured interviews were conducted with the students. They provided the opportunity to explore the information more deeply on various aspects of their experience and insight. In addition, focus group discussions were conducted during which students might be brought together for engaging interactions that make room for diverse views and common themes. Lastly, observations were on video conferencing sessions to understand the contexts under which students are engaged and how they interact. Other observations included the kinds of academic and technical challenges associated with using the platform. The other complementary activity was document analysis, which involved a close look at course materials, recorded sessions, and student feedback to enrich

the qualitative data from interviews and observations.

Data Analysis

Arising from this, process data analysis was systematically done, comprising interview transcriptions and focus groups initially, then followed up by categorizing and thematizing analysis for pattern, theme, and interpretation relevant to the perceptions and experiences of the students. Careful ethical consideration went through the course of the study, ensuring all informed consents, confidentiality, and upholding in autonomy of all the participants involved.

RESULTS AND DISCUSSION

This study is about examining the views and experiences of the higher education students with respect to the application of video teleconferencing as an instrument of science education for a rural school setting in the pandemic to post pandemic times. The study explored through qualitative analysis of interviews, focus group discussions and observations reveals rich insights into the multifaceted dynamics of integration videoconference technology into environmental science, and science-technology and society classes. Here then, the themes introduced also relate to video teleconferencing's impact on how students engage with and understand the content and the pedagogical approaches and teaching strategies adopted as well as challenges for students.

Impact of Video Teleconferencing on Student Engagement and Understanding in Science

Enhancement of Learning Engagement in Science

Most of students stated that they were more actively engaged with scientific content when it was delivered through video teleconferencing. As they pointed out, the virtual classrooms are more interactive; they allow one to enter into conversations and discussions with other students and instructors in real time. Many of the students were keen on having noted the convenience and flexibility that video conferencing afforded, allowing students to get closer to course materials from any point. Some of the verbalizations of the informants are as follows:

> S05: *The virtual classroom setting lets me participate in discussions, work with my classmates on projects, and ask my teachers questions in real-time, which makes learning so much more interactive and enjoyable especially during the no face-to-face classes in my environmental science class.*
>
> S10: *See, it has proved to be very dynamic to me, and learning has become engaging in pandemic times as well in line with its being able to attend live interactive discussions, doing group assignments with peers,*

and accessing my instructors promptly.

The feedback from students regarding their increased participation and involvement in environmental science through video teleconferencing is expressed in the same breath as recent studies that try to emancipate students regarding the essence of remote learning and tech-enhanced education. According to Orhan and Beyhan (2020), remote learners reported an increased sense of engagement due to the interactivity associated with virtual classrooms. The study, on the one hand, revealed that features such as real-time discussions, peer collaboration, and instant feedback from instructors contributed significantly to students' perception of engagement and participation. On the other hand, the study of Xie, et al. (2022) disclosed that most of the students accepted advantages from remote learning platforms in terms of flexibility and convenience. The access to course materials from anywhere has been pointed out as a major benefit particularly for scholars who have busy schedules or students from remote areas. This finding, therefore, corroborates the feedback of students concerning the convenience and flexibility that video conferencing provided in their science education.

Facilitation of Interactive Learning

All interactive features and tools are recognized by the students as being beneficial in the case of a video conferencing platform. Such features include chat functions, break-out rooms, and collaborative whiteboards, which the students valued for encouraging engagement and participation. Students acknowledged these tools in terms of virtual labs, simulations, and hands-on activities in the context of video conferencing, which were further helpful in grasping scientific concepts. Some quotations from the informants are as follows: S04 and S11.

S04: *The interactive tools available in our video conferencing system have made a significant impact in my learning experience since no face-to-face instruction.*

S11: *Interactive features on video conferencing platforms, keep me attached to environmental science class.*

Especially in video conferencing, interactive learning would require extensive effective features and tools used to promote engagement and collaboration as well as active participation among students. One of the most important within that framework would be chat functions: it has also provided students real time for communication and interaction in virtual

classes. This became possible through chat, so students can ask questions, express their ideas and share their contributions with the community—at all times facilitating active participation and sense of belonging within the learning process (Correia, et al., 2020). Moreover, breakout rooms have now allowed small groups to come together so that at an intimated level, students meet in small groups to work on collaborative projects solving problems or discussing specific topics. With such an exposure, peer have come to know and align with interaction, team building and exchange of ideas will happen, developing the students' critical thinking and communication skills (Roqie-Hernandez, et al., 2023). Collaborative whiteboards, in turn, would further those benefits.

Impact of Conceptual Knowledge

Students acknowledged video teleconferencing as an efficient way of communicating scientific ideas and theories. However, there were views amongst students concerning limited depth regarding having a deep conceptual understanding through virtual instruction in pandemic, especially for complex or abstract topics. The effectiveness of the instructional strategies differed for the students; they also emphasized the need for clear explanations, use of visual aids, and interactive discussions in their conceptual learning. The following are some verbalizations of the informants:

S17: *Video teleconferencing is good for science concepts. The only thing that makes it hard for me is that sometimes, it does not penetrate deep enough on certain topics in science, technology and society and environmental science courses, particularly on difficult ones, because I rely on clear explanations, visual aids, and engaging discussions.*

S21: *I think I can understand well the video teleconferencing in teaching environmental science, but, at times, it also makes it difficult for me to get a really deep understanding of some theories.*

Students seem to appreciate video teleconferencing as an effective means of conveying science concepts and theories especially during pandemic. However, there are considerable limitations in terms of achieving a very deep conceptual understanding, especially with complex or very abstract topics. Some of these limitations have been reported by students: virtual instruction creates challenges that need to be resolved through clear explanation, visual aids, and interactive discussions to further their conceptual comprehension. Recent studies of the effectiveness of instructional strategies in virtual learning

environments tend to support these findings. The results of the study of Inganah, et al. (2023) have shown that although virtual instruction will be used to transfer knowledge, it may fail to meet the depth of understanding given for complex topics without supple internalizing strategies.

Significance in Learning Process

Expansion of Learning Opportunities

Video teleconferencing has been seen one of the most used methods to extend learning beyond four walls of classrooms. To students, virtual lectures and discussions and activities permit exposure of different perspectives and resources through which their education will be maximally enriched, as there will be widening understanding concerning scientific concepts. Here are some of the responses from the informants:

> S02: *Learning opportunities through video teleconferencing could undoubtedly extend beyond the classroom. The variety of activities in that virtual environment truly broadens one's perspective and provides a wealth of resources for comprehending scientific ideas, making the process overall quite enriching in the absence of traditional lectures.*
>
> S03: *We would be closer to the various viewpoints and additional resources that can enhance and expand our knowledge of environmental science if we participated in virtual lectures, conversations, and cooperative activities.*

Informants recognize the value of video teleconferencing in education and how it transcends the boundaries of conventional classrooms. Students have been able to incorporate themselves into a diverse range of viewpoints and materials through online lectures, conversations, and other interactive training exercises, expanding their access to educational opportunities and comprehension of scientific ideas. It means that technology in education has the power to transform, then, as it gives students the opportunity to transcend geographic borders and access materials and viewpoints from a variety of participants in that process. Recent research supports these findings, suggesting that video teleconferencing creates more inclusive learning spaces, paving the way for increased engagement and knowledge transfer among students from multiple backgrounds (Maher, 2020; Tai, 2024). It proves that virtual learning environments strengthen the students' critical thinking and digs deeper into the course content. Thus, video teleconferencing would increase the learning horizons for students and encourage a better understanding of

scientific concepts by exposure to different views and resources (Sharp, et al., 2022).

Integral Educational Component

Students recognized video teleconferencing as a crucial part of their learning process in science education. The majorities regarded virtual interaction by virtue of video conferencing as important as classroom experience through providing opportunities to actively engage, collaborate with others, and acquire knowledge. Such are some of what the informants verbalized:

> S01: *I tend to view video teleconferencing as something very important in my learning process because before I can learn, I have to associate, the most valuable ways it brings me together with my peers and teachers so that I might gain rather like one would in a physical classroom.*
>
> S05: *It is through these virtual interactions that I engage in core parts of my science education in science technology and society and environmental science classes in pandemic, take part in all-their-participations and collaborate without which, traditional approaches to classrooms would be unnecessarily incomplete.*

It has been stressed by many students: the virtual relationships that can be built with the use of video conferencing platforms are apropos as both participation and collaboration. They articulately show that these virtual engagements provide opportunities for active involvement, collaboration, and acquisitions of knowledge. New studies from many quarters support this claim, indicating that video teleconferencing has formed an integral aspect of education, as it brings a dynamic and interactive learning environment. Sweetman (2021), for instance, asserts the transformational effect brought about by virtual interactions on student engagement and participation in science education. Besides, Camilleri and Camilleri (2022) showed how effective video teleconferencing is in facilitating collaborative learning and knowledge sharing by students.

Accessibility and Flexibility

The significance of video teleconferencing emerges from the fact that it improves accessibility and flexibility of the learning process, as students have acknowledged how convenient and adaptable such means are. For example, in rural areas where traditional education resources are limited, the students have valued the opportunity of accessing course materials remotely, so that geography-no longer

serves as an obstacle toward their education. For them, that flexibility made it easier for them to combine their academic experiences with any other obligation, thus personalizing their learning experience-besides making it meet their needs and schedules. Some of the verbalizations of the informants are as follows:

S15: *"Remote access to course materials is highly beneficial, especially in rural areas, in pandemic, since resources are traditionally limited there."*

S18: *"It has made a difference for me regarding flexibility through video conferencing. I can also access course materials from anywhere in environmental science; this is a boon in rural areas in pandemic with fewer resources. "*

Enhancement of Lifelong Learning Skills

In addition to the immediate educational benefits of video teleconferencing, students emphasize the need of using this medium to cultivate lifetime learning abilities. In order to educate students for their future academic and professional pursuits, virtual classrooms helped them build the digital literacy, communication, and teamwork skills necessary for success in an interconnected world. Some of the informant verbalizations are as follow:

S09: *Digital literacy, effective communication, and collaboration skills I've imbibed will add to my success in today's interconnected world .*

S02: *Practicing truth in virtual classrooms in pandemic using video teleconferencing has greatly assisted me in advancing my digital literacy.*

Participation in virtual classrooms makes the students gain very important skills of digital literacy, communication, and collaboration, which become increasingly important for success in both academic and professional settings. Blau et al. (2020) argued that student involvement in virtual learning environments further enhances students' digital literacy and proficiency with technology. Yu (2022), on the other hand, asserted that it positively improved collaborative and teamwork skills in the students. More so, this provided the necessary groundwork through its value as a video teleconferencing tool towards the future academic plans and success of students in their careers. This is also found in industry reports, which have asserted that employers are increasingly highlighting as relevant competences in today's workforce: the value of digital literacy and the art of professional collaboration.

Challenges Faced by Students in Video-Teleconferencing in Science-Related Courses

Technical Issue and Poor Internet Connection

Students faced several technical problems with video-teleconferencing for science-related classes. These included internet connection issues, audio or video feeds that lagged, and platform malfunctions that disrupted the flow of learning activities and hindered effective communication with instructors and peers. Some of the verbalizations of the informants include the following:

> S08: *Poor internet connection and glitches in the platform often cut off our sessions, which makes it difficult to communicate and fully participate in the learning process.*
>
> S07: *Having a slow-speed internet connection and a latency in audio or video-signal feeds are some of the technical problems affecting my environmental science lectures' ability to conduct video teleconferencing. These issues have made it very challenging for students when they are trying to interact or follow up with professors and classmates in a disrupted state.*

The experience of students taking scientific classes through video teleconferencing was not without its challenges. It has been characterized by technical difficulties that greatly affected their learning-the ones that include delayed audio or video feeds; platform issues; and internet access, which had become a major source of problems in learning activities and consequently reduced student peer or teacher interaction. All these would further annoy the participant through broken arguments or distributed collaboration of group projects-inhibiting the learning process as a whole (Kleftodimos & Triantafillidou, 2023; Kimble-Hill et al., 2020).

Accessibility Issue

Inaccessibility issues detained students from the participation in video-teleconferencing sessions in off-site areas with an inadequate technology infrastructure. A lack of appropriate equipment or limited access to high-speed internet prevented full participation in virtual classrooms for some students, which worsened inequities in educational opportunities and access. Some of the responses of the informants are as follows:

> S09: *It is hard for me to participate within virtual classrooms, given the unavailability of proper equipment and restriction to high-speed internet, which further heightens access gap in education.*
>
> S01: *Bad technology infrastructure has been a problem for a number of students, myself included.*

There is thus a problem for students in remote locations with no access to technology; major obstacles prevent these from accessing video teleconferencing. Some students met complete exclusion from virtual classrooms because of lack of high-speed internet and appropriate equipment; this even heightened already existing inequalities in educational opportunity and access. Kmble et al. (2021), cite that poor technology infrastructure and limited internet access have left students in rural settings with constraints in obtaining online learning resources.

Environmental Distractions

Accordingly, the ambient settings in which students are positioned during video conferences are primarily responsible for attention and concentration disturbances. This could include details like outside noises in a shared living environment or interruptions from family members or pets, which frequently make it difficult for students to participate fully in class discussions and course material. Some of the informants' verbalizations:

> S25: *Most often, there's a distraction of other human elements; noises from family living space or other animals prevent my attention on course activities and discussion materials.*
>
> S14: *Sometimes I do experience concentration issues with video-teleconferencing events, primarily because of so many distracting elements in my surroundings.*

These distractions, which include noise disruptions in shared living spaces and interruptions from family members or pets, are significant obstacles to students' ability to actively engage with course materials and discussions.

Less Engagement and Learning Motivation

Maintained engagement and motivation to students have always been constant problems during video-teleseminars. The absence of presence and physical cues from instructors and peers, for some students, makes it difficult to maintain their focus and motivation during virtual lectures or discussions, resulting in their diminished participation and interaction. Some verbalizations of informants are the following:

> S03: *The lack of face to face, makes us very hard to be focused and motivated during virtual lectures or discussions, which led to decreased participation.*
>
> S04: *The absence of face-to-face interaction made it very difficult for me to remain focused in virtual lectures, resulting in a decreased*

level of engagement and interaction with the course material.

The lack of face-to-face interaction, and the bogus physical cues coming from both instructor and peer, however, made student life in a video-teleconferencing environment a continuous challenge. Even audio recorded sources are sometimes unable to create that instant closeness, making it somewhat difficult for the student to stay focused and motivated during virtual lectures or discussions. Without that physical presence and proper audio-visual cues from the class environment, it becomes difficult for a learning student to get connected with the material and learning community, relying heavily on their scant interaction and participation (Chatterjee, 2021).

Even where it exists, absence of face-to-face interaction will go further to curtail spontaneity and immediacy of feedback at crucial moments, which combinations are important for keeping the motivation and interest up as possible for students in the learning processes. They, therefore, can create informal situations in which students can convey their understanding of the material in real-time to the teacher or one another.

Passive Instructional Approaches

There cannot be any doubt about the fact that students actually demand teachers or instructors to modify their teaching styles and instructional strategies to engage these students fully in video-teleconferencing. However, some students reported that they more often encounter unsatisfying effects as a result of passive learning modes such as long boring lectures or tedious presentations which failed to utilize the full potential of virtual classrooms and thus proved detrimental or even invalidating in terms of their understanding of the course material. Some verbalizations by informants are:

S06: *Passive approaches like long lectures or monotonous presentations do not really engage us effectively and prove dexterous obstacles in understanding the material. Using interactive activities in virtual classrooms would do much good for us.*

S11: *It's just that long lectures and boring presentations make it hard to keep up with it all and not get an understanding of what we're actually supposed to be learning.*

The students mentioned that these instructors have to change their modes of teaching and instructional strategies so that they engage students effectively in video-teleconferencing settings. Students have pointed out the need for changing the teaching methods and the instructional strategies of these instructors so that they may successfully

engage students in the video-teleconferencing setting. For instance, students feel that passive approaches to instructional methods, such as long lectures or monotonous presentations, have not tapped the interactivity of virtual classrooms. They have been unable to understand course materials well, as they would in any other traditional face-to-face setting. Students learn by dynamic interactions, real-time feedback, and hands-on activities. But while transferring to virtual platforms, it involves an adjustment of instructional methods to enhance the active interaction and successful knowledge transfer.

This suggests that passive instructional approaches within virtual environments can lead to fewer participating students, less interaction, and poor learning results. According to Mehring (2021), likely disengagement in a virtual classroom is with students who sit through passively delivered lectures and presentations. Furthermore, the work of Jung, et al. (2024) suggests that active learning strategies such as problem-based learning and group activities facilitate more profound understanding and retention of course material in virtual environments.

CONCLUSION

This study emphasizes the post-pandemic era and pandemic, and reveals how video teleconferencing can play a key role in improving science education like in environmental science and science, technology and society classes, especially in rural schools setting. The students of environmental science find video teleconferencing as a great boon to engage, gain easy access, and develop lifelong skills, despite the limitations presented in the form of technical flaws, limited resources, and lack of concentration. It would thus be important to overcome these limitations while extracting maximum benefits from video teleconferencing to promote equity and effectiveness in science education. Investment in up-gradation of digital infrastructure in schools located in rural areas with regard to ensuring internet availability and devices will be highly essential in breaking technical barriers. Collaboration of schools with the community would ensure proper technical support and training both for students and teachers so that they can operate video teleconferencing tools efficiently. Further, partnership between government and private agencies would also ensure subsidizing of technological resources to make it accessible for the underserved communities.

The second step is to strengthen the motivation of students. Instructors can use stimulating teaching methods like gamification, real-time quizzes, and group work to keep attention in video

classes. Involving students in such an interactive and participative learning environment encourages critical thinking and keeps them engaged fully. Acknowledging their accomplishments and rewarding them raises morale and motivation to study further.

External barriers could also be overcome by having family involvement. Schools can organize workshops or orientation sessions to educate parents on the importance of digital tools in learning and prepare them with the necessary skills to assist their children.

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