Research Article

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Virtual Learning of Science During Pandemic: Students' Perspectives

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Abstract

With COVID-19 pandemic, virtual teaching and learning of all subjects had become a new norm of education. Though virtual teaching and learning used to be a common practice in some higher learning institutes in many countries that offer distant education, the implementation of this mode across all education levels in Samoa only happened since March 2020. Due to this sudden shift of teaching and learning modes, most of the students as well as teachers (lecturers) entered this new norm of education quite unprepared. Despite of numerous reviews and changes implemented in virtual teaching and learning since it was started, there is limited effort made to understand students' perceptions about the virtual learning of science. Literature studies showed there were both advantages and disadvantages experienced by students participating in virtual learning in many different places around the world. Therefore, this paper aimed to explore students' perspectives of FOE science students in virtual learning and the impact of these sessions to them. In particular, the students enrolled in the course HTE360: Teaching Science at Primary Level, during COVID-19 pandemic were involved in this study.

Qualitative research design was selected and data from the research participants were collected through in-depth interviews methods. The study suggests shifting the focus onto the learner/user of the virtual platform prior to the implementation of the course to ensure they are equipped with the knowledge and necessary skills. In addition, ongoing supports should be available to enhance tasks/activities participation, build community of learners and motivate peer collaborations throughout the virtual learning process. Future study in the similar scope is recommended to be conducted with multiple research approach to gather more in-depth insights about virtual teaching and learning of FOE courses.

Keywords: Virtual teaching, virtual learning, pandemic, activity participation, university course.

Introduction

With the threat of COVID-19, many educational institutions worldwide had to go virtual to enable their students to continue studies, while countries attempted to control a disease that was rapidly taking lives and for which a treatment was not yet available. Associated with that threat were calls for social distancing, hand washing, mask wearing and lockdowns, necessitating the Samoa Education Sector to move teaching and learning at all levels virtual. The National University of Samoa (NUS) had to make swift transition into virtual learning, as social distancing was a health requirement, to avoid community transmission (Murphy, 2020). Crawford, Butler-Henderson, Rudolp, Malkawi, Glowatz, Burton, Magni, and Lam (2020) investigated 20 countries' higher education responses to COVID-19 and found that there were those that made quick responses through putting courses wholly virtual while on the other end of the spectrum, there were institutions that had not much of a response. Most of the developed countries closed their campuses and shifted virtual, while several developing nations closed the institutions but also implemented varying digital strategies in which the NUS adopted during COVID-19 pandemic.

Background of Study

Learning is defined as an active process where learners engage in as they make sense of information, and how they integrate that information into their mental models so that it becomes new knowledge (Saunders & Wong, 2020). Similarly, Entwistle (2000, 2003) stated that deep learning and understanding of scientific concepts is supported by constructivist's views that includes active learning processes involving relating ideas to daily life and looking for patterns and principles. It involves constructing, creating, inventing, and developing one's own knowledge and meaning of realities based upon interpretations of one's experience (Jonassen, 1991; Liu & Chen, 2010; Taber, 2011). Under the above conditions, learning is seen as an active process of sense making, which occurs in the minds of learners as they attempt to construct a meaningful representation of the information (Phillips, 1995). How one constructs knowledge is a function of the existing knowledge, experiences and understanding, mental structures and beliefs that one uses to interpret objects and events (Bodner, Klobuchar, & Geelan, 2001; Jonassen, 1991). These processes occur either individually or socially.

Views of social constructivism are familiar to the Samoans, particularly its social context and *fa'aSamoa* where work and activities are carried out by groups, family members or members of the community (Leaupepe, 2009; Suaalii, 2013). Participation in activities in the community is often strongly influenced by an adult with knowledge of a particular phenomenon who gives direct instructions and guidance to help young children learn new ideas and complete tasks. Views of social constructivism are also promoted in science education curriculum, where the emphasis is on "students constructing [knowledge] from their experiences" through "the use of activities such as investigation, problem solving and group work" (Ministry of Education Sports and Culture, 2004, p. 18 & 19). In this regard, views of social

constructivism tends to be more emphasised compared to individual views however, it is not yet known how or whether they are enacted in Samoa classrooms.

Learning is divided into two categories: individual learning and social learning (also known as exploration and exploitation, respectively) (Boyd & Richerson, 1985). Individual learning, such as trial and error and insight, refers to learning that occurs independently of any social influences. Social learning, including imitation, involves the transmission of traits or behaviours through interaction with other individuals, in which a characteristic exhibited by a 'model' is acquired by an 'observer' (Crawford, 2005). There is a wide theoretical agreement that individual and social learning are adaptations to temporally and/or spatially variable environments, as innate behaviour is sufficient to cope with a constant environment. The relative advantages of individual and social learning depend on the environmental constancy: in short, unless the environment is extremely stable so that innate behaviour is most advantageous, social learners (SLs) are advantageous in a moderately variable environment because they can acquire adaptive behaviour without engaging in costly individual learning but run a risk of carrying an inept behaviour in a highly variable environment.

However, during COVID-19 pandemic, learning suddenly adopted the approach of virtual learning; a method that was considered foreign to both teachers and students of HTE360. Virtual learning is an approach that involves interactions between the instructors and students remotely. In this process, students learn from their own homes while the instructor teaches from another location other than the classroom (Dorovolomo, Rodie, Fito'o, & Rafiq, 2021). Such way of learning is implemented in synchronous and asynchronous processes. In the synchronous process, learning takes place in real time, where a group of people are engaging in learning simultaneously. This includes the use of video conferencing, telephone conferencing, live discussions, or live lectures (Henriksen, Creely, & Henderson, 2020). The asynchronous process, however, refers to courses where students access course materials—lectures, readings, and assignments—on their own time because there's no set class time (Clark & Mayer, 2016).

What is Virtual learning?
Many people use the terms 'distance learning', 'e-learning', 'online learning', and 'virtual learning' interchangeably. E-learning, online learning, and virtual learning all fall into the umbrella concept of technology-enhanced learning. However, they mean different things, and all focus on a different aspect of education. In this study we will focus on the use of virtual learning as it was used in the implementation of HTE360 during pandemic. Virtual learning offers advantages (Liu, Lomovtseva, & Korobeynikova, 2020), such as flexible learning activities and accessible learning resources. Additionally, virtual learning allows instructors to update the materials anytime and anywhere (Gamage, Ayres, & Behrend, 2022). Virtual learning can also be a strategy to boost learners' autonomy through the available digital platforms in their hand.

The implementation of virtual learning is not a new concept because virtual learning started in certain countries as early as the 1800s. Even though the internet was not developed in that era, Isaac Pitman taught a group of students short-typing through letters in the year 1840. In the year 1924, the first test machine that can allow students to perform self-assessment was launched. Virtual learning then developed further until live learning sessions were implemented in the early 2010 (Stephenson, 2018). But all these virtual learning activities involved long distance courses in higher education institutions.

Virtual learning in HTE360 (and other FOE courses) started to gain more attention during the COVID-19 outbreak at the beginning of 2020. The health crisis forced education systems in Samoa and all over the world to search for ways to replace face-to-face teaching. It was aimed at solving the problem of students' learning interruption after the Government announced lockdown to all businesses as well as education providers (including the National University of Samoa) within the country. While the lockdown was at a sudden rate and under emergency conditions, virtual learning functioned as a recovery strategy at the National University of Samoa to ensure teaching and learning continued. The new norm of learning has its own differences compared to face-to-face learning. All communications, course materials, activities including the assessment and marking suddenly transformed and migrated to digital forms (Pokhrel & Chhetri, 2021). Virtual learning in the education sector in Samoa has been implemented through various platforms by various institutions. But the two virtual platforms adopted by the National University of Samoa, were Moodle and Zoom Applications to assist the teachers and students perform virtual teaching and learning (Selvanathan, Hussin, & Azazi, 2020).

The course HTE360-Teaching Science at Primary Level
The course is offered at the Faculty of Education, where students are trained to become teachers at ECE, Primary and Secondary levels. The course HTE360, enables students to plan, deliver and assess a basic range of learning experiences for Primary School children. It demonstrates knowledge of the science concepts and the skills required to teach at the Primary Level. This course focuses on the aims, achievement objectives, learning outcomes, approaches to teaching and learning, assessment in science, and Science concepts covered in the Samoa Primary Science Curriculum. It also provides students with the opportunity to choose appropriate types of resources and project materials, put together sequencing of lessons, and apply investigative inquiry and interpretive skills that are essential for teaching science at Primary Levels.

Statement of Problem
The decision to start virtual learning occurred very quickly. Unexpected spike in COVID-19 cases resulted in emergency university lockdown whereby students and teachers did not have adequate preparations. The impact was observed more among the students in terms of using mobile apps or troubleshooting computers. Since there was no opportunity for any classroom face-to-face meeting or consultation, students were not able to express the challenges they experience during the virtual lessons and determine possible solution for the issues.

The methods and processes for teaching and learning at the National University of Samoa shifted completely from classroom face-to-face to virtual sessions began in March 2020. Teachers started to use more of the Moodle and Zoom applications and teaching schedules were rearranged with the hope that students had full access to technological devices as well as suitable Internet connections (Dorovolomo, Rodie, Fito'o, & Rafiq, 2021). The main goal was to ensure complete implementations of the university courses including HTE360.

However, there are not many studies conducted in Samoa education to analyse issues faced by students, particularly using virtual mode of delivery. Most of the research (for example Crawford, Butler-Henderson, Rudolp, Malkawi, Glowatz, Burton, Magni, & Lam, 2020; Demuyakor, 2020) discussed challenges of virtual learning from a general perspective. Therefore, literature provides very limited or no insight on Samoan university students' perceptions about virtual learning. The present study is expected to close the existing gap by collecting and analysing university students' perspectives about their virtual learning experience, particularly in HTE360 during pandemic. To achieve this, two questions will guide the implementation of this study:

1. What are the challenges of virtual learning experienced by the students during the delivery of HTE360?
2. What strategies to help improve virtual learning of HTE360?

The findings of this research will inform educators about the students' perspectives about virtual delivery that is currently implemented at the Faculty of Education. It will provide evidence-based insights into whether teaching science (HTE360) using this delivery mode can lead to quality science education and the preparations of quality teachers for primary schools in Samoa. Additionally, the research will offer recommendations for improving this delivery mode for science education. It will also empower policy makers to advocate for educational policies that prioritize quality teaching and learning modes suitable for all students enrolled in university virtual courses.

Literature Review
Introduction
The aim of this research was to explore issues faced by Samoan university students in the virtual delivery of HTE360 and their impacts upon their learning process. Since there is very limited research on the impacts of virtual learning on Samoan university students the literature review highlights the general population's views about virtual learning. Findings from the literature review are presented from two different perspectives as presented below.

Effectiveness of Virtual Learning
Virtual learning involves learning and teaching procedures completed in cyberspace with multiple approaches that benefit students, the community (Arauju, de Lima, Cidade, Nobre, & Neto, 2020) as well as the institution. Farrell and Brunton (2020) found that virtual learning increases students' participation in the learning activities. Their finding was accompanied with factors such as peer, type of virtual learning module used by the teachers and flexibility level while learning from a comfortable place. These findings imply virtual learning still can be equally effective as classroom face-to-face learning if the learning material can be modified to suit distance learning style. Besides this, every student attending virtual learning sessions from the comfort of their own house (Dorovolomo, Rodie, Fito'o, & Rafiq, 2021) is surrounded by a friendly environment. Thus, their participation in the learning session increased. Similar views about virtual learning reported in the studies by Khan, Egbue, Palkie and Madden (2017), Martin and Bolliger (2018) as well as Gillett-Swan (2017).

Jefferson and Arnold (2009) also reported in their findings that virtual learning is advantageous for students because there are multiple facilities available for them to complete the learning without many obstacles. Research towards the learning process of science and technology showed students achieved learning objectives successfully because they are supplied with complete information through video sharing and animations. Therefore, the students can learn effectively just as classroom face-to-face learning. These findings aligned with the outcomes reported by Ferri, Grifoni, & Guzzo (2020) who identified that virtual learning creates more opportunities for the students to express their talents.

Virtual learning strategy found to be beneficial because teachers gain the opportunity to use various types of tools compared to the classroom face-to-face learning mode. Gregory & Bannister-Tyrrell (2017) listed a few learning tools and explained the advantages of using those tools. Virtual discussion forum was identified as a tool that motivates students to ask immediate questions during the lesson. At the same time, the students can give feedback to their peers through the virtual discussion forum. Based on the review of this work, virtual learning can help to prevent students from waiting a long time before getting feedback for their inquiries.

Virtual learning increases students' interaction through the applications that can encourage them to participate in the class discussion. Wang & Tahir (2020) claimed that the game-based learning tool known as Kahoot can be used to review students' knowledge, for formative assessment or as a break from traditional classroom activities. This virtual learning tool is suitable to be used in any subject because of the feature that allows teachers to construct various types and levels of questions. Based on the research conducted by Licorish, Owen, Daniel, & George (2018), using Kahoot in virtual teaching and learning had increased students' achievement because they received faster and simple feedback and helped them focus more on the content being taught in the class.

The factor of ease of mobility created an advantage for virtual learning because students acquire access to the lesson content in multiple ways. This is because learning tools and materials are available in electronic forms and can be accessed on other devices besides the personal computer. Based on the findings in this study, interaction between the teacher and the students increased because teachers were able to assess students' work and sent feedback of the work in a short period of time using Moodle platform.

Moodle (**M**odular **O**bject **O**riented **D**evelopment **L**earning **E**nvironment) is currently, the world's leading open-source learning management systems (LMS), and it is used by various disciplines within academia, including Science, Technology, Engineering, and Mathematic (STEM) education. Such LMS can be used to manage, deliver and measure training and learning virtual. It allows the institution to build and upload e-learning content, deliver it to registered learners, assess them on that content, track their progress and recognise their achievements. The National University of Samoa adopted this learning platform due to its popularity around the world especially in education. For instance, Henrick (2018) stated that Moodle is a cloud-based LMS and among the top 20 best LMS's based on user experiences. Its popularity and usage continues to increase from 78 million in 2015 (Singh, 2015) to over 294

million in 2021. In addition, Moodle encourages collaboration through forums, Wikis, chat functionality and groups, so learners have lots of collaborative areas to share thoughts and ideas, as well as work together on projects. Such capabilities confirm that the advantages of peer and classroom interactions are not taken away but improved upon in a different mode. Moodle can often be integrated seamlessly with other virtual platforms such as Microsoft Teams or Zoom for video conferencing functionality (Dorovolomo, Rodie, Fito'o, & Rafiq, 2021).

Review on the past studies about virtual learning showed facility, skills and strategies used are in alignment with the current trends of education within the Pacific region (Reddy, Sharma, & Chaudhary, 2022; Dorovolomo, Rodie, Fito'o, & Rafiq, 2021). This is because learning in the pacific island schools in this era is focused on inquiry-based learning that encourages students to explore the concepts related to each topic being taught (Crawford et al, 2020). Virtual learning allows the students to acquire unlimited information that can facilitate inquiry-based learning. Laksana, Dasna, & Degeng (2019) and Andrini (2016) supported the effectiveness of virtual learning towards inquiry-based learning that is flexible, interactive and provide opportunity to discuss and to provide feedback.

Issues in Virtual Learning
While virtual learning in the National University of Samoa is still new, students' participation level might consume longer time due to lack of computer literacy in addition to learning the content of the science subject. With the diversity of students in terms of computer knowledge and skills, limited exposure to newly developed computer programmes and software, it is more likely that they find learning very challenging. As such, the students tend to take a long time to process and come to some understanding of what the virtual materials provide. Sweller Ayres and Kalyuga (2011) referred to this as cognitive overload where the learner is not able to retain content and has to re-read material several times in order to retrieve or understand it. Without connecting to the students' prior knowledge in order to build new knowledge, information will seem new or unrelated, which may lead to attentional shifts and distractions (Roda & Thomas, 2006). Furthermore, the students will find it difficult to apply scientific ideas to their lives, which may contribute to the reasons why some students do not learn what the teacher is trying to teach in class.

The students are also challenged when responding to assigned tasks/activities or submitting their responses/answer sheets (Gillett-Swan, 2017). Basically, this new way of submitting activities where students should be trained to do so, is also limiting. As a result, Gillett-Swan, (2017), stated that the number of submissions often decreases when the students are required to use virtual submission. Based on the research conducted by Ilias & Baidi (2020), the technical aspects created issues in virtual learning. For example, knowledge in using certain computer programs to send virtual assignments is difficult for students who are newly exposed to the internet of things. These students need assistance the entire time in order to learn the methods of using the same mobile app or computer programs used by their teachers. There are situations where the students are unable to take part in class discussions during virtual learning. For example, when teachers require students to collaborate through google doc or spreadsheet. Students need technical knowledge to accomplish such tasks.

Dorovolomo, *et al* (2021) stated that external factors can create issues in virtual learning. Their research identified irregularities in the speed of the internet in different places as a barricade for smooth virtual learning. Similarly, Ismail, Bakar and Wafa (2020) stated in their study that the main challenge for virtual learning is less satisfaction with the internet service. This issue caused some students to not take part in the virtual learning activity, regular absence from virtual/online class sessions (Dorovolomo, Rodie, Fito'o, & Rafiq, 2021; Mohd, Mansor, Jamaludin, & Alias, 2021).

Lack of sufficient tools to take part in the learning sessions (Adnan & Anwar, 2020) is also one of the external factors that created issues in virtual learning. Based on the news reported by The Samoa observer (Likou, 2017, pg. 1), students that share devices with other family members seldom attend classes on time. They have to skip some classes since one device is used by more people in the house. Therefore, the timetable of virtual lessons does not fit into certain students' device availability schedules. This issue could be minor among students in the higher income families compared to the lower income families.

Review on foreign studies also showed issues of virtual learning due to technical problems. One such study is by Ngampornchai & Adams (2016) among the Thailand school students. This study showed that despite students having a positive attitude towards virtual learning, lack of experience in using certain applications and programs continue to become obstacles to achieving learning objectives. Some students often get stuck with password logged out without any assistance for troubleshooting (Volkmann, Miller, & Jochems, 2020). As a result, they give up on participating in the session/task with so much frustration dur to such technical difficulties. Fidalgo, Thormann, Kulyk, & Lencastre (2020) among the students in Portugal, UAE and Ukraine students attending virtual lessons reported time management issues and lack of motivation to participate in the class activities. Not all the students are able to complete the given virtual activity within the timeframe provided. Due to the difference in the amount of attention given by the teachers in virtual lessons, some students tend to feel isolated (Dorovolomo, Rodie, Fito'o, & Rafiq, 2021).

Research Methodology
Research Design
This study adopts a qualitative research method to collect and analyse data. The selection of qualitative methodology because it provides a deep understanding of the problem by asking participants to share their experiences. Crewell (2007) stated that qualitative research methods are valuable in providing rich descriptions of complex phenomena where people are often involved. As this study aims to invite students from a university course—HTE360, qualitative method is essential for this investigation as it sets out to explore their beliefs, their experiences, and personal perceptions about their participation in the delivery of the course.

This technique involves data collection through direct verbal interaction between the researcher and the research participant. It allows the researcher to gain insights into participants' perspectives on the phenomenon under study. It is particularly useful, in order to ascertain the participants' thoughts, perceptions, feelings and retrospective accounts of 52 events (Rallis & Rossman, 2011), since these could not be directly observed (Merriam, 2009; Patton, 2002). Due to the nature of

this tool, it allows new questions to be introduced and offers opportunities to probe deeper into the "situation at hand, to the emerging worldview of the participants and to new ideas on the topic" (Merriam, 2009, p. 90).

This design is advantageous for researchers since the task of data interpretation can be done simultaneously while data collection is performed. It is convenient for the researchers to relate the responses provided by the research participants during data interpretation. In contrast to quantitative research design, using qualitative research design is able to gather reasons and justifications for the responses samples provide. Interview questions will be in an open-ended format which provides a wide opportunity for the researcher and samples to continue question and answer sessions and enrich the data (Cardano, 2020).

Research Participants

Due to time constraints for this investigation, this study invited university students who registered in the course-HTE360 during the COVID-19 pandemic. These students completed the requirements of the course while it was delivered fully virtual. Ten students volunteered to participate, and they represented diverse regions of Samoa from which they were connected from during the implementation of the course. These areas are shown in figure 1 (coloured dots).
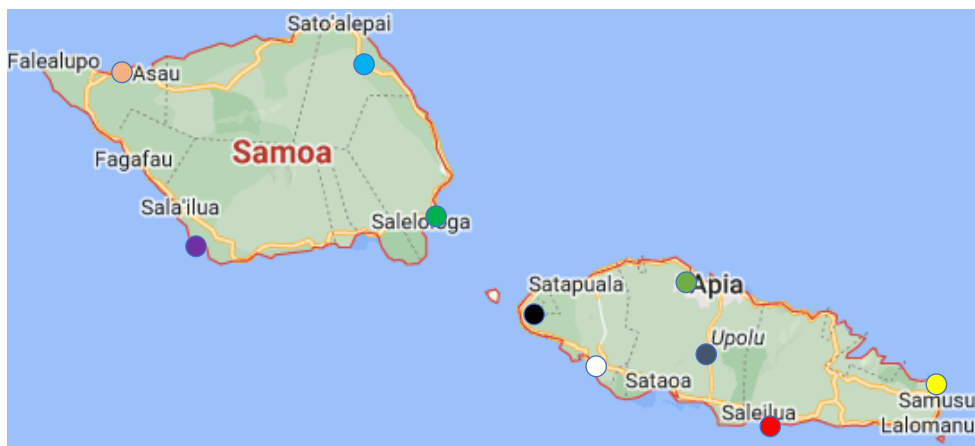

Figure 1: Locations of research participants.

The confidentiality and anonymity of the research participants in the dissemination of the data were ensured by using codes (refer to table 1).

Table 1: Research participants identification.

Research participants	Codes	Locations in colour (figure 1)	Programme of study
1	RP1		Bachelor of Education (Primary)
2	RP2		Bachelor of Education (Primary)
3	RP3		Bachelor of Education (Primary)
4	RP4		Bachelor of Education (Primary)
5	RP5		Bachelor of Education (Primary)
6	RP6		Bachelor of Education (Primary)
7	RP7		Bachelor of Education (Primary)
8	RP8		Bachelor of Education (Primary)
9	RP9		Bachelor of Education (Primary)
10	RP10		Bachelor of Education (Primary)

Due to the isolation of the research participants as well as the goal of utilising virtual platforms, the interviews were conducted virtually for each participant, given that s/he agreed to do so. However, the researcher announced that face-to-face interviews can also be carried out either in office or an agreeable place to ensure the privacy and comfort of the research participants.

Data Collection Method/Instrumentation

Data collections were carried out on a voluntary basis whereby researcher sent an invitation to the ten research participants through email with consent forms. Once the consent forms were received, the researcher arranged appointment for a virtual meeting/office face-to-face at a selected time for each participant.

All interviews were audio recorded. Prior to the start of each interview session, the participants were reminded about the recording and their right to stop it at any time. The use of audio recording provided the researcher with more time to concentrate on what individual participant was trying to say rather than trying to write it all down. Given the nature of the research participants, the research participants were invited to choose their preferred language for the interview. Samoan was chosen by most research participants, and it was used predominantly in their responses.

Data Analysis Method

Data collected from audio records of interviews were transcribed as the first step of the data analyses. The transcribing step provided an opportunity for the researcher to obtain a sense of the data collected by listening to the recordings as well as

reading the transcripts. Once the data was transcribed and confirmed, the researcher began to formulate groups/categories of familiar ideas to facilitate the development of relevant themes. Some of the data analyses are presented with some quantitative information for ease of discussions. The use of a

thematic approach for this research involved searching for common threads that extend across the data received from the research participants (Stake, 2005). Steps for data analysis in this research is summarized in figure 2.
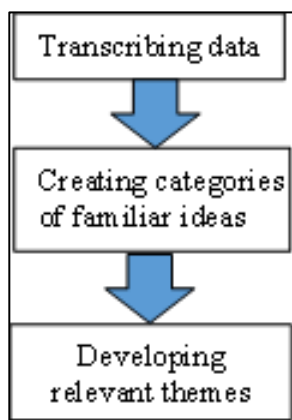

Figure 2: Steps of data analysis.

Findings and Discussion

According to the findings of this study, the research participants seemed to face issues in certain aspects of virtual learning while they are quite pleased in few other aspects. The findings indicate that traditional methods of learning-offline (Table 2) are still significant and they are eager to attend the classroom face-to-face lessons. This is because the series of steps that they face when doing and submitting tasks/activities virtually do not exist in classroom face-to-face delivery mode. As a result, variations in the rate of students' participation to the tasks/activities in this course as opposed to offering in offline/classroom mode (Refer to table 2) were identified in this study.

Table 2: Virtual versus offline tasks' participation.

Research participants	Rate of Virtual tasks participation [%]	Rate of Offline/classroom task participation [%]
RP1	30	100
RP2	40	95
RP3	50	98
RP4	100	100
RP5	50	98
RP6	30	90
RP7	100	100
RP8	40	90
RP9	45	95
RP10	40	95
Average Percentage	**52.5%**	**96.1%**

Although the average percentage of virtual tasks participation is just above 50%, most of the research participants stated that:
"… there are more steps to do when doing virtual tasks/activities"—RP9 Interview.
"I have to download ... takes a long time … then I have to look for the submission folder and go through the uploading, naming the file before hitting the submit button ..."—RP10 Interview.
Classroom task is straight forward ... teacher gives us the handout and we do it ... give back at the end ... virtual way is too long ... very confusing"—RP2 Interview.
Similarly, responses from RP3, RP6 and RP8 confirmed that they face huge challenges when it comes to doing activities virtual. As such, they get very frustrated especially they are given timeframes to complete each task/activity. They always run out of time because of the steps they must go through as well as losing track of what to do to successfully submit an activity/task virtual.

The Internet connectivity was also reflected from the findings. RP4 and RP7 confirmed that the connection from their homes was great and their constant exposure to technology were of great help for this course. This was reflected by the high rate of participation and submission by these two research participants during virtual and the same if offered offline. In contrast, RP1 and RP5 stated that despite the good connectivity from their homes, the ability to use the features required for this virtual mode were very challenging. In the interview:
"… the connection ... is good but I am not familiar with the use of Moodle to send activities/tasks ... we never had any training for that ..."—RP1 Interview.
"aga kasi a se pusa e kuu uma aku ai a activities e faigofie aku le ga, laga e kele isi mea e oomi ma kau faakali le open mai ..." [if there was only one submission box for all activities, would a lot easier ... as there is too many buttons to press and the long waiting to open up ...]—RP5 Interview.

In addition to doing the tasks/activities the data suggested that the research participants have some learning preference in terms of the topics in the course. As such, the students tended to do and submit more tasks/activities in some topics than others (refer to table 3).

Table 3: Task/activity submission in various topics.

Topics/Unit in the course-HTE360	Virtual classes (hours)	Virtual tasks per unit	Submission Rate
Unit 1-Exploring the Science Curriculum	15	10	40%
Unit 2-Exploring the Nature of Science	10	6	50%
Unit 3-Exploring the World of Life	20	15	50%
Unit 4-Exploring the World and Beyond	15	14	65%
Unit 5-Exploring the World of Materials	20	16	95%
Unit 6-Exploring the World of Physical Phenomena	18	15	95%
Total hours	**98hrs/14 weeks ≈ 7 hrs/week**		

The data in table 3 suggests that the submission rate for units 1, 2 and 3 tended to fall in the category of ≤ 50. When asked for the reasons for the low submission rate in those units, 80% of the research participants confirmed that the tasks/activities in those units were challenging and they did not know how to submit them using Moodle.

Table 4: Low submission rates in Units 1, 2 and 3.

Research participants	Responses
RP1	*"… did not know how to submit concept maps …"*
RP2	*"first 3 units … I was trying to learn science as well as computing at the same time"*
RP3	*"Moodle did not allow large submission of videos that we were asked to do …"*
RP5	if there was only one submission box for all activities, would a lot easier … as there is too many buttons to press and the long waiting to open up [translated]
RP6	*"I was not sure of how to send videos on Moodle … flash drive will be a lot better"*
RP8	*"we should have some training on how to submit files on Moodle … the thing just keeps on turning and turning until the time runs out … and later it says … file too large"*
RP9	*"It's always slow at the start of the course … we are trying to learn the course as well as the use of this virtual thing"*
RP10	*"my first time using this mode … so I am slowly learning …"*

The analyses of the data generated five themes that are relevant to the focus of this research investigation. Table 5 lists the five themes followed by a discussion of each with reference to the data collected from the research participants.

Table 5: Themes generated from the data analyses.

	Themes
1	Virtual learning needs to be user-friendly
2	Training on the use of virtual platforms (i.e., Moodle) before using them in a course
3	Virtual learning accommodates isolated students during pandemic
4	Virtual support for students is needed at all times.
5	Personal concerns about virtual learning experience

Theme 1: Virtual learning needs to be user-friendly

Virtual learning platforms have become increasingly popular and accessible in recent years, especially due to the pandemic. However, not all virtual courses are equally engaging and effective for learners. This study showed that the research participants struggled to navigate the Moodle platform due to lack of experience, exposure, skills and knowledge. Although the analysis further revealed that selecting an e-learning platform (virtual learning) is practical for responding to the global pandemic, however, the choice of digital learning platforms should apply some principles, i.e., flexibility, ease to use, accessibility, and user-friendliness (Kasim, & Khalid, 2016). Five research participants, RP1, RP2, RP6, RP8 and RP10 shared the difficulties that they experienced when using virtual platforms. This of course resulted in the low rate of participation in the activities/tasks as revealed in table 2.

Hands-on activities, which students are encouraged to take part in, are part of scientific inquiry that play distinctive and pivotal roles in science learning (Hofstein, Kipnis, & Kind, 2008; Suaalii, 2013). Mounting evidence suggests that hands-on

activities in science classrooms have the potential to enhance students' higher-order learning skills such as metacognition and argumentation (e.g., Kaberman & Dori, 2009; Kipnis & Hofstein, 2008). Basically, while doing hands-on classroom activities the students are actively engaged in manipulating materials and thinking about what they are learning and doing as the teachers provide guidance for cognitive engagement (Taber, 2011). In this regard, these kinds of activities advocate the use of higher order thinking skills, such as problem-solving, analysis and creativity (Hofstein & Lunetta, 2004; Suaalii & Bhattacharya, 2007; Suaalii, 2013).

It is obvious that the goal of doing activities/tasks as outlined in this course is to promote higher order learning skills unfortunately the difficulties of using this virtual platform prevented it from happening. As a result. The students will continue to experience ineffective learning of science and the cycle of 'science is a hard subject to learn' continues (Suaalii, 2021).

Theme 2: Training on the use of virtual platforms (i.e., Moodle) before using them in a course

Moodle platform was used in this course as a pedagogical tool for students. It includes record-keeping for student's learning, planning for student's learning, instruction for student's learning, and assessment for (and of) student's learning. In addition, Moodle includes communication, general student data, school personnel information and LMS administration (Watson & Watson, 2007). The dynamic nature of online forums, discussion boards and other means of communication either synchronous or asynchronous integrated in LMS portray the conversational and collaboration tools. These enable students to work together cooperatively to achieve their common learning objectives (Suaalii & Bhattacharya, 2007).

In contrast to the goals and designs of Moodle platform, the analyses revealed that such pedagogical tool is foreign to all research participants. They were not aware of such tool and therefore they were placed in the darkness while trying to learn science, pass the course—HTE360, and complete their programme of study—Bachelor of Education (Primary). In the

interview RP1, RP3, RP5, RP6, RP8, RP9 and RP10 respectively stated that

"… I am not familiar with the use of Moodle …"
"… this is new to me …"
"… too many buttons to press … but not sure …"
"… not sure how to send videos …"
"… should have … training …"
"… trying to learn … use of this virtual thing …"
"… my first time using …"

It is obvious that this virtual platform is not familiar to the research participant, which requires some sort of guidance and training for the use and navigating throughout this LMS before it is used in any teaching and learning programme. There is also a sense of incompetence where the students are unable to perform learning activities/tasks. Consequently, the lack of training leads to poor learning and low rate of activity participation which eventually results in poor science academic achievements (Suaalii 2013, 2021).

Theme 3: Virtual learning accommodates isolated students during pandemic

Figure 1 identifies the location of the research participants; two from the outskirts of Apia, the capital of Samoa (where the university is located); four from rural areas of Upolu Island and four from Savaii Island. Basically, 80% of the research participants live far away from the university and if they were required to be on-site (classroom face-to-face) they must travel very long distances. The Savaii research participants would have to find accommodation to save costs and time going back and forth.

During COVID-19 pandemic, the course (HTE360) had already started, and it would be very unfair to suspend its delivery especially those who were near the end of their academic journey. Therefore, the complete transfer from classroom face-to-face to virtual teaching and learning modes were significant and was well appreciated by the research participants. Table 6 below demonstrates the responses from RP1, RP2, RP5, RP6, RP7 RP8, RP9 and RP10 which show their appreciation of the shift to virtual learning. They also wished for other courses to be offered virtually even without pandemic.

Table 6: Virtual learning accommodates isolated students.

Research participants	Responses
RP1	*"… this is good as I live far away from university …"*
RP2	*"coming to university … expensive … more course online?"*
RP5	*"great to continue our course … wish all others the same"*
RP6	*"pandemic but still can learn and complete our course …"*
RP7	*"seki a [all good] … despite lockdown can still proceed with our studies this way … wish more courses do this too …"*
RP8	*"Savaii too costly to come to Apia … great to have our course online … although lockdown but still on …"*
RP9	*"a very good decision by our lecturer to use online … this is my last course … must finish now …"*
RP10	*"thanks to Mr for continuing to do this for us in Savaii otherwise … wait for another time to come to Apia …"*

Theme 4: Virtual support for students is always needed.

The pandemic didn't cause problems in many schools as much as it exposed them. The emotional impact of this will continue to play out further into the future. For years, there's been an evident need to empower students, preparing them to learn in any environment, even on their own, but this means putting them

(learners) in the driver's seat, and us (teachers) in the passenger seat, guiding them by providing an internal compass. When virtual learning is handled well, it makes room for a student to be responsible, to learn self-motivation and self-discipline. This study reveals that we (the coordinators of the course) haven't

done this at all even though some appreciations of using virtual learning were identified.

Successful virtual learning requires students to possess specific skills and attributes. As Brindley (2014) emphasised, "studying … [virtually] requires maturity, a high level of motivation, the capacity to multi-task, goal-directedness, and the ability to work independently and cooperatively" (p. 278). Basically, there is a need for support in various ways as identified in this study including:

Peer support and community of learners
Peer support improves students' adaptation to online learning environment, contribute to the development of communication skills, and results in better academic performance and a higher persistence. The research participants in this study confirmed the significance of continuous peer collaborations (RP8, RP9 and RP10—Interview) in and out of class sessions (something that cannot be done in classroom face-to-face sessions) to assist them with the use of the virtual platform as well as the activities. At the same time the formation of a community of learners who are in the same course with similar capacity in the use of virtual platforms. These communities (groups) of learners support virtual learning and their learning experience where they can socialize and support each other's learning.

Meaningful relationships
The continuous engagement and connection of learners virtually has a positive effect on retention numbers. This is because the students are motivated to collaborate at any time from anywhere. For instance, in the interviews RP8, RP9 and RP10 mentioned the great support that they shared using this platform that is always available despite their isolated locations. Eventhough it

was pandemic and the whole country was in lockdown mode they still managed to create such relationship while doing HTE360.

The study also revealed that implementing rapport-building teaching strategies, such as video updates, constant Moodle messages, and frequent feedback/comments on activities/tasks enable the students to challenge themselves and continue to participate in other activities.

Development of necessary skills
Support with the development of skills necessary for virtual learning enhance students' learning experience. As mentioned earlier, pre-course training on Internet-based technology can enhance their online interactions and tasks participation as well as their overall learning experience and progress. In the study conducted by McLoughlin and Alam (2014), students were assisted in developing skills to work with social media and reported benefits of collaboration and peer networking of such support. RP3 stated that *"I asked RP4 for some help … has a relative who is an IT at the university … was very helpful"* Certainly RP3 was able to receive necessary skills for this virtual course using such ongoing collaboration in and out of class times.

Theme 4: Personal concerns about virtual learning experience
The analysis also revealed adverse effect of virtual learning session. This includes both physical and emotional discomfort. Based on the responses provided by the research participants, the continuous virtual classes (7 hours/week for 14 weeks—table 3) might be overwhelming due to the pre-existing stress of confined at one place.

Table 7: Personal concerns about virtual learning experience.

Impacts	Description	Respondents
Understanding	Difficult, videos and pictures help, not clear	RP1, RP2, RP5, RP6, RP7, RP8, RP9, RP10
Health and fitness	Muscle pain, eye health, starting to use reading glasses, tiring sitting in front of computer	RP1, RP2, RP6, RP7, RP9, RP10
Confinement	One place, isolated, boring at times	RP3, RP4, RP8, RP9, RP10
Cash power	High usage of electricity, room light, computer/laptop	All
Data	Internet data too expensive	All

The analysis revealed some concerns that the research participants found while participating in this virtual course (refer to table 7). These concerns are personal indicating their own individual experience during the implementation of the course.

It is evident that independent work is uneasy for the research participants, difficult as they do not have a teacher to guide them as in a physical classroom. They felt that they were confined within an isolated space, a very quiet environment where no one is around to guide, to help and keep them accompanied. It appeared that the research participants rely on the teacher for their learning. In contrast the literature (i.e. Andrini, 2016; Heggart & Yoo, 2018) found online learning is more advantageous than face-to-face learning because students can make use of the mobility and information from search engines. Some health concerns were surfaced in the analysis as mentioned by 60% of the research participants. Such health conditions, if persists may impact on students' learning, activity/tasks participation, and class attendance.

The last two concerns revealed in this analysis came out very strong not only as a perspective but also as a form of criticism to the virtual delivery of this course. This is because the university continues to charge normal tuition fees. In addition, a user fee of ST$200, charged "per semester to cover all services used by the student including but not limited to library services, labs, ICT, student services, etc" (NUS Calendar 2024, pg. 441). However, this study revealed that the research participants organised their own cash power and Internet data sufficient for the virtual implementation of HTE360—7 hours per week (table 3).

Conclusion
While international literature found poor Internet connectivity and lack of devices to be most problematic when it comes to online/virtual learning, this study revealed the need to look at the learner/user and their ability to use the platform. The study identified various challenges relating to the learner/user while learning science (HTE360) virtually during pandemic. These challenges include the:

- significance of the virtual platform to be user-friendly,
- provision of some training of student about the virtual platform,
- importance of virtual learning in accommodating isolated students,
- provision of virtual support at all times, and
- awareness of personal concerns about virtual learning.

It is evident from this study that there is a mixture of positive and negative perspectives found in the implementation of HTE360 virtual learning sessions during pandemic. The significance of the findings from this study is the fact that the university can control and manage these areas. Basically, the university needs to provide guidelines, training, support and assist students who register in virtual courses. These are fundamental developments to assist with the ongoing shift of university course delivery from classroom face-to-face into virtual learning mode.

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