

# Science Teachers' Knowledge, Beliefs, and Practices towards learning Science during Covid-19 Pandemic Outbreak

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## Abstract

*The virtual mode of classes was accepted as the universal method across the globe during the pandemic. However, researchers found different challenges, barriers, and obstacles in virtual mode. It is crucial to understand how classroom practices are going during the pandemic, particularly for science, which is a practical and activity-based subject. Thus, this study aimed to discover what knowledge, beliefs, and practices science teachers had regarding science learning during the pandemic. In the study, 83 science teachers, were surveyed using a Google form with 12 items. The questionnaires covered curricular goals, teacher training, student regulations, modes of instruction, best strategies and approaches to teaching, the effectiveness of virtual classes, their obstacles, the evaluation of students, and suggestions for implementing virtual classes effectively. According to the results obtained, conclusions were drawn, and the study's implications were discussed.*

**Keywords:** Covid-19, Virtual learning, teaching approaches, online platform

## Introduction

Covid -19 pandemic hit various aspects of life across the globe. Schools were closed, economic activities stopped, and face-to-face classes were not continued due to the fear of transmission. Lockdowns around the world have restricted citizens to stay inside their homes and students' actual classroom learning has been stopped for many months. The lockdown implemented by countries has stopped students from receiving physical classes. In this context, how learning should continue, is an important issue that has come under discussion at communities, national and international levels. The COVID-19 pandemic produces several challenges in educational as well as all other social aspects (Huber and Helm, 2020). In such context, many countries have shifted into online classes to continue their students' education. Therefore, E-learning has been identified as a transition to online education around the globe (Murphy, 2020).

E-learning is a means for teaching, which includes electronic devices and tools and an interface between learners and instructors linked with the process of education (Dobre, 2007). However, many countries including Nepal was not prepared for the situation due to the lack of facilities for running virtual classes for students. The COVID-19 outbreak affected 63 million teachers globally and rarely do they receive any training by any nation on online mode of teaching (UNESCO, 2020). Bates (2018) stressed that in the present digital world online, blended, and open learning are essential development in the field of teaching and learning. Online learning tools have also added significant development in the field of education. Moreover, Sonmez, Gocmez, Uygun & Ataizi (2018) highlighted that the use of such tools in the online mode of learning influences positively to enhance students' motivation, self-regulation, and customizing their learning context.

Teachers need to have the skill of effective use of such tools and devices while conducting online mode of teaching. In such a context, teachers need to be trained about the use and implementation of the new online tools and devices for conducting effective classes. However, Markoe (2012) argued that most of the teachers are not familiar with these devices and teachers should be provided with the training for proper use and integration of such devices while implementing online classes.

The various researcher conducted studies on the challenges, barriers, and obstacles of running online classes during pandemic (Joshi et al., 2020; Rahayu and Wirza, 2020). The study conducted by Rahayu and Wirza (2020) in Indonesia found that teachers perceive comfortable use of online learning during the pandemic outbreak, however, older instructors find difficulties in engaging learners in the content, explaining, and providing advice through the e-learning mode. Moreover, Joshi et al., (2020) identified lack of training, lack of clear direction towards instruction, teachers' problem, and negative attitude as the obstacle in e-learning. The study of Bao (2020) also highlighted the lack of teachers' training on virtual mode as the obstacle for e-learning.

Private schools in Nepal started some online classes at the early stages of the pandemic. However, still many public schools were not able to deliver such classes to their students. Online and virtual classes cannot be continued in absence of internet devices such as mobile phones, laptops, I-pod, and iPad. Students from a rich economic background may have access to such devices but students who belong to poor families do not have access to such devices.

In recent years growing number of universities in the world offering online education, which helps those working people to attain their desired degrees without attending the actual classroom. Nepal Open University established on 2016 A.D. to offer virtual classes for those who want to continue their education but cannot attend the real face-to face classroom. However, there was no practice of such classes in Nepal before this pandemic situation. This study tries to explore the teachers' practices of teaching during the pandemic and the challenges and obstacles they bear while conducting online classes. Several studies have been performed in a global context on the teachers' perspectives on teaching and learning. Nepal is a developing nation and many schools as well as teachers may not have access to the internet and online learning tools and devices.

The higher number of students are also from low and poor economic backgrounds. In such a context higher number, of students may not have access to the internet and e-device to learn through online education. Therefore, in this scenario, it is essential to know how the teaching and learning processes are conducted during the pandemic. Dede et al (2004) stress that E-learning is worthwhile and acceptable means for teaching and learning science. Although. A limited study has been performed in the context of Nepal but no study is performed in Nepal in the case of science teachers' knowledge, belief, practices, and challenges on online mode of instruction. Therefore, this study aimed at finding the science teachers' practices for teaching science during the COVID pandemic. In this context, it is equally important to know how e-learning supports science learning. Therefore, the study also aimed in finding the challenges and obstacles for online science learning. Finally, the study aimed at finding the science teachers' recommendation for effective conducting of online learning of science.

## **Materials and Methods**

The survey design was used in this study to get the science teachers' responses on their knowledge, belief, practices, and perspectives on online learning during the pandemic period. The study area of this study includes all provinces of Nepal. The purposive sampling method was employed in this study to collect the data from science teachers with the view of covering all parts of Nepal. The email address of 120 science teachers from different provinces was collected from different resources before conducting the survey. A survey questionnaire consisting of 12 items was developed initially for obtaining information from science teachers about online learning on the google form. The survey questionnaires both inquires about qualitative and quantitative information from the respondents. The survey questionnaire was mailed to 120 science teachers teaching science in different provinces of Nepal. However, 83 teachers from different provinces completed their responses on the google form. Therefore, 83 science teachers were the sample of the study. Therefore, the study analyzed the data obtained from those 83 science teachers. The collected data were filled in the excel form. The data obtained from the teachers were calculated to the percentage of particular responses, whereas other responses on items were analyzed by quantitative and qualitative methods. In the case of quantitative analysis, a statistical package for the social science (SPSS) was used to find the mean and percentage response of the teachers in different items. In the case of qualitative analysis, different themes were developed according to responses or information obtained from the teachers. The qualitative data thus analyzed based on the themes developed from science teachers.

## **Result and Discussion**

Teachers were asked about their knowledge, beliefs, practices, challenges, and obstacles they faced during a teaching in Covid pandemic period. The issues were analyzed according to the science teachers' responses. The teachers' responses were categorized and analyzed in different aspects that are explained in this section.

### **Frequency of Background Variables**

The background variables of the study were gender, institution type, teaching grade, experience, and province. The number of respondents across the background variables is calculated in Table 1.



Teachers Descriptions		Total	%
<b>Gender</b>	<i>Male</i>	66	79.50
	<i>Female</i>	17	20.50
<b>Institution</b>	<i>Public</i>	62	74.7
	<i>Private</i>	19	22.9
	<i>Not stated</i>	2	2.4
<b>Teaching Grade</b>	<i>Basic</i>	5	6
	<i>Secondary</i>	65	78.3
	<i>College</i>	9	10.8
	<i>Not stated</i>	4	4.8
<b>Experience</b>	<i>Below 2 years</i>	5	6
	<i>2-5 years</i>	11	13.3
	<i>5-8 years</i>	13	15.7
	<i>Above 8 years</i>	51	61.4
	<i>Not stated</i>	3	3.6
<b>Province</b>	<i>1</i>	3	3.6
	<i>2. Madhesh</i>	3	3.6
	<i>3 Bagmati</i>	50	60.2
	<i>4 Gandaki</i>	7	8.4
	<i>5 Lumbini</i>	8	9.6
	<i>6 Karnali</i>	4	4.8
	<i>7 Far Western</i>	7	8.4
	<i>Not stated</i>	1	1.2

The sample size of the study was 83 teachers teaching science in seven provinces of Nepal. As shown in the table, gender-wise distribution of teachers showed a higher percentage (79.50%) of respondents were male. The teaching grade shows that a large proportion (78.3%) of the sample was from the secondary level. The teachers with teaching experience above 8 years were higher (61.4%). The responses were highest in percentage (60.2%) from Bagmati Province.

### Curriculum Goal and Online class

Teachers were asked to give their views on whether the online science teaching meets the curriculum goal. The students were asked to give their response on five point Likert scale (strongly disagree to strongly agree). The table no. 2 below shows teachers' response on the relation between curriculum goal and online class.

**Table 2.** Teachers perspectives on whether the online class meet the curricular goal of science

Options	Total Number	Percentage	Overall Average
<i>Strongly Disagree</i>	1	1.2	3.64
<i>Disagree</i>	9	10.8	
<i>Neutral</i>	16	19.3	
<i>Agree</i>	45	54.2	
<i>Strongly agree</i>	11	13.3	
<i>Not stated</i>	1	1.2	
<b>Total</b>	83	100	

The table number 2 shows that 54.20 % of the students agreed that conducting online class meet the curriculum goal of science. Only 13.3 % of teachers strongly agreed the statement. However, about 20 % of the teachers were not aware whether it meets curriculum goal or not. About 12% of the teachers showed their disagreement on the statement.

### **Teachers training with online class and conducting online science classes**

Science teachers were also ask to response whether they receive any training for conducting online class and either they are conducting online classes. The below table shows the percentage of teachers received training and percentage of them conducting online class.

**Table 3.** *Teachers training for conducting online classes and status of online class*

<b>Features</b>		<b>Total</b>	<b>%</b>
Online Class	Received	19	22.9
	Not received	64	77.1
running Training	Total	83	100
Running online	Running	41	49.4
	Not running	42	50.6
science classes	Total	83	100

Majority of the teachers found not receiving any kind of training related to conducting online classes. Whereas least portion (22.9%) of the teachers found to be trained with the ideas of conducting online classes. However, about 50% of the schools were not running any kind of online classed during the outbreak period of Covid-19. The study of Roshni (2021) stated that less than 20% of the teachers were training about digital method of training.

### **Students' Regularity in Online Class**

Only 80 science teachers respond to the regularity of their students in their online classes. The responses of science teachers showed that 40% of the students neither attend online classes. Only 8.8% of the students showed above 75% attendance in their online classes, 17.5% showed 51-75% of attendance, 11.3% of students showed 26-50% attendance and 22.5% of students showed below 25% of attendance. Therefore, the regulatory of the student in online class has been found be to one of the important issues for effectively running the virtual mode of class. The regularity problem of the students may be due to lack of internet facility, lack of skills and no devices to join virtual mode of class.

### **Impact on science learning**

The science teachers were also asked about the impact of science learning due to the Covid outbreak. 78 teachers give their responses on the impact on science learning. The majority of the teachers the pandemic adversely affect science learning due to which no classes were running. A higher proportion (30.76%) of teachers saw the high impact on the experiment or practical classes of science as no such class was running during the pandemic period. After that 7.6 % of teachers found the major impact on field-based learning, 7.6 % of teachers found the online class to be less effective to science students, 7.6 % of teachers found problems in students understanding of science concepts. Furthermore, 5.12% of the teachers found an effect on very interactive classes as such types of classes were not running, 5.12% showed an impact on inquiry-

based learning. Similarly, other impacts according to the teachers were in students' involvement and engagement, meaningful learning practices, and collaboration. Therefore, science teachers believed that although online classes were running but some areas (experiment based learning, student engagement, collaboration, inquiry based learning, and field based learning) of science learning could not be addressed.

#### **Problem or obstacle to conduct online class**

Teachers were asked to respond about the problem or obstacle they face to conduct online classes. Only 81 science teachers' responded on this item. A higher proportion (49.4%) of the teachers' responded that lack of internet access was the main obstacle for them for running online classes. 18.07% of the teachers responded that students' poor motivation, lack of interest, and lower engagement in the content as the main obstacle to running online classes. 14.46% of the respondent stated that no strategic plan and infrastructure of their institute was the major problem. Poor internet service was the main obstacle for 7.4% of the science teachers. (Sangeeta and Tandon, 2020) also highlighted that poor internet connections as one of the obstacles faced during online classes.

Furthermore, 4.82% of the respondents state that they feel uncomfortable with online classes. Lack of training on online mode education was the problem for 2% of the teachers. Increased education burden was the main obstacle for 1.20% of the teachers. Davis, Gough, and Taylor (2019) highlighted learner barriers to online learning as the delusion of beliefs, time management, and interpersonal communication, and instructor obstacle to maintaining interaction and giving feedback and comment to the students. Furthermore, the study of Joshi et al., (2020) finds several obstacles in e-learning such as lack of facilities, disturbance from family, lack of training to teachers, no proper direction for running class, and teachers skills and teachers negative attitude. Sangeeta and Tandon (2020) also highlighted that among the several technological obstacles encountered poor internet quality was one of them. The study of Burns (2011) also added that low-speed internet, lack of training for teachers, and students' ignorance of using technology were the three obstacles faced during implementing online classes. Moreover (Ramij and Sultana, 2020) found that learners lacking online learning devices, low-quality internet, and the weak economy of the family as the hindrance or obstacles for virtual learning during the pandemic.

#### **Effectiveness of Virtual science teaching during the pandemic**

Science teachers were asked whether the virtual model of teaching is effective during the pandemic. 77 teachers gave their responses to this question. Only 45 of the teachers state yes or no, out of which 23 teachers give a yes response whereas 22 teachers gave no response. The responses of the teachers towards either effective or not have been given in the below table.

**Table 4.** Teachers responses on either virtual class is effective or not

<i>Effective</i>	<i>Not Effective</i>
Virtual learning is only the means of teaching during the pandemic	Lack of skilled or trained teachers
Effective when real classroom teaching is not possible	Lack of access to internet facilities and devices
Effective in the situation as the means for students get some knowledge	Poor internet quality
The best alternative for face to face mode	No regular supply of electricity
Because of no other choice	Limited to urban areas only not effective to rural teaching
Learning continues	Practical or experiment-based learning cannot be continued
If internet facility be provided to students	Lack of interaction between teachers and students
Effective for university level	For lower classes
If teachers are trained about the use of online resources and devices	The economic condition of students especially studying in public schools
In the case when teachers are trained by the government	

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#### **Mode of Classes Adopted**

Teachers were asked about how they continued science instruction during the pandemic to find the mode of teaching they followed during the period. On the response on the mode of science instruction, 68 teachers gave their perspectives. The majority of the teachers responded that they were using the online platform for instructing science during the pandemic. The study of Shetty et al.,(2020) also supports the finding of this study as virtual teaching is the alternative for conventional teaching methods during the time of COVID-19. The study of Martinez (2020) also aligned with the findings of this study as the study supports shifting to online classes as an alternative mode of teaching at the time of the outbreak of corona. They replied that for online teaching they use ZOOM, MS team as means whereas content-related youtube videos were suggested to students to watch for their self-learning. Schools and campuses are conducting their students' assessment by means of Google meet, Microsoft Teams, Zoom, etc during covid 19 period (Time, 2020).

Moreover, it was found 25% of the teachers received training about running online classes. According to 8.82% of the teachers, the science classes were running through television, F.M., and radios. One of the public school teachers from Bagmati province states that it is different for different organizations. Some institutions are conducting online classes but not in many others. Some students are learning science through radio, television, books, and self-learning through the search engine. Another teacher from Lumbini province public school states that no initiation for teaching science was particularly observed during pandemics except some schools going for online teaching through google classroom, Facebook, Viber, zoom like apps. Recently, radio and television broadcast has been supporting in teaching science in this pandemic. The other teachers



from the private school of Lumbini province private school responded that not enough activities and resources were used. Classes mostly depended on PowerPoint and youtube videos, video lectures, and slide presentations. Additionally one of the teachers from the Gandaki Province public school state that science instructions are continued with the help of virtual classes. However, it is not effective because it is not conducted everywhere due to the lack of facilities for students.

### **Best Strategies and Approaches to Instruct Science**

Teachers were asked to give their views on the best strategies and approaches to be adopted for instructing science during the pandemic. Among the total, 68 teachers only replied to the statement. Teachers were with common thought that online mode of instruction using modern electronic devices is the best approach to instruct science during the pandemic. The majority of the teachers state that teachers' training for virtual learning and adoption of virtual learning is the best strategy for conducting science classes during the pandemic. The other responses were providing access to the internet and teacher, students and teachers need to be facilitated with electronic devices, online classes through ZOOM, LMS, MS team, broadcasting classes through radio and television, and using PowerPoint slides in the online class. Al-Fraihat, Joy, & Sinclair(2020) state that there was high level of use of online learning platforms such as MS Teams or Zoom which increase students knowledge on the usefulness of e-learning. The study of Wu (2021) also highlighted that the teachers need to be provided with the devices such as computers, laptops, or cell phones to carry good quality virtual learning

One of the public school teachers from province 2 (Madesh) states that: practically for real application government should take bold & strong decision like providing free internet data for student & teachers, arrange the good technical team that can work with IT sector. The teacher-training program should be conducted. Another respondent from the public school of Lumbini province gave the view that open distance learning especially through radio could be an affordable and easy option to coverage wide learners for all subjects, including science, and mainly more applicable for theories. The other teachers from private schools of Bagmati province gave their opinion in my opinion searching and emphasizing indigenous, local science practice will be the best approach, however, to make it organized related educational aid can be provided through audio, video, and print medium. One of the teachers of public schools from Far western province responds that developing videos/audios about science subjects and broadcasting through television and radio.

### **Strategies for Evaluation of students' Science Learning**

Evaluation of students is a critical part of learning. Students' learning cannot be assessed physically during the pandemic. Therefore, teachers were asked to give their views on the strategies to be adopted for evaluating science learning. The science teachers suggested several methods of assessing students' science learning. Only 61 teachers gave their views on means of evaluation for students in a virtual class. 20 students viewed to provide the online assignment to the students. Whitelock (2009) stated that online assessment is a novice model and approach played gradually significant role in the change of education. Osuji (2012) state that ICTs is used for online evaluation of the students' form preparing , delivering of assignments and grading of

the student. According to, Crisp (2011) online assessment defined as a distinctive practice of tracking students' feedbacks and providing advice.

Majority of the teacher stated that online exams are to be conducted for evaluating students' science learning in the online class. The other forms of evaluation as viewed by teachers were assigning multiple-choice and open-ended questions, assigning science projects, preparation of models, involvement in online collaborative work, conducting online quizzes, asking oral questions, presentation, and report writing. One of the private school teachers from Bagmati province stated that students' assessment can be done by their interaction and discussion, involvement in collaborative work, and submission of assignments. The other teacher from the private school of Lumbini province highlights providing students with project works, model preparation, making quizzes, and assignment for the students' evaluation in science learning

Moreover, one of the teachers from a public school of Province 1 stated that "the formative evaluation should be done time to time by different methods such as Quiz, Puzzles, Webinars, Presentation, Virtual lab demonstration, assignments, report writings, etc".

### **Effective Implementation of Virtual Class**

Teachers were also asked to give their suggestions for conducting effective online classes during the pandemic. Among the total, only 65 teachers gave their views for implementing effective online classes. The majority of the teachers gave their view on providing free internet for teachers and students and training for teachers related to online teaching for implementing effective classes during pandemics. One group of teachers stresses providing high-quality internet facilities to the students and teachers and using online tools and platforms. The other group of teachers viewed launching radio and television programs for continuing learning during the pandemic. The other common views of some teachers were engaging students in activities through assignments, Virtual workshop, webinars and training, and launching Programs for motivating students to online learning. One of the teachers suggested that the curriculum development center should develop or revise a curriculum that is suitable for conducting the online class. The studies (Kundu and Bej, 2021; Moss et al., 2020) highlighted the parental backing for making effective online teaching. Teachers and students need to be prepared and trained on digital skills for online learning (Cong, 2020). Studied showed that teachers face difficult to keep touch with students' due to lack of digital skills of the students (Stenman and Pettersson, 2020).

### **Conclusion and Implication**

The study comes to the view that online mode of class is the best alternative of continuing education. The radio and television programme is appropriate for distance and remote students who lacks facilities. However, there is students' regulatory problem. The pandemic have affected to experiment based learning, engaged learning practices, collaborative learning, field based and inquiry approach learning of science according to science teachers. Lack of internet, poor motivation, lower engagement, lack of strategic plan, poor infrastructure, low speed internet were viewed to be main obstacle for virtual mode of learning. Virtual learning is effective when internet facility is provided to students and teachers and teachers are trained to e-learning approach. Lack of internet facility, experiments cannot be continued, poor economic status of students and lack

of skills among the teachers for conducting virtual mode of classes were some problems for effectiveness of e-learning. The online platform like, ZOOM, MS Team, YouTube videos related to content, lectures through radio and television, and videos lectures are the source to continue learning. Conducting virtual classes by trained teachers using online platform like ZOOM, LMS, MS team, launching radio and television programme for remote students are the best approach for continuing learning. Providing assignment, and project work, quizzes, preparation of model, discussion in online class, preparing and presenting report are the appropriate method students' evaluation.

For implementing effective online classes teachers need to be trained, students and teachers should be provided with high quality internet, students should be engaged in activities like virtual workshop and webinars, revision of curriculum for virtual learning, and launching effective program through radio and television. Schools should be provided with the entire infrastructure essential for running virtual classes. Furthermore, Video and audio recording of the lectures should be done and sent to the remote and the students who lacks facilities for joining online classes. Moreover, Videos of science activity and experiments given in science textbook should be prepared by curriculum development center. Those videos should be played during virtual classes and through television broadcasting.

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